Patient-Provider Communication on Clinical Outcomes, Healthcare Resource Utilisation, Engagement, and Clinical Trial Recruitment of Dermatology Patients

A thesis submitted for the degree of Doctor of Philosophy from Imperial College London

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Statement of Originality

I declare that this thesis is my own work except where work by others has been properly referenced.

Abstract

Background: Patient-provider communication occurs in daily clinical encounters and is important to improve patient outcomes. The perception of high-quality patient-provider communication is associated with better patient outcomes. Therefore, understanding which factors may be associated with the perception of high-quality patient-provider communication is important to improve outcomes like engagement and disease severity.

Objectives: Among dermatology patients, this thesis aimed to: 1) determine the impact of patients' physical and mental health status on the perception of patient-provider communication, 2) determine the impact of patient-provider communication on healthcare resource utilisation, and 3) determine the effect of tailored delivery of education on engagement, disease severity, and clinical trial recruitment.

Methods: Part 1 (aims 1 and 2) aims to determine the factors that may be associated with patients' perception of patient-provider communication quality. Part 2 (aim 3) aims to determine the effect of tailored delivery of education on engagement, disease outcomes, and clinical trial recruitment.

Results: In part 1, symptoms of psychological distress and depression as well as lower levels of mental or physical health functioning were associated with the

perception of low-quality patient-provider communication. Furthermore, the perception of lower quality patient-provider communication was associated with greater healthcare utilisation. In part 2, compared to patients who received non-tailored delivery of education, patients who received tailored delivery of education had an overall greater level of engagement, medication adherence, clinical trial recruitment, and patient knowledge, but there was no difference in disease severity.

Implications: For part 1, the implication is that it is important for providers to be adaptable and supportive in their communication style and to develop novel methods to improve patient experience with the patient-provider interaction to minimize the unnecessary overutilisation of healthcare resources. For part 2, the implication for practice is that it is important for providers to consider how we disseminate educational materials to optimise patient outcomes.

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Declaration of Contributors

All the work written in this thesis was accomplished by the author. Other contribution to this thesis from a third party is detailed below:

Aim 3:

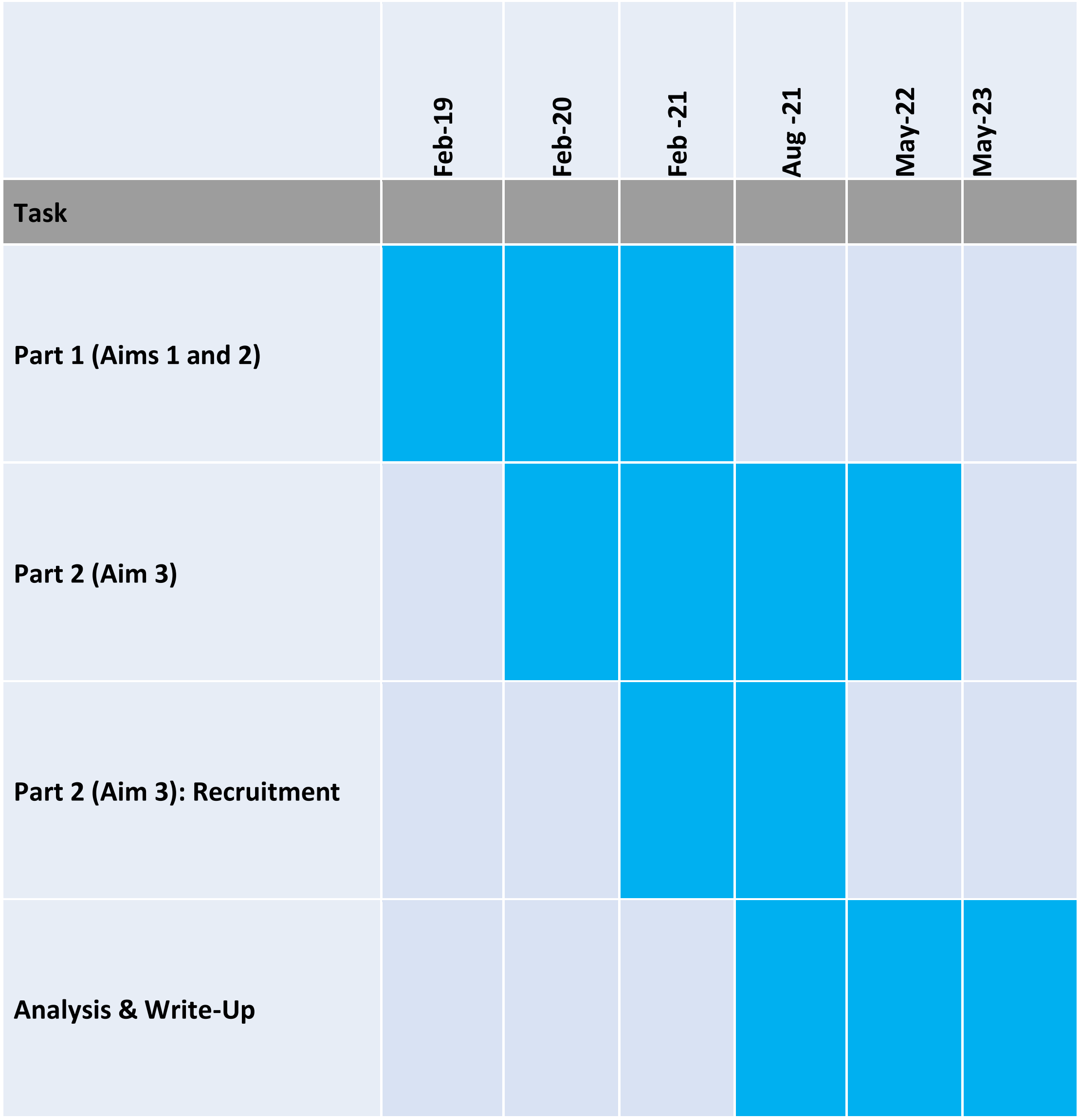
The data collection and extraction were performed with the assistance of the *Wecudos* team.

Abbreviations

AHRQ	Agency for Healthcare Research and Quality
ANOVA	Analysis of Variance
AOR	Adjusted Odds Ratio
AVA	Armstrong Viewer Assessment
Β Coef	Beta coefficient
BSA	Body Surface Area
CCI	Charlson Comorbidity Index
CI	Confidence Interval
EHR	Electronic Health Records
ER	Emergency Room
GDPR	General Data Protection Regulation
HIPAA	Health Insurance Portability and Accountability Act
ICD-9	International Classification of Diseases, Ninth Revision
ICD-10	International Classification of Diseases, Tenth Revision
IRB	Institutional Review Board
K6	Kessler 6-item Psychological Distress Scale
LA	Los Angeles
MAQ	Medication Adherence Questionnaire
MCS	Mental Component Summary
MEPS	Medical Expenditures Panel
N	Number typically refers to subjects
No.	Number
PAM-13	Patient Activation Measure-13

PASI	Psoriasis Area and Severity Index
PCS	Physical Component Summary
PGA	Physician Global Assessment
PHQ-2	Patient Health Questionnaire-2
PPPY	Per Person Per Year
Ref	Reference
SEM	Standard Error of the Mean
SF-12	Short Form Health Survey
SMS	Short Messaging Service
U.S. or US	United States
USC	University of Southern California
χ^2	Chi-squared

Gantt Chart



Task	Feb-19	Feb-20	Feb -21	Aug -21	May-22	May-23
Part 1 (Aims 1 and 2)	■	■	■			
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Chapter I: Introduction

Introduction

Patient-Provider Communication

Patient-provider communication refers to the development of an interpersonal relationship and the transfer of information between a patient and healthcare provider. This is an aspect of the modern-day approach to patient care known as patient-centred care. Patient-centred care places the individual patient's needs and preferred outcomes at the core of a collaborative patient-provider relationship. In this relationship, providers offer recommendations from a clinical, emotional, mental, spiritual, social, and financial perspective that is tailored to the patient.[1] The charitable organization called the Picker Institute has become a leader in the establishment of the core principles of patient-centred care following the founder's experience in the USA healthcare system that was perceived to be insensitive to the individual patient's needs and preferences.[2] The Picker Institute has eight core principles, three of which are largely centred around patient-provider communication: 1) clear information, communication, and support for self-care, 2) involvement in decisions and respect for preferences, and 3) emotional support, empathy, and respect.[3]

Hippocrates may have provided the earliest known consideration that a provider may be able to influence their patients' health.[4] In the 1950s, patient-provider communication specifically was discussed as a crucial element of patient care when clinicians at the Tavistock clinic in London reflected on the association between a patient's diagnosis and the patient-provider relationship.[5] This was at a time when it was still considered unfavourable to patients to share bad news because of poor treatment prospects in oncology.[6,7] Later on, in the 1980s, provider language was found to be a significant factor relating to patient experience and patient outcomes.[8,9] These findings helped to provide a preliminary framework in the theory of patient-provider communication.

The traditional communication modality is face-to-face but with the advent of technology this now includes electronic messaging, for example secure messaging, between providers and their patients.[10] High-quality patient-provider communication allows providers to effectively gather information to facilitate the patient's diagnosis, and provide recommendations and education that promote a collaborative therapeutic relationship.[10] To patients, high-quality patient-provider communication is the perception that their provider has the ability to clearly communicate, listen, and show them respect.

There are now multiple frameworks that can be used to demonstrate high-quality patient-provider communication. In the U.K., the Good Medical Practice guidelines set by the General Medical Council provide guidance for physicians to communicate effectively, establish and maintain partnerships with patients, and show respect for patients.[11] The National Institute for Health and Care Excellence provides more detailed guidance on: 1) how providers should learn about their patients as individuals, 2) how providers should provide essential requirements of care such as respect for the patient, 3) how providers should tailor healthcare services for each patient such as determining patient views and preferences, and 4) how providers should enable patients to actively participate in their care through communication, information, shared decision making and education programmes.[12]

Effective patient-provider communication is important to improving patient outcomes. The perception of high-quality patient-provider communication is associated with superior adherence, clinical outcomes, and quality-of-life practice.[13–23] For example, among patients with cardiovascular and hepatobiliary diseases, patients who reported high-quality patient-provider communication had improved perceptions of physical and mental health and had fewer emergency room visits and hospitilisations.[24,25] Additionally, among Hispanics and Blacks, high-quality patient-provider communication was associated with greater odds of receiving cancer screenings.[23]

However, there is a gap in our understanding of whether patients' health status and healthcare utilisation are associated with the patients' perception of the quality of patient-provider communication. We chose dermatology conditions to examine these important associations due to the high prevalence, the varied patient socio-demographic and clinical characteristics, and the large disease burden of dermatoses.[26] Furthermore, due to the chronicity of many dermatological conditions, the relationship between providers and patients is typically long-term.

The association between patient-provider communication quality and patient outcomes has rarely been studied systematically in dermatology patients. Specific challenges that Dermatology providers may face during the patient-provider interaction include limited visit time with patients and communication challenges with certain patient populations due to language barriers and low health literacy. [27,28] Consequently, many adult patients with chronic skin diseases may be ineffectively recruited intro clinical trials[29] and may demonstrate poor patient engagement.[30,31] Investigating the association between patient-provider communication and clinical outcomes, healthcare utilization, engagement, and clinical trial recruitment among dermatology patients could inform where gaps exist in patient-provider communication and provide the basis for using novel strategies to improve patient outcomes such as engagement and disease severity.

Non-Tailored Patient-Provider Communication

Non-tailored patient-provider communication refers to a generalised approach to communication in clinical settings that is not customised to each patient. In medicine, non-tailored delivery of communication often relates to verbal communication during clinic visits and information that is shared via hardcopy e.g., leaflets and posters. As described previously, when the verbal patient-provider communication is of high-quality, improved patient clinical outcomes and medication adherence are observed. [13–23] Similarly, well-designed information shared via hardcopy can lead to greater satisfaction with providers, less frequent use of healthcare resources, greater knowledge regarding their disease, and modification of patient attitudes.[32–35] For example, in two French emergency departments, patient information leaflets improved the perception of patient-provider communication quality, increased patient satisfaction with their provider, and led to fewer emergency department visits.[34]

However, many real-world challenges limit the exchange of non-tailored patient-provider communication. For example, non-tailored patient-provider communication often relies on direct patient contact and the ability for patients to be present in a clinical setting as well as the uncertainty that information that is mailed or placed within a public setting is seen by the intended audience. More specifically, first, there is a limited patient population that can be seen in clinic as many patients have geographic, physical, financial, or scheduling constraints that prevent regular clinical consults. Second, there is a reliance on electronic databases for patient contact details that are not comprehensive and are irregularly updated. Third, it is difficult to ensure that both the patient and provider can reach one another during the specific time point that a connection attempt is made. Fourth, patients may express dissatisfaction with having their medical records exploited and being disturbed at certain times of the day.

Tailored Patient-Provider Communication

In response to the real-world challenges faced with non-tailored patient-provider communication and to address the communication needs between providers and patients, healthcare providers may tailor how their communication with patients. Tailored patient-provider communication refers to interventions that can customise the content, the context of the content, the deliverer, and/or the delivery channel of patient-provider communications.[36,37] Tailored communication aims to increase the relevance and accessibility of communication to generate positive changes in patient response.[38]

Most studies demonstrate that tailored patient-provider communication is more effective at fostering positive changes than non-tailored patient-provider communication.[39–43] For example, a 2013 systematic review showed that the majority of tailored patient-provider communication interventions showed a statistically significant increase in health-promoting effects such as medication adherence and diet.[44]

Effective application of tailored patient-provider communication may especially benefit those from rural or underserved communities who may have limited or even no access to specialist provider care due to geographic, physical, financial, or scheduling constraints. Additionally, many patients lack good understanding of their condition and its management. Therefore, tailored delivery of patient-provider communication can increase the accessibility of high-quality, individualised educational content.

Patient Education

Patient education is an important aspect of healthcare. Patient education involves the healthcare provider delivering information surrounding a patients diagnosis including the aetiology, the treatment options available, the expected prognosis, next steps in preparing for the proposed management plan, the recovery process, and clinical trial opportunities.[45] When patient education is effective, improvements are seen in patient engagement with shared decision-making, medication adherence, patient satisfaction, and outcomes.[46,47]

Traditional models of patient education typically involve non-tailored patient-provider communication whereby the healthcare provider provides information verbally or may facilitate a patient's access to the information in hardcopy format. However, non-tailored patient education models are constrained by multiple factors. First, patients often express a desire to be more involved in their healthcare and to learn more about their health. To encourage patient engagement and improve clinical outcomes via non-tailored patient-provider communication methods, patients must rely on their healthcare provider to be effectively informed about their disease and clinical trial opportunities during clinic visits. Additionally, the patients themselves may be unable to retain all the information they receive during the limited visit duration which can be related to the communication style of the provider (such as using jargon) and/or the sociodemographic characteristics and learning style of the patient.[45,48,49] Furthermore, patients living in rural or underserved communities, may have limited or even no access to specialist provider care secondary to difficulties accessing specialists due to geographic, physical, financial, or scheduling constraints. Patients may also learn about dermatology-related educational content through their General Practitioner but the patients themselves do not have a formalised means of communicating with dermatology healthcare providers outside the clinical setting. Additionally, the quality of communication exchange between patients and providers may be inconsistent.

Second, providers seek the creation of a broad yet accessible network of patients who may benefit from the receipt of educational content. Dermatologists face several key barriers to optimal patient education using non-tailored patient-provider communication methods. Such specialists are usually limited to in-person contact with patients referred to their clinic. Therefore, there are likely many patients who do not receive high-quality relevant educational content relevant to their dermatosis from qualified specialist healthcare providers secondary to current inefficient methods of connecting patients to the associated providers. Furthermore, many patients are unaware of clinical trial opportunities. This is because of providers' restricted access to potentially eligible participants and current inefficient methods of connecting patients to providers. Patients who most often experience challenges in accessing healthcare are from rural or underserved communities. The patient population in these regions often houses the most in-need volume of patients who are otherwise unable to receive regular specialist education that can lead to enhanced patient engagement and improved clinical outcomes.

Therefore, it is important to develop more effective methods to deliver education that can help to improve patient outcomes such as patient engagement and clinical outcomes.

Tailored Delivery of Education

While non-tailored patient-provider communication methods can be helpful, a new delivery model could be advantageous to improve the accessibility of high-quality education as well as patient engagement and clinical outcomes. Furthermore, patients and their caregivers have previously expressed a desire for easier access to dermatology-approved patient engagement using preferred communication portals. To address real-world challenges faced with the dissemination of patient education, the delivery of patient education can be tailored. Tailored delivery of patient education specifically refers to the individualization of patient-provider communication regarding the mode of communication used to deliver educational messages. This type of tailored communication aims to ensure that content reaches the intended audience. The mode of communication depends on each patient's preferred method of communication. This can include social messaging platforms such as e-mail, SMS, WhatsApp, and Facebook, collectively described as 'eHealth' and 'mHealth'. Using technology in the healthcare setting can facilitate the transfer of relevant educational content to a larger cohort of patients to increase population-wide patient engagement and clinical outcomes.[30,31,50,51] Social messaging or electronic communication is increasingly recognized as a potentially powerful modern tool to improve patient-provider communication and patient engagement with their healthcare, and ultimately patient outcomes.[52–58] These communication methods purport to and meet individual patient needs whilst ensuring that information is received and in a format that is familiar to each patient. For example, one patient may prefer to communicate via WhatsApp while another patient may prefer to communicate via e-mail. Once patient preferences are determined, patient-provider communication can be tailored for each individual. Few studies have performed head-to-head comparisons of delivery channels on patient outcomes and, to our knowledge, no studies have included social media platforms in their comparisons.[59–61] Specifically, in dermatology, there is a gap in our understanding of the effect of tailored delivery of communication and clinical outcomes, patients' engagement in their healthcare, and clinical trial recruitment rates.[29–31,62–66] These data will help inform how we should educate patients to affect their disease outcomes.

A patient-centric, personalized care engine called *Wecudos* can be used to send educational content via customized or non-customized modes of delivery. This online communication portal is capable of secure multi-channel communication that can be used to enable non-tailored and tailored delivery of education. *Wecudos* is fully compliant with the Health Insurance Portability and Accountability Act (HIPAA) and the General Data Protection Regulation (GDPR), which legally defines the data privacy and security provision for safeguarding medical information in the U.S and Europe, respectively. *Wecudos* seeks to improve the delivery of education by facilitating the use of non-tailored and patient preferred communication methods and embedding this with outcome data analytics. Through this, patient-communicated responses can be evaluated and observed for trends in specific patient outcomes such as clinical trial recruitment, patient engagement, and clinical outcomes (Figure 1).

Figure 1. A flowchart outlining the process of using tailored delivery of education via *Wecudos.*

Meaningful application of *Wecudos* can enable us to study and evaluate non-tailored and tailored patient-provider communication. Notably, *Wecudos* can allow direct, versatile, and expedient multi-channel communication between dermatology patients and healthcare providers. To be responsive to real-world workflow, *Wecudos* can allow patients and providers to submit and transfer information at any time. Specifically, providers can send educational content relevant to each patient's dermatological condition(s) in video format via a weblink. Weblinks can be sent using non-customized (hardcopy) modes of delivery or customized (patient choice of social messaging). Weblinks can direct all patients to the educational video as well as any associated questionnaires. The simplicity of an electronically distributed patient-provider communication method facilitates rapid patient responses and allows for providers to monitor the feedback provided which can be stored and used for future reference. Electronic patient-provider communication encourages more regular and consistent lines of communication between patients and their providers which can be used to distribute feedback on educational content delivered.

Little is known regarding the impact of tailored delivery of education on patient engagement and clinical outcomes. This approach underscores patient-centredness using outcome instruments to compare patient engagement and clinical outcomes between non-tailored and tailored delivery of education groups. Overall, tailored delivery of education emphasizes patient-centredness through the determination of patient preferred modes of communication and creating accessible lines of communication between patients and dermatology healthcare providers. The use of an electronic platform that can effectively exploit social messaging to increase the delivery of education is a significant improvement from existing methods of patient-provider communication. This form of technology also eliminates the need for patients to travel to and/or afford specialist healthcare in order to be exposed to receive high-quality educational content. This model can be studied via a pragmatic trial approach to maximise applicability and generalizability.

Because many dermatological conditions such as psoriasis are common and serious, affecting patients from diverse socioeconomic and ethnic backgrounds, these serve as ideal disease cohorts to investigate innovative healthcare models that can be used to care for many types of chronic diseases. [67–70] The distance-independent, time-independent, connective methodology enabled by tailoring delivery of education via *Wecudos* could transform how patients and providers interact with one another. By utilizing technology to meaningfully support accessible, informative, and patient-centred care, a greater number of patients can receive high-quality educational material relevant to their dermatosis.

Patients’ Clinical Outcomes and Medication Adherence

Patients’ clinical outcomes refer to measurable changes in health or quality of life as a result of healthcare such as patients’ mental and physical status, and disease severity. Medication adherence refers to a patient’s often self-reported compliance with their prescribed medications. Patient non-adherence can relate to not taking their medications as prescribed or not taking their medication at all.

Patient-provider communication is important to improving clinical outcomes.[13–23] For example, in patients with cardiovascular diseases, those who reported low-quality patient-provider communication were more than two times more likely to report poor mental or physical outcomes [25] and in patients with chronic coronary disease, depression symptoms were strongly associated with negative perceptions of their providers.[71] In patients with hepatobiliary diseases, those who reported low-quality patient-provider communication were almost three times more likely to report to poor mental status. [24] Additionally, in orthopaedic patients, patients with higher levels of physical functioning were significantly more likely to report greater patient satisfaction with their provider.[72] Furthermore, in patients requiring gynaecologic cancer surgery, those who reported greater experiences - including during the patient-provider communication interaction - had lower odds of in-hospital mortality and less surgical complications.[73] Finally, patients who reported high-quality patient-provider communication, had superior long-term disease control and improved treatment adherence.[24,25,74–77] For example, in the Diabetes Study of Northern California, poor adherence with cardiometabolic medications was associated with patients who reported lower quality patient-provider communication.[78]

However, there is a gap in our understanding of the association between dermatology patients' mental and physical status and patient's perception of the quality of patient-provider communication. Understanding this association is important in dermatology where mental and physical health symptoms can be prevalent. For example, nearly one-third of atopic dermatitis or psoriasis patients report psychological distress and/or depression; a prevalence comparable to those with diabetes or cancer.[79–90] Furthermore, up to 42% of psoriasis patients develop psoriatic arthritis, an inflammatory arthritis with irreversible and disabling joint damage[88,90–92]; and, in atopic dermatitis, physical disruptions such as intense pruritus can lead to poor performances at work or school.[93–97]

Additionally, there is a gap in our understanding regarding how tailored patient-provider communication of education may impact clinical outcomes such as disease severity as well as treatment adherence in dermatology patients. The importance of addressing this gap is in dermatology is two-fold. First, many dermatoses are common conditions. For example, acne is estimated to affect 9.4% of the global population and the eighth most prevalent disease in the world.[98,99] Additionally, atopic dermatitis has the highest disability-adjusted life-year burden out of all skin conditions, ranking 15th in the world out of all conditions and has a prevalence of 7% to 11% among adults in the USA.[100–103] Furthermore, in 2021, psoriasis was reported to affect more than 7.5 million people in the USA and around 125 million people worldwide.[104] Second, treatment adherence is a significant issue among dermatoses. For example, in psoriasis, treatment adherence to topical therapies is reported to be as low as 27% and the overall treatment adherence to both topical and systemic therapies is reported to be as low as 46%.[105,106] Additionally, in atopic dermatitis treatment adherence to topical therapies is reported to be as low as 32% and the overall treatment adherence to both topical and systemic therapies is reported to be as low as 64%.[107,108] Furthermore, in acne patients, treatment adherence to topical therapies is reported to be as low as 14% and treatment adherence to systemic therapies is reported to be as low as 35%.[109,110] Therefore, finding methods that may help to improve disease burden and treatment adherence is important in dermatology.

Healthcare Utilisation

Healthcare resource utilisation refers to healthcare visits such as emergency room visits, inpatient hospitalisations, as well as the use of diagnostic tests and medications. Studies in other diseases highlight the association between patient-provider communication and patients' healthcare resource utilisation. For example, in cardiovascular, hepatobiliary, and surgical diseases, those who perceived high-quality patient-provider communication experienced reduced readmission rates.[18,19,111–114] Specifically, in patients with cardiovascular diseases, those who reported low-quality patient-provider communication were around 1.4 times more likely to have at least two emergency room visits or at least two hospitalizations.[19] In patients with heart failure, across 895 hospitals, patients who reported high-quality patient-provider communication had lower readmission rates.[114] Furthermore, patients with cardiovascular diseases who reported low-quality patient-provider communication had an estimated $1,243 higher annual healthcare expenditure.[19]

Additionally, in patients with hepatobiliary diseases, patients who reported low-quality patient-provider communication were around 2.0 times more likely to have more frequent emergency room visits and 1.9 times more likely to have more frequent hospitalisations.[18] Moreover, in patients who underwent complex abdominal surgery, greater readmission was found in those that reported poor patient understanding.[111] In patients undergoing genitourinary surgery, patients treated in high-performing hospitals - which includes the perception of higher patient-provider communication quality - had shorter hospital stays.[113] Finally, in the primary care setting, patient-centred care was associated with fewer annual specialty care visits, less frequent hospitalisations, and a lower total medical cost. [112]

However, there is a gap in our understanding of the association between patients' healthcare resource utilisation and patients' perception of the quality of patient-provider communication. Understanding this association is important in dermatology where the economic burden secondary to dermatology conditions is significant. For example, in acne, the most common reason to visit a Dermatologist, the total annual cost in the USA was evaluated at $3.1 billion in 2004.[115] In patients with moderate-serve atopic dermatitis, direct annual costs range from €2,000 in Spain to up to €13,702 and $20,000 in the Netherlands and the USA, respectively.[116–118] In psoriasis, direct costs are approximated to range from $52 to $63 billion US dollars, annually.[119] These costs can be sourced to medical resource costs, outpatient services, and hospitalisations, with the latter accounting for almost one third of these costs.[120–123]

Patient Engagement

Patient engagement refers to each patient's knowledge, skills, ability, and willingness to partake in their own healthcare management. This can be summarized into three primary domains: 1) behavioural or the actions a patient takes to face the disease and management, 2) cognitive or the patient's knowledge, understanding, and thoughts regarding the disease and management, and 3) emotional or the psychological and emotional reactions to the patient's disease and management.[124] Patient engagement is strongly associated with health outcomes. In dermatology, increased patient engagement can lead to greater patient satisfaction, adherence, and clinical outcomes.[125] However, studies have shown that patients still lack the confidence, motivation, knowledge, and skillset relating to their personalized healthcare plans.[126,127] High-quality patient-provider communication is known to enhance patient engagement. This can lead to improved overall patient experience, knowledge, healthcare utilisation, behaviour, and health status.[128–132]; and can result in patients having greater self-health awareness, less health-related stress, and greater confidence to improve their general health.[133–135] Furthermore, patients with lower health literacy are less likely to engage in their healthcare.[136–138] Effective patient-provider communication can be used to educate patients and improve overall patient health literacy, defined as the capacity to pursue, comprehend, and action health information.[139,140] Tailored communication can be used to improve patient engagement through improved delivery of disease-specific educational content.[141–143] However, despite understanding the importance of patient engagement, it is widely agreed that further research is required to develop strategies to improve patient engagement.[144] At present, health care organisations, such as the National Health Service (NHS) and the National Committee for Quality Assurance (NCQA) are relied upon to engage patients.[144,145] Although healthcare organisation involvement is essential to improve patient engagement, it is important that we examine novel methods at the provider-level.

Clinical Trial Recruitment

Clinical trial recruitment refers to the process of detecting and enrolling potentially eligible patients for clinical research. Patient recruitment is important to ensure the desired power is achieved for the validity of results[146] and can have significant financial, ethical, and policy implications by allowing superior therapeutics to reach the market and alleviate patient suffering.[147,148] The Clinical Trials Transformative Initiative published in 2018 highlighted that high-quality patient-provider communication is one of the three cardinal strategies necessary to improve clinical trial recruitment.[147] Current examples to recruit patients that require high-quality patient-provider communication include flyers, letters, and phone calls.[149,150]

However, patient recruitment to clinical trials can be challenging.[151] An assessment study in 2015 found that almost one-fifth of registered trials had to close or prematurely end due to an inability to recruit the required number of patients.[152] Furthermore, clinical trials can be delayed due to recruitment difficulties and almost 90% of clinical trials do not meet recruitment targets by the expected timeframe.[153–155] In fact, clinical trial timelines may extend beyond twice the expected enrolment timeframe because of poor recruitment.[156] Failures in meeting recruitment goals have important scientific, financial, ethical, and policy implications.[157–159] In dermatology, the advent of biologics has resulted in a spike of clinical trials being conducted. For example, new psoriasis therapies are being developed on a yearly basis and, in atopic dermatitis, around the world, a report in 2020 cited that there were 517 active, recruiting, or not yet recruiting clinical trials.[160,161] The opportunity to access clinical trials is important for patients because this can help to increase their knowledge and understanding of their disease and also provide a means to receive treatment that they may not be able to receive otherwise due to financial or insurance limitations.[162] Therefore, as the pressure to recruit patients into clinical trials increases, it is important to examine novel methods that may improve clinical trial recruitment.

Hypothesis and Aims of Thesis

Hypotheses

(1) Patients with physical or mental health comorbidities perceive lower-quality patient-provider communication as compared to patients without physical or mental health comorbidities,

(2) Patients who perceive lower-quality patient-provider communication have more emergency-room visits and inpatient hospitalisations as compared to patients who perceive higher-quality patient-provider communication, and

(3) Patients who receive tailored delivery of education are more engaged in their healthcare, have lower disease severity, and are more likely to be recruited into a clinical trial as compared to patients who receive non-tailored delivery of education.

Overall Objectives

1. To determine patient factors that influence patients' perception of patient-provider communication quality.

2. To determine how patient-provider communication impacts healthcare utilisation and patient outcomes.

Aims

Aim 1: To determine the impact of patients' physical and mental health status on patients' perception of patient-provider communication quality.

Aim 2: To determine the impact of patients' perception of patient-provider communication quality on healthcare resource utilisation.

Aim 3: To determine the effect of tailored delivery of education on patient engagement, disease severity, and clinical trial recruitment as compared to non-tailored delivery of education.

Chapter II: Materials and Methods

Materials and Methods

Study Design

This study comprised two parts. Part 1 (Aims 1 and 2) aimed to determine the association between patient-provider communication and dermatology patients' mental and physical health status and their healthcare utilisation. Part 2 (Aim 3) aimed to determine the effect of tailored delivery of dermatology patients' education on their engagement, clinical outcomes, and clinical trial recruitment.

Part 1 (Aims 1 and 2) Methods

Ethical Approval: Aims 1 and 2

The study was approved by the USC local Institutional Review Board (IRB).

Study Cohort: Aims 1 and 2

Patients with the following skin diseases were analysed in Aims 1 and 2: acne, other adnexal diseases (hidradenitis suppurativa and rosacea), atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin neoplasms, psoriasis, and vitiligo and other pigmentation disorders.

Aim 1 Methods

Aim 1: To determine the impact of patients' physical and mental health status on patients' perception of patient-provider communication quality.

Data Source and Study Population

I evaluated the effect of the physical and mental health status of dermatology patients on the perception of patient-provider communication using longitudinal population survey data from the Medical Expenditure Panel Survey (MEPS) database from 2004 to 2017 for mental health comorbidities (psychological distress and depression symptoms) and 2000-2017 for mental or physical functioning. MEPS is a set of large-scale surveys administered since 1996 by the Agency for Healthcare Research and Quality (AHRQ) from the U.S. Department of Health. The MEPS survey asks responders several questions related to healthcare using validated measurement tools and scores and their responses are then coded into variables. It is designed to provide nationally representative estimates of health expenditure, utilisation, payment sources, health status, health insurance coverage, and access to care information for the non-institutionalised U.S. population that is followed up for approximately two consecutive years.[163]

The study population included all adults (≥ 18 years) alive during the calendar year who reported a diagnosis of acne, other adnexal diseases (hidradenitis suppurativa and rosacea), atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin neoplasms, psoriasis, and vitiligo and other pigmentation disorders, and who reported patient-provider communication quality, and completed the Short Form Health Survey (SF-12), Kessler 6-Item Psychological Distress Scale (K6), and/or Patient Health Questionnaire-2 (PHQ2). I used the Medical Conditions data file to identify patients who had a diagnosis of acne, other adnexal diseases (hidradenitis suppurativa and rosacea), atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin neoplasms, psoriasis, and vitiligo and other pigmentation disorders identified by the *International Classification of Diseases, Ninth Revision (ICD-9)* codes or the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (*ICD-10*) codes. For acne, the ICD-9 and ICD-10 codes used were 706 and L70, respectively. For other adnexal diseases (hidradenitis suppurativa and rosacea), the ICD-9 and ICD-10 codes used were 705 or 695 and L73 or L71, respectively. For atopic dermatitis and other dermatitis conditions, the ICD-9 and ICD-10 codes used were 691 or 692 and L20 or L30, respectively. For melanoma and non-melanoma skin neoplasms, the ICD-9 and ICD-10 codes used were 172 or 173 and C43, C44, or D04, respectively. For psoriasis, the ICD-9 and ICD-10 codes used were 696 and L40, respectively. For vitiligo and other pigmentation disorders, the ICD-9 and ICD-10 codes used were 709 and L81, respectively. The MEPS database has been previously used to evaluate patients with acne, other adnexal diseases, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, and vitiligo and other pigmentation disorders.[164–170] I used the Full-Year Consolidated data file to obtain mental and physical health comorbidity and patient-provider communication quality data.

Dependent Variable (Patient-Provider Communication Quality)

The dependent variable was patient-provider communication quality as measured using the “patient-provider communication composite score”. The patient-provider communication composite score is a validated instrument that combines patient responses to four patient-provider communication domains: (1) listening carefully to the patients, (2) explaining diagnoses and management in ways patients could understand, (3) showing respect for patients’ perspective, and (4) patients’ perception whether providers spent enough time with them.[171,172] Patient are scored using the following 4-point Likert scale from 1 (“never”) to 4 (“always”). Global scores range from 4-16. Based on existing literature, patient-provider composite scores were categorised into three groups: (1) low-quality patient-provider communication (patient-provider composite score = 4-9), (2) medium-quality patient-provider communication (patient-provider composite score = 10-15), and (3) high-quality patient-provider communication (patient-provider composite score = 16).[18,173–176]

Independent Variables (Mental and Physical Health Comorbidities)

The independent variables were patients’ mental and physical health comorbidities, as measured by the presence of psychological distress symptoms or depression symptoms, or mental or physical health functioning. I used the SF-12, K6, and PHQ2 questionnaires. I conducted independent analyses for each measurement.

The SF-12 (Appendix 3) is a validated 12-item measure of health derived from the Short Form-36 (SF-36), comprised of two subscales: the Physical Component Summary (PCS) and Mental Component Summary (MCS).[177–179] The PCS and MCS are 6-item measures of physical and mental functioning. The PCS evaluates physical function, general health, bodily pain, and role limitations due to physical health.[177] The MCS evaluates social function, mental health, vitality, and role limitations due to emotional health.[177] For both subscales, a weighted global score, ranging from 0 to 100 is calculated in accordance with a published algorithm.[178] Greater scores on the PCS and MCS subscales indicate better physical and mental functioning, respectively. A global score of 50 ± 10 on either subscale is considered the national average score for the general U.S. population.[179] PCS and MCS scores were each categorised into three levels of functioning: (1) below average physical or mental functioning ($PCS<40$; $MCS<40$), (2) average physical or mental functioning ($PCS\geq40$ to ≤60; $MCS\geq40$ to ≤60), and (3) above average physical or mental functioning (PCS=>60; MCS=>60).[179]

The K6 scale (Appendix 1) is a validated 6-item measure of psychological distress. It evaluates aspects of nervousness, hopelessness, restlessness, depression, apathy, and worthlessness over a 30-day reference period.[180,181] Each item is scored on a 5-point Likert scale from 0 (“none of the time”) to 4 (“all of the time”). Global score range from 0 to 24; a score of ≥13 is considered predictive of a serious mental illness and significant psychological distress.[180] A validation study of mental health comorbidity measures in the MEPS database, demonstrated that all K6 items loaded strongly on the mental health factor using factor analysis.[182] K6 scores were categorised into three groups: no or mild psychological distress symptoms (K6 = 0 to <5), moderate psychological distress symptoms (K6 = 5 to <13), and severe psychological distress symptoms (K6 = 13 to 24).[183]

The PHQ-2 (Appendix 2) is a validated 2-item screening measure for depression.[184,185] Responders are asked to report whether, over the past 2 weeks, they have been "feeling down, depressed, or hopeless," or have "little interest or pleasure in doing things,". Each item is scored on a 4-point Likert scale from 0 ("not at all") to 3 ("nearly every day"). Global scores range from 0-6; a score of ≥3 is considered a positive screen for a depressive disorder (sensitivity 94%, specificity 75%).[185] PHQ2 scores were categorised into three groups: no or mild depression symptoms (PHQ2 = <1.5), moderate depression symptoms (PHQ2 = ≥1.5 to <3), and severe depression symptoms (PHQ2 = 3 to 6).[185,186]

Covariates

Potential demographic confounders were adjusted for including age, sex (male or female), race, ethnicity (Hispanic or non-Hispanic), marital status, employment status (employed or unemployed), educational level, poverty level category, the year the survey was conducted (to account for how communication perceptions can change over time), and whether the patient and clinician speak the same language.[187–192] Additionally, potential clinical confounders were adjusted for including cognitive limitations, social limitations, and comorbidities. Cognitive limitations were defined as confusion or memory loss, problems making decisions, or the requirement of supervision for safety. Social limitations were defined as any social, recreational, or family activity limitations secondary to mental or physical impairments. Comorbidities were assessed using the Charlson Comorbidity Index (CCI), excluding depression owing to its collinearity with mental health comorbidities.[193] The CCI is a validated measure of the approximated mortality risk from comorbidities. It has been adapted for use with ICD-9 codes and has been used with the MEPS.[193–200]

Statistical Analysis

I conducted separate analyses for each mental health comorbidity measure (K6, PHQ2, and MCS) and for each physical health comorbidity measure (PCS). I applied descriptive statistics for socio-demographic and clinical covariates. Socio-demographic covariates included age, gender, race, ethnicity, marital status, employment status, education level, and poverty level category. Clinical covariates included the presence of cognitive limitations, social limitations, and comorbidities. Comorbidities were calculated using the Charlson Comorbidity Index (CCI).[201]

I assessed differences in socio-demographic and clinical characteristics between patients with varying severities of mental health symptoms or varying levels of mental or physical health functioning using chi-squared (χ^2) analyses for categorical variables and analysis of variance (ANOVA) for continuous data.

To determine whether differences exist in patient-provider communication quality among patients with varying severities of mental health symptoms or levels of mental or physical health functioning, I performed a univariate analysis using ANOVA. Multivariable linear regression models were used to assess the outcome of patient-provider communication quality as a continuous outcome variable. Multivariable logistic regression models were used to assess the outcome of patient-provider communication quality as a categorical outcome variable.[24,173–176]

To obtain nationally representative population sums, I applied person-level sampling weights and a variance estimation stratum to account for unequal selection probabilities and non-response rates. $P \leq 0.05$ was established *a priori* as statistically significant. All statistical analyses were conducted using STATA version 13.0 (StataCorp LLC).

Aim 2 Methods

<u>Aim 2:</u> To determine the impact of patients' perception of patient-provider communication quality on healthcare resource utilisation.

Data Source and Study Population

I evaluated the effect of the perception of patient-provider communication on healthcare resource utilisation using longitudinal population survey data from the aforementioned Medical Expenditure Panel Survey (MEPS) database from 2000 to 2017.

The study population included all adults (≥ 18 years) alive during the calendar year who reported a diagnosis of acne, other adnexal diseases (hidradenitis suppurativa and rosacea), atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin neoplasms, psoriasis, and vitiligo and other pigmentation disorders, and who reported patient-provider communication quality. I used the Medical Conditions data file to identify patients who had a diagnosis of acne, other adnexal diseases (hidradenitis suppurativa and rosacea), atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin neoplasms, psoriasis, and vitiligo and other pigmentation disorders identified by the aforementioned ICD-9 and ICD-10 codes. I used the Full-Year Consolidated data file to obtain emergency room visit, overnight inpatient hospitalisation, outpatient visit, total expenditure, and patient-provider communication quality data.

Dependent Variable (Healthcare Resource Utilisation)

The dependent variables were measures of healthcare resource utilisation and expenditure. Healthcare resource utilisation was measured by the frequency of emergency room (ER) visits, overnight inpatient hospitalisations, and outpatient visits per person per year (PPPY). Healthcare expenditures were measured by the total annual costs attributable to prescriptions, ER visits, overnight inpatient hospitalizations, and outpatient visits adjusted to 2020 U.S. dollars. Healthcare expenditures included out-of-pocket and insurance payments.

Independent Variables (Patient-Provider Communication Quality)

The independent variable was patient-provider communication quality as measured using the aforementioned “patient-provider communication composite score”.

Covariates

Potential demographic confounders were adjusted for, including age, sex (male or female), race, ethnicity (Hispanic or non-Hispanic), marital status, employment status (employed or unemployed), insurance status, educational level, poverty level category, the year the survey was conducted (to account for how communication perceptions can change over time), and whether the patient and clinician speak the same language.[202–208] Additionally, potential clinical confounders were adjusted for, including cognitive limitations, social limitations, and comorbidities. Cognitive and social limitations were described above. Comorbidities were assessed using the aforementioned CCI.

Statistical Analysis

I conducted separate analyses for each healthcare resource utilisation measure (ER visits, overnight inpatient hospitalisations, and outpatient visits) and for healthcare expenditure. I applied descriptive statistics for socio-demographic and clinical covariates. Socio-demographic covariates included age, gender, race, ethnicity, marital status, employment status, insurance status, education level, and poverty level category. Clinical covariates included the presence of cognitive limitations, social limitations, and comorbidities. Comorbidities were calculated using the Charlson Comorbidity Index (CCI).[201]

I assessed differences in socio-demographic and clinical characteristics between patients who reported different levels of patient-provider communication quality using chi-squared (χ^2) analyses for categorical variables and analysis of variance (ANOVA) for continuous data.

To determine whether differences exist in mean healthcare utilisation and expenditure between different levels of patient-provider communication quality, I performed a univariate analysis using ANOVA. Multivariable linear regression models were used to assess the outcome of healthcare resource utilisation and expenditure as continuous outcome variables. Multivariable logistic regression models were used to assess the outcome of healthcare resource utilisation as categorical outcome variables.[18,173–176]

To obtain nationally representative population sums, I applied person-level sampling weights and a variance estimation stratum to account for unequal selection probabilities and non-response rates. $P \leq 0.05$ was established *a priori* as statistically significant. All statistical analyses were conducted using STATA version 13.0 (StataCorp LLC).

Part 2 (Aim 3) Methods

Aim 3: To determine the effect of tailored delivery of education on patient engagement, disease severity, and clinical trial recruitment as compared to non-tailored delivery of education.

Ethical Approval

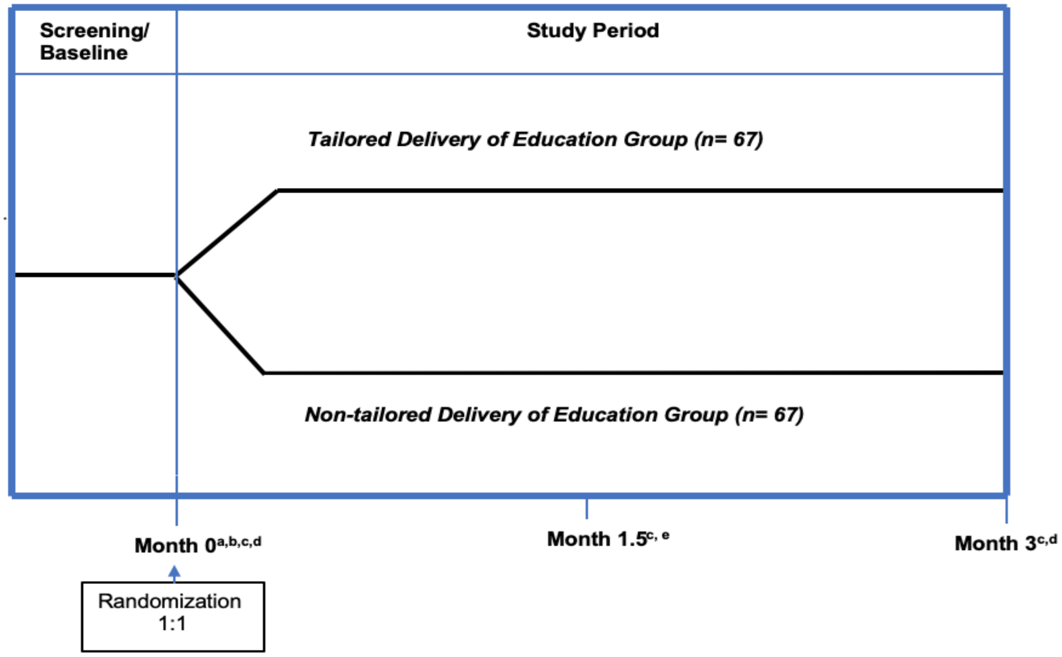
The study was approved by the University of Southern California (USC) local Institutional Review Board (IRB).

Study Design

A 3-month pragmatic randomised controlled study (ClinicalTrials.gov ID: NCT04633616) was conducted to evaluate the effect of tailored delivery of education on patient engagement and clinical outcomes compared to non-tailored delivery of education (Figure 1).[209–212] 134 psoriasis patients were randomised 1:1 to receive either tailored or non-tailored delivery of psoriasis education. Psoriasis patients were chosen for this study given the high prevalence and poor outcomes reported in this population including low patient knowledge and medication adherence.

At month 0, 1.5, and 3, all patients received access to weblinks to educational videos (Appendix 4) and associated questionnaires (three in total). The video content was disease-specific and pertained to patient education of disease awareness and disease management and/or any associated clinical trial opportunities (psoriasis treatment overview: https://www.youtube.com/watch?v=s5wrUEsJvNY ; psoriasis and diet: https://www.youtube.com/watch?v=n0-WtWhuPL8; skin research: https://www.youtube.com/watch?v=_GaXPxfpUm0). Because it is known that for the creation of educational materials patient involvement is informative, we performed a needs assessment for the educational topics created to determine which information patients wanted to receive.[213] Additionally, we conducted a survey asking 67 psoriasis patients what their most preferred communication channel would be to ensure that these options could be provided in our tailored group. Weblinks were enabled by *Wecudos*, a patient-centric, personalised care engine that can be used to send educational content via tailored or non-tailored modes of delivery.

Figure 2. Overview of pragmatic trial evaluating effectiveness of tailored delivery of education versus non-tailored delivery of education



[a] Patients were screened at month 0. Patient eligibility was assessed, informed consent was obtained, and the medical history, baseline demographics, and socioeconomics data was collected.

[b] Patients were randomised at month 0 to tailored or non-tailored delivery of education groups.

[c] Weblinks directing patients to an educational video were sent at month 0, 1.5, and 3 via tailored or non-tailored delivery.

[d] Patient engagement was assessed for all patients via patient response rates (click rates), the patient activation measurement-13 (PAM-13) questionnaire, the Armstrong Viewer Assessment (AVA), and patient dropout rates. Clinical outcomes (disease severity and treatment adherence) were assessed. Psoriasis disease severity was assessed using the Physician Global Assessment (PGA), Body Surface Area (BSA), and Psoriasis Area and Severity Index (PASI). Treatment adherence was assessed using the Medication Adherence Questionnaire (MAQ).

[e] Patient engagement was assessed by patient response rates, the patient activation measurement-13 (PAM-13) questionnaire, the Armstrong Viewer Assessment (AVA), and patient dropout rates.

Intervention Arm (Tailored Patient-Provider Communication)

Communication was tailored as the mode of weblink delivery was customised to patient preference. Patients could choose messages to be delivered via e-mail, SMS, WhatsApp, or Facebook. For example, if one patient determined SMS messaging as their preferred communication mode, then this patient received a weblink via SMS directing the patient to customised educational videos and questionnaires.

Control Arm (Non-Tailored Patient-Provider Communication)

Communication was non-tailored such that patients were not able to choose their preferred mode of communication. All patients received hardcopy with QR codes to access education via weblinks directing the patient to the same customised educational videos and questionnaires as received by those in the intervention arm.

Recruitment

We enrolled 134 participants in the study from a target population of approximately 32,310 adult dermatology patients in southern California. Participants included current, past, and new patients with active mild, moderate, or severe disease that were being treated or not treated with topical and/or systemic therapies. These participants were recruited via invitation letters, e-mails, telephone calls, or in-person from a variety of sources. These sources included the Department of Dermatology at USC and LA County+USC Medical Centre and the USC Electronic Health Records

(EHR)-enabled database. For EHR-enabled practices, we obtained a list of patients with psoriasis and then conferred with relevant providers regarding appropriate patients to contact for this study. Participants were informed that the study was about investigating alternative methods of communication between doctors and participants which we hoped would help us learn about the relevance and effectiveness of social messaging for clinical trial recruitment and participant education (Appendix 12).

Inclusion Criteria

In order to be eligible to participate, the individual had to have met all of the following criteria:

- Provided signed and dated informed consent form
- Spoke English or Spanish
- Male, female, or other, at least 18 years of age
- Had active, physician-diagnosed psoriasis
- Had access to an electronic device that was capable of capturing images with a minimum resolution of 1024x768 pixels
- Had access to at least one form of social messaging (e-mail, SMS, WhatsApp, or Facebook) which could connect online

Exclusion Criteria

An individual who met any of the following criteria was excluded from participation:

- Did not have active psoriasis at the beginning of the study
- Did not live in southern California
- Unable to fulfil the required tasks of the study

Randomisation

To ensure enrolment of patients representing the full spectrum of disease severity, we performed stratified randomisation using computer-generated random block sizes. This process was based on patients randomised 1:1 to non-tailored or tailored patient-provider communication, stratified by disease severity. This recruitment method contributed to a diverse patient population in demographic, socioeconomic, and their disease state. Allocation concealment was ensured as the randomisation was not performed until the patient was recruited into the trial, which took place after all baseline measurements were completed. Regarding blinding, the study team knew which form of communication each patient would receive while study participants did not know the different types of communication being studied.

Power Calculation

The sample size formula $N = (Z_{\alpha/2}+Z_{\beta})^2 * (p_1(1-p_1)+p_2(1-p_2)) / (p_1-p_2)^2$ was used, where N is the total number of weblinks sent. At a significance level of $\alpha = 0.05$ and power of 99.5%, $Z\alpha/2 = 1.96$ *and* $Z_{\beta} = 2.58$. The effect size (p_1-p_2) was calculated as the difference between the experimental ($p_1 = 0.6$) and control group ($p_2 = 0.3$) primary endpoint, where p represents the expected proportion of weblinks that are clicked on in each study group. Based on these values, for a total of 200 weblinks sent (three weblinks per patient), we calculated a total of 67 participants (34 per each arm) would be required. We enrolled a total of 134 patients (67 per each arm) by considering an estimated dropout rate of 50%.[214,215] Thus, all power estimates were conservative because we would have partial information on the 67 patients who were expected to dropout.

Our sample size calculation was based on the assumption that each weblink sent represents an independent trial and that the total “successes” of weblinks clicked would approximate a normal distribution. It is important to acknowledge that there may be some correlation for the clicking habits for each patient who will each receive 3 weblinks. Therefore, by assuming click rates as independent trials and not as a repeated measure, the true power may be less. However, with a calculated power of 99.5% using conservative measures for both the effect size (0.3) and drop-out rates (50%), we believe the proposed sample size to be appropriate.

Outcome Measures (Primary Outcome)

The primary outcome was patient response rates as measured by click rates. Click rates were calculated using the proportions of patients in both study populations who chose to click on the weblinks delivered throughout the study, regardless of whether or not the questionnaires were completed. The time elapsed from when the weblink was sent and when the weblink was clicked was also recorded. The time elapsed will be useful to determine how quickly patients can view education when sent weblinks via social messaging platforms rather than as a comparison between the study groups given that the control arm receives the educational link via mail and will therefore have a greater time elapsed.

Outcome Measures: Secondary Outcomes

The secondary outcomes were patient engagement, disease severity, treatment adherence, clinical trial recruitment rate, and patient knowledge.

Patient engagement was measured using the patient activation measurement-13 (PAM-13), Armstrong Viewer Assessment (AVA), and patient dropout rates. The PAM-13 score (Appendix 5) is a validated scale consisting of 13 questions that was used to determine patient ‘activation’, or ‘empowerment’ of a patient to participate in their healthcare.[216] This examines the third step of patient engagement by assessing a patient’s self-involvement of a patient in their disease process and management.[217] The higher the score, the higher the activation level. Patients in level 1 may still believe their nurse or doctor will “fix” them. Patients in level 2 may understand they must be involved in their healthcare but lack the knowledge and confidence to take care of their conditions. Patients in level 3 are beginning to gain confidence to take on self-management behaviours and need to experience small successes to build a sense of self-efficacy and increase activation. Patients in level 4 have the confidence and skills to manage their health but may need help with maintaining their progress during stressful times. Patient activation was assessed by the proportion of patients achieving patient activation level 3 or 4 on the PAM-13. The AVA (Appendix 6) is a validated scale that was used to determine patient experience with the educational materials viewed.[218] The AVA is a single-question questionnaire that asked how each participant felt about the video using a 5-point Likert scales between 0-4, where 0=very poor, 1=poor, 2=fair, 3=good, and 4=very good. High patient experience was assessed by the proportion of patients who reported “good” or “very good” and low poor patient experience was assessed by the proportion of patients who reported “poor” or “very poor”. Patient dropout rates were calculated as the proportion of patients who no longer click on weblinks during the remainder of the study out of those who had clicked on at least one weblink.

Psoriasis disease severity was measured by the Physician Global Assessment (PGA), Body Surface Area (BSA), and the Psoriasis Area and Severity Index (PASI). The PGA is a validated instrument that measures the overall psoriasis severity. PGA (Appendix 10) is an ordinal 5-point scale ranging from 0 (clear) to 4 (severe).[219] The BSA (Appendix 11) assessment is a well-established, validated measure used by psoriasis providers to report the percent body surface affected by psoriasis in numerous prior studies.[220] BSA ranges from 0% (no involvement) to 100% (complete body surface affected). PASI (Appendix 9) is a validated instrument that enables providers to assess psoriasis disease severity.[221] PASI combines the assessment of lesion severity (erythema, induration, and scale) and the affected areas into a single score between 0 (no disease) to 72 (maximal disease).[221] For all three measures, disease severity was measured by two un-blinded assessors with a third in cases of discrepancies for quality assurance at baseline and at month 3 either in-person or via high-quality photographs (Appendix 13). Assessors were trained via formal certification of these disease severity measurements.

Treatment adherence was measured by the Medication Adherence Questionnaire (MAQ). This questionnaire is also referred to as the 4-item Morisky Medication Adherence Scale (MMAS-4) and the Morisky Scale.[222–225] The MAQ (Appendix 7) is a generic, self-reported medication-taking scale commonly used in research for chronic diseases. The MAQ consists of four items pertaining to patient adherence to their prescribed treatments with a scoring scheme of "Yes" = 1 or "No" = 0. The total possible score can range from 0-4. A score of 0 indicates treatment adherence and a score of 1-4 indicates treatment non-adherence.[226–229] Treatment adherence was measured as the proportion of patients who reported an MAQ score of 0.

Clinical trial recruitment was determined by the proportion of patients recruited into clinical trials. Patients who were interested in participating in a clinical trial would contact the study team after watching the relevant educational video using the contact information provided. This outcome measure will not account for participants who express interest in participating in a trial but are ineligible.

Patient knowledge was assessed using customised 5-question questionnaires (Appendix 8).

Statistical Analysis

I conducted separate analyses for each primary and secondary outcome measure. Baseline demographics and clinical characteristics were reported including age, gender, race, ethnicity, marital status, employment status, insurance status, education level, income, and disease severity. I assessed differences in sociodemographic and clinical characteristics between patients who received tailored patient-provider communication and patients who received non-tailored patient-provider communication using chi-squared (χ^2) analyses for categorical variables and the t-test for continuous data. They were examined to determine the success of randomisation. Descriptive statistical analysis was applied to determine proportional data regarding click rates, patient engagement measures (PAM-13, patient experience, and patient drop out), disease severity, treatment adherence, clinical trial recruitment, and patient knowledge. For psoriasis disease severity, percentage, and proportional changes between disease scores at baseline and month 3 were calculated. $\chi^2$and t-test analyses were performed, as appropriate. Multivariable linear regression models were used to assess the outcome of click speed and patient knowledge as continuous outcome variables. Multivariable logistic regression models were used to assess the outcome of click rates, click speed, patient activation, patient experience, patient drop out, treatment adherence, and clinical trial recruitment as categorical outcome variables. Multivariable linear and logistic regression models were adjusted for patients' demographics including race, gender, socioeconomic status, and age as well as clinical characteristics.

All patients who participated and completed questionnaires were included in the study analysis. Patients who drop out were not included in the study analysis. If the drop out exceeds 50% of the participants, we planned to utilize a missing data model for intention to treat. $P \leq 0.05$ was established *a priori* as statistically significant. All statistical analyses were conducted using STATA version 13.0 (StataCorp LLC) and *Wecudos* in-built analytic methods were used for statistical analysis.

Chapter III: Results

Results

Aim 1 Results: Psychological Distress and Depression Symptoms

<u>Aim 1:</u> To determine the impact of patients' physical and mental health status on patients' perception of patient-provider communication quality.

Acne: Study Population Characteristics

A weighted total of 26,413,621 US adults with acne (unweighted, 2,038 US adults with acne) who reported mental health comorbidities during a 14-year period from the 2004-2017 MEPS database were included in the analysis. The mean (SEM) age was 41.3 (0.45) years. Females constituted 68% of the population. The mean patient-provider communication quality score was 13.9 (95% CI, 13.8-14.0).

Acne: Psychological Distress Symptoms

Regarding the Kessler 6-item psychological distress scale, 72% of acne patients had no or mild symptoms, 23% had moderate symptoms, and 5% had severe symptoms (Table 1).

Table 1. Sociodemographic and clinical characteristics of us adult patients with acne by severity of psychological distress symptoms from the Medical Expenditure Panel Survey

Characteristic	Severity of Psychological Distress Symptoms, No.[a]			*P* value
	No or Mild (Weighted no.= 19,083,979)	**Moderate** (Weighted no.= 6,041,762**)**	**Severe** (Weighted no.= 1,287,880**)**	
Age, mean (SEM) years	41.6 (0.49)	40.3 (0.97)	42.4 (1.33)	0.266[b]
Gender, female no. (%)	12,591,844 (66%)	4,341,745 (72%)	900,176 (70%)	0.087[c]
Unemployed, no (%)	4,972,398 (26%)	1,802,855 (30%)	682,088 (53%)	<0.0001[c]
Race, no. (%)				
White	15,710,148 (82%)	5,125,496 (85%)	1,141,982 (89%)	0.236[c]
Black	2,205,153 (12%)	536,642 (9%)	79,735 (6%)	
Asian, Native Hawaiian or Pacific Islander	908,613 (5%)	284,464 (5%)	59,037 (5%)	
American Indian or Alaskan Native	237,818 (1%)	22,700 (0.4%)	7,126 (0.6%)	
Multiple races reported	22,247 (0.1%)	72,460 (1%)	0 (0%)	
Ethnicity, Hispanic no. (%)	1,297,872 (7%)	501,418 (8%)	116,119 (9%)	<0.001[c]
Marital Status, no. (%)				
Married	9,441,285 (49%)	2,559,591 (42%)	550,917 (43%)	0.0001[c]
Widowed	889,093 (5%)	185,588 (3%)	27,345 (2%)	
Divorced	1,678,380 (9%)	634,172 (10%)	261,114 (20%)	
Separated	144,499 (0.8%)	69,203 (1%)	56,831 (4%)	
Never Married	6,930,723 (36%)	2,593,208 (43%)	391,675 (30%)	
Cognitive Limitations, no. (%)	269,406 (1%)	476,170 (8%)	299,565 (23%)	<0.0001[c]
Social Limitations, no. (%)	373,334 (2%)	529,146 (9%)	367,831 (29%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	1,794,316 (9%)	738,940 (12%)	79,931 (6%)	0.0001[c]
High School	5,331,307 (28%)	2,073,387 (34%)	602,185 (47%)	
≥ 1 year College	11,958,356 (63%)	3,229,435 (53%)	605,765 (47%)	
Poverty Level Category, no (%)				
Poor	1,095,789 (6%)	641,863 (11%)	308,065 (24%)	<0.0001[c]
Near Poor	351,897 (2%)	185,113 (3%)	64,391 (5%)	
Low Income	1,678,626 (9%)	803,332 (13%)	248,204 (19%)	
Middle Income	5,134,860 (27%)	1,589,114 (26%)	453,930 (35%)	
High Income	10,822,808 (57%)	2,822,342 (47%)	213,290 (17%)	
Provider and Patient do not Speak Same Language, no (%)	124,975 (0.7%)	48,142 (0.8%)	24,644 (2%)	0.077[c]
CCI, mean (95% CI)	1.21 (1.18-1.23)	1.17 (1.12-1.21)	1.25 (1.15-1.34)	0.663[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

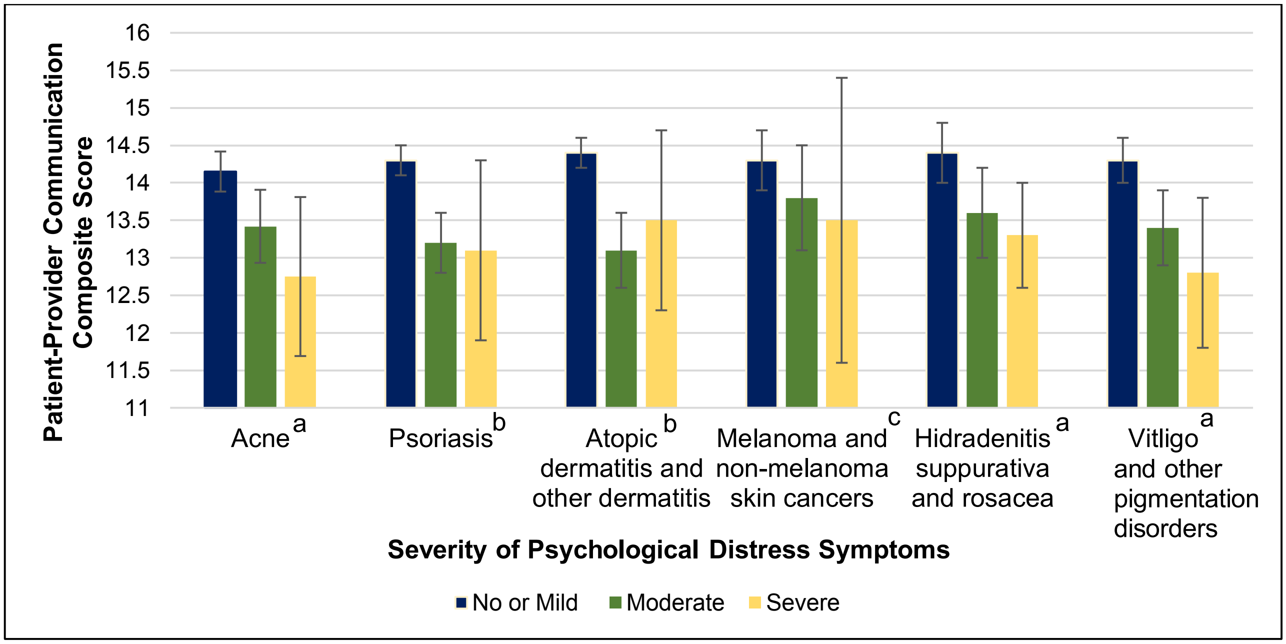
[b] Analysis of variance of differences between adult patients with acne who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[c] Using the χ^2 test of differences between adult patients with acne who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient satisfaction score was 14.2 (95% CI, 14.0-14.3) for acne patients with no or mild psychological distress symptoms, 13.4 (95% CI, 13.2-13.7) for acne patients with moderate psychological distress symptoms, and 12.8 (95% CI, 12.2-13.3) for acne patients with severe psychological distress symptoms ($P<0.0001$) (Figure 3).

Figure 3: Patient-provider communication quality among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorder patients by severity of psychological distress symptoms from the Medical Expenditure Panel Survey.



Patient-provider communication quality as measured by the patient-provider communication composite score. The vertical lines indicate 95% CIs.

^{a} P<0.0001; ^{b} P<0.001; ^{c} P=0.02

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients with no or mild psychological distress symptoms, acne patients with moderate or severe psychological distress symptoms had a patient-provider communication quality score decrement of 0.7 and 1.3, respectively (adjusted *B* coefficient, -0.7 [95% CI, -1.0, -0.4]; P<0.001 and -1.3 [-1.9, -0.7]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients with no or mild psychological distress symptoms, acne patients with severe psychological distress symptoms were 3.7 times more likely to report low-quality patient-provider communication (adjusted OR [AOR], 3.7 [95% CI, 1.9-6.9]; P< 0.001) (Table 2).

Table 2: Association between the severity of psychological distress symptoms and patient-provider communication quality among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders from the Medical Expenditure Panel Survey.

Independent Variables*	**Psychological Distress (K6)**			
	Dependent Variable: Patient-Provider Communication Quality (B Coef.) / Low-quality patient-provider communication (AOR)			
	Adjusted *B* Coef. (95% CI)	***P* value**	**AOR (95% CI)**	***P* value**
Mental Health Symptom Severity: Acne				
No or Mild	1[Ref]	NA	1[Ref]	NA
Moderate	-0.7 (-1.0, -0.4)	<0.001	1.6 (1.0-2.6)	0.080
Severe	-1.3 (-1.9, -0.7)	<0.001	3.7 (1.9-6.9)	<0.001
Mental Health Symptom Severity: Psoriasis				
No or Mild	1[Ref]	NA	1[Ref]	NA
Moderate	-0.9 (-1.2, -0.6)	<0.001	2.8 (1.5-4.9)	0.001
Severe	-0.8 (-1.5, -0.2)	0.01	2.3 (1.1-4.7)	0.030
Mental Health Symptom Severity: Atopic dermatitis and other dermatitis conditions				
No or Mild	1[Ref]	NA	1[Ref]	NA
Moderate	-1.3 (-1.6, -1.0)	<0.001	2.9 (1.7-5.1)	<0.001
Severe	-1.1 (-1.7, -0.4)	0.002	7.5 (3.1-17.8)	<0.001
Mental Health Symptom Severity: Skin Cancers (Melanoma and Non-Melanoma)				
No or Mild	1[Ref]	NA	1[Ref]	NA
Moderate	-0.6 (-1.1, -0.1)	0.01	1.2 (0.5-2.8)	0.73
Severe	-0.9 (-1.9, 0.1)	0.08	12.0 (4.4-32.9)	<0.001
Mental Health Symptom Severity: Hidradenitis suppurativa and Rosacea				
No or Mild	1[Ref]	NA	1[Ref]	NA
Moderate	-1.0 (-1.3, -0.6)	<0.001	1.1 (0.3-4.1)	0.860
Severe	-2.2 (-3.4, -0.9)	0.001	12.8 (2.2-76.4)	0.005
Mental Health Symptom Severity: Vitiligo and other pigmentation disorders				
No or Mild	1[Ref]	NA	1[Ref]	NA
Moderate	-0.9 (-1.2, -0.6)	<0.001	3.2 (1.8-5.6)	<0.001
Severe	-1.3 (-1.9, -0.7)	<0.001	8.3 (3.7-18.6)	<0.001

AOR, adjusted odds ratio; CI, confidence interval; K-6, Kessler 6; NA, not applicable; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, poverty level category, cognitive limitations, social limitations, and Charlson comorbidity index. Only mental health symptom severity data shown.

Acne: Depression Symptoms

Regarding the patient health questionnaire 2 for depression, 79% of acne patients had no or mild symptoms, 13% had moderate symptoms, and 8% had severe symptoms (Table 3).

Table 3. Sociodemographic and clinical characteristics of US adult patients with acne by severity of depression symptoms from the Medical Expenditure Panel Survey

	Severity of Depression Symptoms, No.[a]			
Characteristic	**No or Mild** (Weighted no.= 20,903,435)	**Moderate** (Weighted no.= 3,483,638)	**Severe** (Weighted no.= 2,026,550)	***P* value**
Age, mean (SEM) years	41.2 (0.52)	41.0 (1.12)	42.8 (1.39)	0.248[b]
Gender, female no. (%)	13,957,564 (67%)	2,442,139 (70%)	1,434,062 (71%)	0.435[c]
Unemployed, no (%)	5,394,963 (26%)	1,033,990 (30%)	1,028,388 (51%)	<0.0001[c]
Race, no. (%)				
White	17,416,690 (83%)	2,849,124 (82%)	1,711,813 (84%)	0.155[c]
Black	2,241,727 (11%)	384,424 (11%)	195,380 (10%)	
Asian, Native Hawaiian or Pacific Islander	949,997 (5%)	209,100 (6%)	93,018 (5%)	
American Indian or Alaskan Native	252,876 (1%)	3,963 (0.1%)	10,804 (0.5%)	
Multiple races reported	2,145 (0.01%)	37,027 (1%)	15,535 (0.8%)	
Ethnicity, Hispanic no. (%)	1,380,435 (7%)	406,526 (12%)	128,450 (6%)	<0.001[c]
Marital Status, no. (%)				
Married	10,218,299 (49%)	1,410,997 (41%)	922,496 (46%)	0.003[c]
Widowed	899,039 (4%)	143,209 (4%)	59,777 (3%)	
Divorced	1,769,209 (8%)	447,667 (13%)	356,789 (18%)	
Separated	181,791 (0.9%)	50,261 (1%)	38,480 (2%)	
Never Married	7,835,096 (37%)	1,431,503 (41%)	649,007 (32%)	
Cognitive Limitations, no. (%)	430,419 (2%)	216,626 (6%)	398,096 (20%)	<0.0001[c]
Social Limitations, no. (%)	504,252 (2%)	304,080 (9%)	461,978 (23%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	2,118,913 (10%)	340,194 (9%)	154,079 (8%)	<0.001[c]
High School	5,947,273 (28%)	1,105,552 (32%)	954,053 (47%)	
≥ 1 year College	12,837,248 (61%)	2,037,891 (58%)	918,417 (45%)	
Poverty Level Category, no (%)				
Poor	1,208,730 (6%)	422,924 (12%)	414,062 (20%)	<0.0001[c]
Near Poor	415,671 (2%)	89,188 (3%)	96,541 (5%)	
Low Income	1,887,470 (9%)	365,052 (10%)	477,640 (24%)	
Middle Income	5,554,446 (26%)	1,029,715 (30%)	593,742 (29%)	
High Income	11,837,117 (57%)	1,576,759 (45%)	444,564 (22%)	
Provider and Patient do not Speak Same Language, no (%)	127,107 (0.6%)	38,680 (1%)	31,974 (2%)	0.136[c]
CCI, mean (95% CI)	1.20 (1.18-1.23)	1.17 (1.12-1.23)	1.19 (1.18-1.26)	0.788[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

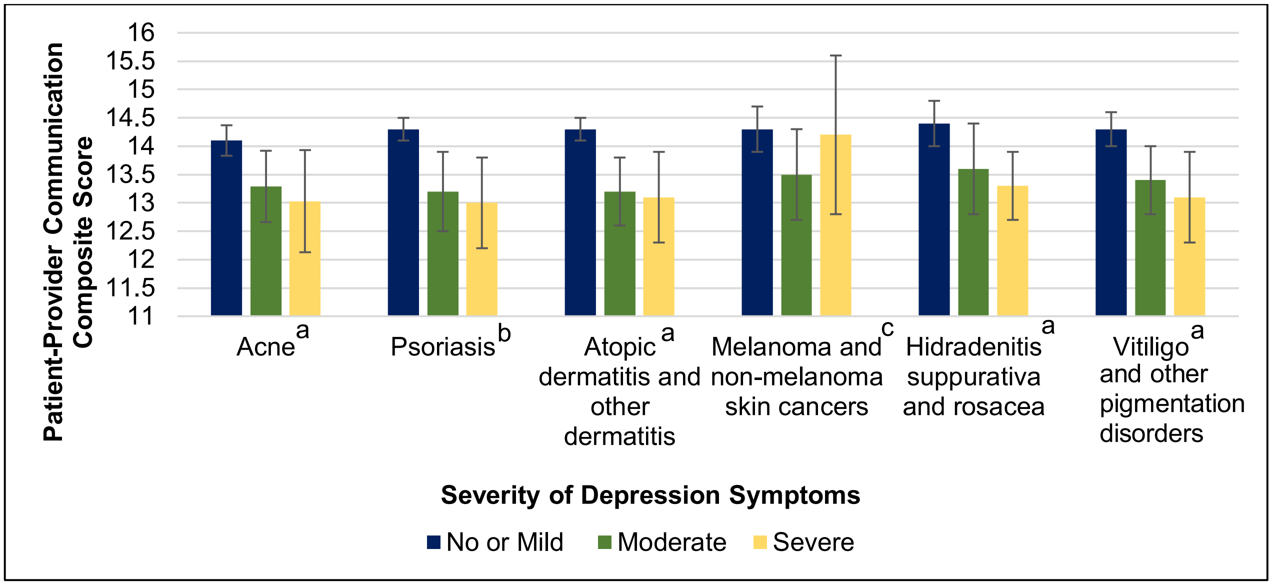
[b] Analysis of variance of differences between adult patients with acne who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[c] Using the χ^2 test of differences between adult patients with acne who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient satisfaction score was 14.1 (95% CI, 14.0-14.2) for acne patients with no or mild depression symptoms, 13.3 (95% CI, 13.0-13.6) for acne patients with moderate depression symptoms, and 13.0 (95% CI, 12.6-13.5) for acne patients with severe depression symptoms ($P<0.0001$) (Figure 4).

Figure 4. Patient-provider communication quality among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorder patients by severity of depression symptoms from the Medical Expenditure Panel Survey.



Patient-provider communication quality as measured by the patient-provider communication composite score. The vertical lines indicate 95% CIs.

[a] P<0.0001; [b] P=0.002; [c] P=0.03

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients with no or mild depression symptoms, acne patients with moderate or severe depression symptoms had a patient-provider communication quality score decrement of 0.7 and 0.9, respectively (adjusted *B* coefficient, -0.7 [95% CI, -1.1, -0.4]; P<0.001 and -1.3 [-1.4, -0.4]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients with no or mild depression symptoms, acne patients with severe depression symptoms were 2.7 times more likely to report low-quality patient-provider communication (AOR, 2.7 [95% CI, 1.5-5.0]; P=0.001) (Table 4).

Table 4: Association between the severity of depression symptoms and patient-provider communication quality among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders from the Medical Expenditure Panel Survey.

Independent Variables*	**Depression (PHQ-2)**			
	Dependent Variable: Patient-Provider Communication Quality (B Coef.) / Low-quality patient-provider communication (AOR)			
	Adjusted *B* Coef. (95% CI)	***P* value**	**AOR (95% CI)**	***P* value**
Mental Health Symptom Severity: Acne				
No or Mild	1[Ref]		1[Ref]	
Moderate	-0.7 (-1.1, -0.4)	<0.001	1.6 (0.8-3.0)	0.150
Severe	-0.9 (-1.4, -0.4)	<0.001	2.7 (1.5-5.0)	0.001
Mental Health Symptom Severity: Psoriasis				
No or Mild	1[Ref]		1[Ref]	
Moderate	-0.7 (-1.2, -0.2)	0.004	4.6 (2.1-10)	<0.001
Severe	-0.5 (-1.1, -0.03)	0.04	1.8 (1.0-3.4)	0.06
Mental Health Symptom Severity: Atopic dermatitis and other dermatitis conditions				
No or Mild	1[Ref]		1[Ref]	
Moderate	-1.0 (-1.4, -0.7)	<0.001	3.3 (1.6-6.8)	0.001
Severe	-1.3 (-1.7, -0.8)	<0.001	4.6 (2.2-9.4)	<0.001
Mental Health Symptom Severity: Skin Cancers (Melanoma and Non-Melanoma)				
No or Mild	1[Ref]		1[Ref]	
Moderate	-0.8 (-1.4, -0.3)	0.002	5.5 (3.3-9.2)	<0.001
Severe	0.1 (-0.7, 0.8)	0.85	0.6 (0.1-2.8)	0.51
Mental Health Symptom Severity: Hidradenitis suppurativa and Rosacea				
No or Mild	1[Ref]		1[Ref]	
Moderate	-0.9 (-1.4, -0.4)	0.001	3.5 (0.8-15.9)	0.100
Severe	-1.3 (-1.8, -0.8)	<0.001	15.9 (4.0-63.7)	<0.001
Mental Health Symptom Severity: Vitiligo and other pigmentation disorders				
No or Mild	1[Ref]		1[Ref]	
Moderate	-0.8 (-1.2, -0.5)	<0.001	2.9 (1.4-5.8)	0.003
Severe	-1.0 (-1.4, -0.5)	<0.001	3.4 (1.7-6.9)	0.001

AOR, adjusted odds ratio; CI, confidence interval; PHQ-2, Patient Health Questionnaire 2; Ref, reference.

Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, poverty level category, cognitive limitations, social limitations, and Charlson comorbidity index. *Only mental health symptom severity data shown.

Atopic Dermatitis and Other Dermatitis: Study Population Characteristics

A weighted total of 24,802,752 US adults with atopic dermatitis and other dermatitis (unweighted, 1,964 US adults with atopic dermatitis and other dermatitis) who reported mental health comorbidities during a 14-year period from the 2004-2017 MEPS database, were included in the analysis. The mean (SEM) age was 48.4 (0.46) years and females constituted 61% of the population. The mean patient-provider communication quality score was 14.1 (95% CI, 13.9-14.2).

Atopic Dermatitis and Other Dermatitis: Psychological Distress Symptoms

Regarding the Kessler 6-item psychological distress scale, 75% of atopic dermatitis and other dermatitis patients had no or mild symptoms, 22% had moderate symptoms, and 3% had severe symptoms (Table 5).

Table 5. Sociodemographic and clinical characteristics of US adult patients with atopic dermatitis and other dermatitis by severity of psychological distress symptoms from the Medical Expenditure Panel Survey

Characteristic	Severity of Psychological Distress, No.[a]			*P* value
	No or Mild (Weighted no.= 18,524,051)	**Moderate** (Weighted no.= 5,417,514)	**Severe** (Weighted no.= 861,187)	
Age, mean (SEM) years	48.6 (0.52)	47.3 (0.67)	50.4 (0.67)	0.152[b]
Gender, female no. (%)	11,289,724 (61%)	3,410,939 (63%)	505,521 (59%)	0.715[c]
Unemployed, no (%)	4,975,364 (27%)	1,663,724 (31%)	558,827 (65%)	<0.0001[c]
Race, no. (%)				
White	15,373,935 (83%)	4,398,649 (81%)	624,526 (73%)	0.065[c]
Black	1,885,347 (10%)	626,904 (12%)	173,611 (20%)	
Asian, Native Hawaiian or Pacific Islander	963,274 (5%)	320,951 (6%)	47,840 (6%)	
American Indian or Alaskan Native	188,645 (1%)	27,285 (1%)	(0%)	
Multiple races reported	112,850 (1%)	43,725 (1%)	15,210 (2%)	
Ethnicity, Hispanic no. (%)	1,019,574 (6%)	488,865 (9%)	107,113 (12%)	0.002[c]
Marital Status, no. (%)				
Married	11,662,408 (63%)	2,809,765 (52%)	378,744 (44%)	0.001[c]
Widowed	935,673 (5%)	307,134 (6%)	56,886 (7%)	
Divorced	1,983,101 (11%)	871,792 (16%)	189,074 (22%)	
Separated	215,981 (1%)	102,935 (2%)	29,326 (3%)	
Never Married	3,726,888 (20%)	1,325,888 (24%)	207,156 (24%)	
Cognitive Limitations, no. (%)	214,653 (1%)	438,422 (8%)	325,563 (38%)	<0.0001[c]
Social Limitations, no. (%)	512,330 (3%)	572,385 (11%)	302,299 (35%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	1,508,835 (8%)	489,585 (9%)	216,119 (25%)	0.0001[c]
High School	4,864,275 (26%)	1,634,964 (30%)	204,189 (24%)	
≥ 1 year College	12,150,941 (66%)	3,292,966 (61%)	440,879 (51%)	
Poverty Level Category, no (%)				
Poor	911,996 (5%)	770,473 (14%)	214,961 (25%)	<0.0001[c]
Near Poor	337,287 (2%)	244,759 (5%)	145,016 (17%)	
Low Income	1,431,526 (8%)	568,886 (11%)	185,238 (22%)	
Middle Income	5,098,108 (28%)	1,774,181 (33%)	161,737 (19%)	
High Income	10,745,134 (58%)	2,059,215 (38%)	154,235 (18%)	
Provider and Patient do not Speak Same Language, no (%)	133,568 (1%)	65,936 (1%)	53,562 (6%)	0.0004[c]
CCI, mean (95% CI)	0.14 (0.12-0.16)	0.17 (0.13-0.21)	0.29 (0.18-0.40)	0.00[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with atopic dermatitis and other dermatitis who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[c] Using the χ^2 test of differences between adult patients with atopic dermatitis and other dermatitis who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient satisfaction score was 14.4 (95% CI, 14.2-14.6 for atopic dermatitis and other dermatitis patients with no or mild psychological distress symptoms, 13.1 (95% CI, 12.6-13.6) for atopic dermatitis and other dermatitis patients with moderate psychological distress symptoms, and 13.5 (95% CI, 12.3-14.7) for atopic dermatitis and other dermatitis patients with severe psychological distress symptoms (P<0.001) (Figure 3).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients with no or mild psychological distress symptoms, atopic dermatitis and other dermatitis patients with moderate or severe psychological distress symptoms had a patient-provider communication quality score decrement of 1.3 and 1.1, respectively (adjusted *B* coefficient, -1.3 [95% CI, -1.6, -1.0]; P<0.001 and -1.1 [-1.7, -0.4]; P=0.002). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients with no or mild psychological distress symptoms, atopic dermatitis and other dermatitis patients with moderate or severe psychological distress symptoms were 2.9 times and 7.5 times more likely to report low-quality patient-provider communication, respectively (AOR, 2.9 [95% CI, 1.7-5.1]; P< 0.001 and 7.5 [3.1-17.8]; P<0.001) (Table 2).

Atopic Dermatitis and Other Dermatitis: Depression Symptoms

Regarding the patient health questionnaire 2 for depression, 80% of atopic dermatitis and other dermatitis patients had no or mild symptoms, 13% had moderate symptoms, and 7% had severe symptoms (Table 6).

Table 6. Sociodemographic and clinical characteristics of US adult patients with atopic dermatitis and other dermatitis by severity of depression symptoms from the Medical Expenditure Panel Survey

Characteristic	Severity of Depression Symptoms, No.[a]			*P* value
	No or Mild (Weighted no.= 19,834,120)	**Moderate** (Weighted no.= 3,205,602)	**Severe** (Weighted no.= 1,763,030)	
Age, mean (SEM) years	48.4 (0.51)	46.5 (0.57)	52.0 (0.66)	0.115[b]
Gender, female no. (%)	12,058,920 (61%)	2,122,900 (66%)	1,024,363 (58%)	0.239[c]
Unemployed, no (%)	5,241,516 (26%)	898,307 (28%)	1,058,091 (60%)	<0.0001[c]
Race, no. (%)				
White	16,487,937 (83%)	2,530,078 (79%)	1,379,095 (78%)	0.233[c]
Black	1,952,355 (10%)	461,211 (14%)	272,295 (15%)	
Asian, Native Hawaiian or Pacific Islander	1071,572 (5%)	176,866 (6%)	83,628 (5%)	
American Indian or Alaskan Native	184,504 (1%)	18,624 (1%)	12,802 (1%)	
Multiple races reported	137,752 (1%)	18,823 (1%)	15,210 (1%)	
Ethnicity, Hispanic no. (%)	1,152,076 (6%)	287,392 (9%)	176,083 (10%)	0.029[c]
Marital Status, no. (%)				
Married	12,559,676 (63%)	1,515,854 (47%)	775,386 (44%)	<0.0001[c]
Widowed	1,010,741 (5%)	123,026 (4%)	165,928 (9%)	
Divorced	2,070,473 (10%)	621,109 (19%)	352,386 (20%)	
Separated	221,109 (1%)	77,249 (2%)	49,883 (3%)	
Never Married	3,972,121 (20%)	868,365 (27%)	419,446 (24%)	
Cognitive Limitations, no. (%)	372,200 (2%)	173,752 (5%)	432,687 (25%)	<0.0001[c]
Social Limitations, no. (%)	687,357 (3%)	241,357 (8%)	458,300 (26%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	1,584,274 (8%)	325,321 (10%)	304,944 (17%)	0.0003[c]
High School	5,134,792 (26%)	936,118 (29%)	632,517 (36%)	
≥ 1 year College	13,115,054 (66%)	1,944,163 (61%)	825,568 (47%)	
Poverty Level Category, no (%)				
Poor	1,190,004 (6%)	282,190 (9%)	425,236 (24%)	<0.0001[c]
Near Poor	421,751 (2%)	175,063 (5%)	130,250 (7%)	
Low Income	1,533,661 (8%)	316,792 (10%)	335,197 (19%)	
Middle Income	5,530,569 (28%)	1,068,783 (33%)	434,675 (25%)	
High Income	11,158,136 (56%)	1,362,775 (43%)	437,672 (25%)	
Provider and Patient do not Speak Same Language, no (%)	139,863 (1%)	28,261 (1%)	84,942 (5%)	<0.0001[c]
CCI, mean (95% CI)	0.14 (0.12-0.17)	0.12 (0.07-0.17)	0.25 (0.17-0.34)	0.002[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with atopic dermatitis and other dermatitis who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[c] Using the χ^2 test of differences between adult patients with atopic dermatitis and other dermatitis who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient satisfaction score was 14.3 (95% CI, 14.1-14.5) for atopic dermatitis and other dermatitis patients with no or mild depression symptoms, 13.2 (95% CI, 12.6-13.8) for atopic dermatitis and other dermatitis patients with moderate depression symptoms, and 13.1 (95% CI, 12.3-13.9) for atopic dermatitis and other dermatitis patients with severe depression symptoms (P<0.0001) (Figure 4).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients with no or mild depression symptoms, atopic dermatitis and other dermatitis patients with moderate or severe depression symptoms had a patient-provider communication quality score decrement of 1.0 and 1.3, respectively (adjusted *B* coefficient, -1.0 [95% CI, -1.4, -0.7]; P<0.001 and -1.3 [-1.7, -0.8]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients with no or mild depression symptoms, atopic dermatitis and other dermatitis patients with moderate or severe depression symptoms were 3.3 times and 4.6 times more likely to report low-quality patient-provider communication (AOR, 3.3 [95% CI, 1.6-6.8]; P=0.001 and 4.6, [2.2-9.4]; P<0.001) (Table 4).

Psoriasis: Study Population Characteristics

A weighted total of 8,876,767 US adults with psoriasis (unweighted, 652 US adults with psoriasis) who reported mental health comorbidities during a 14-year period from the 2004-2017 MEPS database were included in the analysis. The mean (SEM) age was 52.1 (0.7) years and females constituted 54% of the population. The mean patient-provider communication quality score was 14.0 (95% CI, 13.8-14.2).

Psoriasis: Psychological Distress Symptoms

Regarding the Kessler 6-item psychological distress scale, 73% of psoriasis patients had no or mild symptoms, 22% had moderate symptoms, and 5% had severe symptoms (Table 7).

Table 7. Sociodemographic and clinical characteristics of US adult patients with psoriasis by severity of psychological distress symptoms from the Medical Expenditure Panel Survey

	Severity of Psychological Distress, No.[a]			
Characteristic	**No-to-Mild** (Weighted no.= 6,457,943)	**Moderate** (Weighted no.= 1,926,000)	**Severe** (Weighted no.= 492,824)	***P* value**
Age, mean (SEM) years	52.25 (0.660)	51.11 (1.564)	53.16 (1.691)	0.662[b]
Gender, female no. (%)	3,484,884 (54%)	1,010,161 (52%)	261,888 (53%)	0.934[c]
Unemployed, no (%)	1,895,066 (29%)	870,031 (45%)	333,336 (68%)	<0.0001[c]
Race, no. (%)				
White	5,508,714 (85%)	1,731,590 (90%)	455,232 (92%)	0.098[c]
Black	602,434 (9%)	140,770 (7%)	5,998 (1%)	
Asian, Native Hawaiian or Pacific Islander	212,742 (3%)	53,640 (3%)	13,457 (3%)	
American Indian or Alaskan Native	49,876 (1%)	0 (0%)	18,137 (4%)	
Multiple races reported	84,177 (1%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic no. (%)	418,437 (6%)	200,191 (10%)	75,590 (15%)	0.003[c]
Marital Status, no. (%)				
Married	4,408,550 (68%)	989,657 (51%)	270,191 (55%)	0.0007[c]
Widowed	422,956 (7%)	182,333 (9%)	26,370 (5%)	
Divorced	608,207 (9%)	324,877 (17%)	108,192 (22%)	
Separated	53,326 (1%)	11,554 (1%)	2,242 (0%)	
Never Married	964,904 (15%)	417,580 (22%)	85,829 (17%)	
Cognitive Limitations, no. (%)	149,006 (2%)	207,153 (11%)	233,725 (47%)	<0.0001[c]
Social Limitations, no. (%)	282,459 (4%)	208,523 (11%)	143,857 (29%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	776,461 (12%)	210,139 (11%)	111,110 (23%)	0.014[c]
High School	1,582,922 (25%)	638,629 (33%)	174,734 (35%)	
≥ 1 year College	4,098,560 (63%)	1,077,232 (56%)	206,981 (42%)	
Poverty Level Category, no (%)				
Poor	240,914 (4%)	212,121 (11%)	79,484 (16%)	<0.0001[c]
Near Poor	135,597 (2%)	28,364 (1%)	36,061 (7%)	
Low Income	372,572 (6%)	256,547 (13%)	155,018 (31%)	
Middle Income	1,77,9467 (28%)	435,570 (23%)	121,213 (25%)	
High Income	3,929,393 (61%)	993,399 (52%)	101,049 (21%)	
Provider and Patient do not Speak Same Language, no (%)	40,656 (1%)	27,987 (1%)	21,351 (4%)	0.002[c]
CCI, mean (95% CI)	0.89 (0.83-0.95)	0.89 (0.72-1.07)	0.93 (0.79-1.07)	0.627[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with psoriasis who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[c] Using the χ^2 test of differences between adult patients with psoriasis who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient satisfaction score was 14.3 (95% CI, 14.1-14.5 for psoriasis patients with no or mild psychological distress symptoms, 13.2 (95% CI, 12.8-13.6) for psoriasis patients with moderate psychological distress symptoms, and 13.1 (95% CI, 11.9-14.3) for psoriasis patients with severe psychological distress symptoms (P<0.001) (Figure 3).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients with no or mild psychological distress symptoms, psoriasis patients with moderate or severe psychological distress symptoms had a patient-provider communication quality score decrement of 0.9 and 0.8, respectively (adjusted *B* coefficient, -0.9 [95% CI, -1.2, -0.6]; P<0.001 and -0.8 [-1.5, -0.2]; P=0.01). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients with no or mild psychological distress symptoms, psoriasis patients with moderate or severe psychological distress symptoms were 2.8 times and 2.3 times more likely to report low-quality patient-provider communication, respectively (AOR, 2.8 [95% CI, 1.5-4.9]; P= 0.001 and 2.3 [1.1-4.7]; P=0.03) (Table 2).

Psoriasis: Depression Symptoms

Regarding the patient health questionnaire 2 for depression, 79% of psoriasis patients had no or mild symptoms, 13% had moderate symptoms, and 8% had severe symptoms (Table 8).

Table 8. Sociodemographic and clinical characteristics of US adult patients with psoriasis and other dermatitis by severity of depression symptoms from the Medical Expenditure Panel Survey

	Severity of Depression Symptoms, No.[a]			
Characteristic	**No-to-Mild** (Weighted no.= 6,995,345)	**Moderate** (Weighted no.= 1,180,290)	**Severe** (Weighted no.= 701,132)	***P* value**
Age, mean (SEM) years	51.56 (0.634)	52.97 (2.406)	55.49 (2.034)	0.317[b]
Gender, female no. (%)	3,821,056 (55%)	536,694 (45%)	399,183 (57%)	0.255[c]
Unemployed, no (%)	2,080,057 (30%)	541,398 (46%)	76,979 (11%)	<0.0001[c]
Race, no. (%)				
White	6,023,511 (86%)	1,026,737 (87%)	645,288 (92%)	0.204[c]
Black	621,780 (9%)	97,925 (8%)	29,497 (4%)	
Asian, Native Hawaiian or Pacific Islander	222,261 (3%)	51,071(4%)	6,506 (1%)	
American Indian or Alaskan Native	48,172 (1%)	0 (0%)	19,841(3%)	
Multiple races reported	79,620(1%)	4,557 (0%)	0 (0%)	
Ethnicity, Hispanic no. (%)	494,679 (7%)	91,248 (8%)	108,291 (15%)	0.008[c]
Marital Status, no. (%)				
Married	4,651,698 (66%)	659,655 (56%)	57,045 (8%)	0.070[c]
Widowed	500,312 (7%)	76,713 (6%)	54,635 (8%)	
Divorced	680,632 (10%)	197754 (17%)	162,890 (23%)	
Separated	51,276 (1%)	5,518 (0%)	10,328 (1%)	
Never Married	1,111,427 (16%)	240,651 (20%)	116,234 (17%)	
Cognitive Limitations, no. (%)	150,519 (2%)	180,921 (15%)	258,444 (37%)	<0.0001[c]
Social Limitations, no. (%)	340,893 (5%)	100,032 (8%)	193,913 (28%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	788,051 (11%)	143,185 (12%)	166,474 (24%)	0.039[c]
High School	1,780,020 (25%)	406,549 (34%)	209,715 (30%)	
≥ 1 year College	4,427,274 (63%)	630,556 (53%)	324,943 (46%)	
Poverty Level Category, no (%)				
Poor	248,797 (4%)	155,336 (13%)	128,385 (18%)	<0.0001[c]
Near Poor	143,559 (2%)	18,173 (2%)	38,291 (5%)	
Low Income	502,379 (7%)	109,470 (9%)	172,287 (25%)	
Middle Income	1,891,113 (27%)	235,356 (20%)	209,780 (30%)	
High Income	4,209,497 (60%)	661,955 (56%)	152,389 (22%)	
Provider and Patient do not Speak Same Language, no (%)	55,829 (1%)	3,732 (0%)	30,432 (4%)	0.0003[c]
CCI, mean (95% CI)	0.88 (0.82-0.93)	0.96 (0.67-1.24)	0.94 (0.83-1.06)	0.916[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with psoriasis who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[c] Using the χ^2 test of differences between adult patients with psoriasis who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient satisfaction score was 14.3 (95% CI, 14.1-14.5) for psoriasis patients with no or mild depression symptoms, 13.2 (95% CI, 12.5-13.9) for psoriasis patients with moderate depression symptoms, and 13.0 (95% CI, 12.2-13.8) for psoriasis patients with severe depression symptoms (P=0.002) (Figure 4).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients with no or mild depression symptoms, psoriasis patients with moderate or severe depression symptoms had a patient-provider communication quality score decrement of 0.7 and 0.5, respectively (adjusted *B* coefficient, -0.7 [95% CI, -1.2, -0.2]; P=0.004 and -0.5 [-1.1, -0.03]; P=0.04). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients with no or mild depression symptoms, psoriasis patients with moderate depression symptoms were 4.6 times more likely to report low-quality patient-provider communication (AOR, 4.6 [95% CI, 2.1-10]; P<0.001) (Table 4).

Melanoma and Non-melanoma Skin Cancers: Study Population Characteristics

A weighted total of 4,268,730 US adults with melanoma and non-melanoma skin cancers (unweighted, 332 US adults with melanoma and non-melanoma skin cancers) who reported mental health comorbidities during a 14-year period from the 2004-2017 MEPS database were included in the analysis. The mean (SEM) age was 68.0 (0.8) years and females constituted 51% of the population. The mean patient-provider communication quality score was 14.1 (95% CI, 13.9-14.3).

Melanoma and Non-melanoma Skin Cancers: Psychological Distress Symptoms

Regarding the Kessler 6-item psychological distress scale, 59% of melanoma and non-melanoma skin cancer patients had no or mild symptoms, 33% had moderate symptoms, and 8% had severe symptoms (Table 9).

Table 9. Sociodemographic and clinical characteristics of US adult patients with melanoma and non-melanoma skin cancers by severity of psychological distress symptoms from the Medical Expenditure Panel Survey

	Severity of Psychological Distress Symptoms, No.[a]			
Characteristic	**No or Mild** (Weighted no.= 2,512,330)	**Moderate** (Weighted no.= 1,392,949)	**Severe** (Weighted no.= 363,451)	***P* value**
Age, mean (SEM) years	67.6 (0.72)	70.1 (0.87)	62.1 (--)	0.044[b]
Gender, female, no. (%)	1,214,192 (48%)	760,062 (55%)	212,992 (59%)	0.277[c]
Unemployed, no (%)	1,536,910 (61%)	1,044,286 (75%)	298,975 (82%)	0.002[c]
Race, no. (%)				
White	2,330,819 (93%)	1,289,822 (93%)	320,018 (88%)	0.385[c]
Black	121,738 (5%)	62,662 (4%)	26,889 (7%)	
Asian, Native Hawaiian or Pacific Islander	45,851 (2%)	25,399 (2%)	16,544 (5%)	
American Indian or Alaskan Native	13,921 (0.6%)	15,066 (1%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic no. (%)	90,747 (4%)	44,694 (3%)	3,572 (1%)	0.280[c]
Marital Status, no. (%)				
Married	1,540,750 (61%)	777,898 (56%)	187,100 (51%)	<0.0001[c]
Widowed	337,333 (13%)	371,876 (27%)	59,404 (16%)	
Divorced	380,679 (15%)	162,632 (12%)	15,417 (4%)	
Separated	29,703 (1%))	1,477 (0.1%)	39,368 (11%)	
Never Married	223,865 (9%)	79,066 (6%)	62,162 (17%)	
Cognitive Limitations, no. (%)	119,391 (5%)	281,815 (20%)	167,299 (46%)	<0.0001[c]
Social Limitations, no. (%)	178,362 (7%)	397,312 (29%)	211,321 (58%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	262,468 (10%)	267,614 (19%)	54,110 (15%)	<0.0001[c]
High School	705,144 (28%)	672,720 (48%)	208,667 (57%)	
≥ 1 year College	1,544,717 (61%)	452,615 (32%)	100,675 (28%)	
Poverty Level Category, no (%)				
Poor	126,284 (5%)	132,287 (9%)	124,108 (34%)	<0.0001[c]
Near Poor	128,262 (5%)	34,487 (2%)	19,353 (5%)	
Low Income	337,985 (13%)	321,791 (23%)	99,596 (27%)	
Middle Income	547,529 (22%)	469,717 (34%)	84,524 (23%)	
High Income	1,372,269 (55%)	434,667 (31%)	35,870 (10%)	
Provider and Patient do not Speak Same Language, no (%)	9,577 (0.4%)	22,953 (2%)	1,912 (0.5%)	0.002[c]
CCI, mean (95% CI)	1.41 (1.34-1.49)	1.46 (1.37-1.56)	1.43 (1.28-1.59)	0.818[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with melanoma and non-melanoma skin cancers who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[c] Using the χ^2 test of differences between adult patients with melanoma and non-melanoma skin cancers who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 14.3 (95% CI, 13.9-14.7) for melanoma and non-melanoma skin cancer patients with no or mild psychological distress symptoms, 13.8 (95% CI, 13.1-14.5) for melanoma and non-melanoma skin cancer patients with moderate psychological distress symptoms, and 13.5 (95% CI, 11.6-15.4) for melanoma and non-melanoma skin cancer with severe psychological distress symptoms (P=0.02) (Figure 3).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients with no or mild psychological distress symptoms, melanoma and non-melanoma skin cancer patients with moderate psychological distress symptoms had a patient-provider communication quality score decrement of 0.6 (adjusted *B* coefficient, -0.6 [95% CI, -1.1, -0.1]; P=0.01). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients with no or mild psychological distress symptoms, melanoma and non-melanoma skin cancer patients with severe psychological distress symptoms were 12.0 times more likely to report low-quality patient-provider communication (adjusted OR [AOR], 12.0 [95% CI, 4.4-32.9]; P< 0.001) (Table 2).

Melanoma and Non-Melanoma Skin Cancers: Depression Symptoms

Regarding the patient health questionnaire 2 for depression, 66% of melanoma and non-melanoma skin cancer patients had no or mild symptoms, 20% had moderate symptoms, and 14% had severe symptoms (Table 10).

Table 10. Sociodemographic and clinical characteristics of US adult patients with melanoma and non-melanoma skin cancer by severity of depression symptoms from the Medical Expenditure Panel Survey

	Severity of Depression Symptoms, No.[a]			
Characteristic	**No or Mild** (Weighted no.= 2,824,645)	**Moderate** (Weighted no.= 859,936)	**Severe** (Weighted no.= 584,149)	***P* value**
Age, mean (SEM) years	68.9 (0.71)	64.7 (0.74)	68.2 (0.31)	0.017[b]
Gender, female no. (%)	1,375,576 (49%)	421,336 (49%)	390,334 (67%)	0.013[c]
Unemployed, no (%)	1,819,324 (64%)	566,064 (66%)	494,782 (85%)	0.002[c]
Race, no. (%)				
White	2,640,162 (93%)	791,462 (92%)	509,035 (87%)	0.017[c]
Black	107,098 (4%)	63,285 (7%)	40,907 (7%)	
Asian, Native Hawaiian or Pacific Islander	48,399 (2%)	5,189 (0.6%)	34,207 (6%)	
American Indian or Alaskan Native	28,987 (1%)	0 (0%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic no. (%)	106,157 (4%)	21,185 (2%)	11,671 (2%)	0.567[c]
Marital Status, no. (%)				
Married	1,756,651 (62%)	440,786 (51%)	308,311 (53%)	0.009[c]
Widowed	450,954 (16%)	139,573 (16%)	178,086 (30%)	
Divorced	378,207 (13%)	159,762 (19%)	20,760 (4%)	
Separated	33,557 (1%)	15,725 (2%)	21,265 (4%0	
Never Married	205,277 (7%)	104,089 (12%)	55,727 (10%)	
Cognitive Limitations, no. (%)	178,601 (6%)	138,135 (16%)	251,769 (43%)	<0.0001[c]
Social Limitations, no. (%)	342,859 (12%)	230,976 (27%)	213,160 (36%)	<0.00001[c]
Education Level, no. (%)				
Pre-High School	313,670 (11%)	162,636 (19%)	107,886 (18%)	0.004[c]
High School	881,972 (31%)	442,562 (51%)	261,998 (45%)	
≥ 1 year College	1,629,003 (58%)	254,738 (30%)	214,266 (37%)	
Poverty Level Category, no (%)				
Poor	172,802 (6%)	86,594 (10%)	123,283 (21%)	<0.0001[c]
Near Poor	121,549 (4%)	33,369 (4%)	27,185 (5%)	
Low Income	375,167 (13%)	261,206 (30%)	123,000 (21%)	
Middle Income	652,731 (23%)	195,054 (23%)	253,985 (43%)	
High Income	1,502,397 (53%)	283,713 (33%)	56,696 (10%)	
Provider and Patient do not Speak Same Language, no (%)	9,577 (0.3%)	22,953 (3%)	1,912 (0.3%)	0.001[c]
CCI, mean (95% CI)	1.39 (1.32-1.46)	1.52 (1.43-1.61)	1.49 (1.33-1.66)	0.675[c]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with melanoma and non-melanoma skin cancers who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[c] Using the χ^2 test of differences between adult patients with melanoma and non-melanoma skin cancers who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 14.3 (95% CI, 13.9-14.7) for melanoma and non-melanoma skin cancer patients with no or mild depression symptoms, 13.5 (95% CI, 12.7-14.3) for melanoma and non-melanoma skin cancer patients with moderate depression symptoms, and 14.2 (95% CI, 15.6-13.8) for melanoma and non-melanoma skin cancer patients with severe depression symptoms (P=0.03) (Figure 4).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients with no or mild depression symptoms, melanoma and non-melanoma skin cancer patients with moderate depression symptoms had a patient-provider communication quality score decrement of 0.8 (adjusted *B* coefficient, -0.8 [95% CI, -1.4, -0.3]; P=0.002). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients with no or mild depression symptoms, melanoma and non-melanoma skin cancer patients with moderate depression symptoms were 5.5 times more likely to report low-quality patient-provider communication (AOR, 5.5 [95% CI, 3.3-9.2]; P<0.001) (Table 4).

Hidradenitis Suppurativa and Rosacea: Study Population Characteristics

A weighted total of 1,183,330 US adults with hidradenitis suppurativa and rosacea (unweighted, 98 US adults with hidradenitis suppurativa and rosacea) who reported mental health comorbidities during a 14-year period from the 2004-2017 MEPS database were included in the analysis. The mean (SEM) age was 64.6 (0.73) years and females constituted 56% of the population. The mean patient-provider communication quality score was 14.3 (95% CI, 14.2-14.4).

Hidradenitis Suppurativa and Rosacea: Psychological Distress Symptoms

Regarding the Kessler 6-item psychological distress scale, 54% of hidradenitis suppurativa and rosacea patients had no or mild symptoms, 40% had moderate symptoms, and 6% had severe symptoms (Table 11).

Table 11. Sociodemographic and clinical characteristics of US adult patients with other adnexal diseases (hidradenitis suppurativa and rosacea) by severity of psychological distress symptoms from the Medical Expenditure Panel Survey

Characteristic	**Severity of Psychological Distress, No.[a]**			***P* value**
	No or Mild (Weighted no.= 640,453)	**Moderate** (Weighted no.= 477,170)	**Severe** (Weighted no.= 65,707)	
Age, mean (SEM) years	71.8 (0.36)	69.2 (1.07)	64.4 (0.25)	0.486[b]
Gender, female no. (%)	283,751 (44%)	334,756 (70%)	38,740 (59%)	0.003[c]
Unemployed, no (%)	459,927 (72%)	379,031 (79%)	51,459 (78%)	0.162[c]
Race, no. (%)				
White	481,330 (75%)	328,166 (69%)	57,381 (87%)	0.002[c]
Black	146,138 (23%)	99,585 (21%)	5,138 (8%)	
Asian, Native Hawaiian or Pacific Islander	0 (0%)	44,398 (9%)	3,187 (5%)	
American Indian or Alaskan Native	12,985 (2%)	5,022 (1%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	20,056 (3%)	11,469 (2%)	1,318 (2%)	0.506[c]
Marital Status				
Married	391,923 (61%)	248,183 (52%)	18,556 (28%)	0.0001[c]
Widowed	118,919 (19%)	131,316 (28%)	0 (0%)	
Divorced	90,635 (14%)	52,972 (11%)	5,138 (8%)	
Separated	3,071 (0.5%)	0 (0%)	33,602 (51%)	
Never Married	35,905 (6%)	44,700 (9%)	8,411 (13%)	
Cognitive Limitations, no. (%)	41,382 (6%)	124,725 (26%)	9,644 (15%)	0.0001[c]
Social Limitations, no. (%)	96,209 (15%)	149,779 (31%)	50,339 (77%)	0.004[c]
Education Level, no. (%)				
Pre-High School	55,108 (9%)	108,140 (23%)	0 (0%)	0.0007[c]
High School	194,030 (30%)	128,909 (27%)	42,013 (64%)	
≥ 1 year College	177,813 (28%)	89,694 (19%)	14,050 (21%)	
Poverty Level Category, no (%)				
Poor	37,401 (6%)	40,059 (8%)	16,737 (25%)	0.0001[c]
Near Poor	22,446 (4%)	34,087 (7%)	19,353 (29%)	
Low Income	142,644 (22%)	115,154 (24%)	15,369 (23%)	
Middle Income	260,835 (41%)	140,961 (30%)	14,248 (22%)	
High Income	177,128 (28%)	146,910 (31%)	0 (0%)	
Provider and Patient do not Speak Same Language, no (%)	5,542 (0.9%)	0 (0%)	5,138 (8%)	<0.0001[c]
CCI, mean (95% CI)	1.40 (1.39-1.41)	1.55 (1.39-1.71)	1.20 (1.15-1.25)	0.849[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with hidradenitis suppurativa and rosacea who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[c] Using the χ^2 test of differences between adult patients with hidradenitis suppurativa and rosacea who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 14.4 (95% CI, 14.0-14.8) for hidradenitis suppurativa and rosacea patients with no or mild psychological distress symptoms, 13.6 (95% CI, 13.0-14.2) for hidradenitis suppurativa and rosacea patients with moderate psychological distress symptoms, and 13.3 (95% CI, 12.6-14.0) for hidradenitis suppurativa and rosacea patients with severe psychological distress symptoms (P<0.0001) (Figure 3).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients with no or mild psychological distress symptoms, hidradenitis suppurativa and rosacea patients with moderate or severe psychological distress symptoms had a patient-provider communication quality score decrement of 1.0 and 2.2, respectively (adjusted *B* coefficient, -1.0 [95% CI, -1.3, -0.6]; P<0.001 and -2.2 [-3.4, -0.9]; P=0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients with no or mild psychological distress symptoms, hidradenitis suppurativa and rosacea patients with severe psychological distress symptoms were 12.8 times more likely to report low-quality patient-provider communication (AOR, 12.8 [95% CI, 2.2-76.4]; P=0.005) (Table 2).

Hidradenitis Suppurativa and Rosacea: Depression Symptoms

Regarding the patient health questionnaire 2 for depression, 69% of hidradenitis suppurativa and rosacea patients had no or mild symptoms, 18% had moderate symptoms, and 13% had severe symptoms (Table 12).

Table 12. Sociodemographic and clinical characteristics of US adult patients with other adnexal diseases (hidradenitis suppurativa and rosacea) by severity of depression symptoms from the Medical Expenditure Panel Survey

Characteristic	Severity of Depression Symptoms[a]			*P* value
	No or Mild (Weighted no.= 813,832)	**Moderate** (Weighted no.= 208,512)	**Severe** (Weighted no.= 160,988)	
Age, mean (SEM) years	72.9 (0.29)	67.6 (2.71)	61.1 (0.97)	0.120[b]
Gender, female no. (%)	428,825 (53%)	105,694 (51%)	122,728 (76%)	0.025[c]
Unemployed, no (%)	605,348 (74%)	162,776 (78%)	122,292 (76%)	0.662[c]
Race, no. (%)				
White	640,224 (79%)	138,033 (66%)	88,621 (55%)	0.012[c]
Black	140,796 (17%)	70,478 (34%)	39,587 (25%)	
Asian, Native Hawaiian or Pacific Islander	14,805 (2%)	0 (0%)	32,780 (20%)	
American Indian or Alaskan Native	18,007 (2%)	0 (0%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic no. (%)	31,525 (4%)	0 (0%)	1,318 (0.8%)	0.053[c]
Marital Status, no. (%)				
Married	461,846 (57%)	120,298 (58%)	76,518 (48%)	0.003[c]
Widowed	205,864 (25%)	19,350 (9%)	25,022 (16%)	
Divorced	92,340 (11%)	46,205 (22%)	10,200 (6%)	
Separated	3,071 (0.4%)	14,248 (7%)	19,353 (12%)	
Never Married	50,711 (6%)	8,411 (4%)	29,894 (19%)	
Cognitive Limitations, no. (%)	92,320 (11%)	31,292 (15%)	52,139 (32%)	0.0005[c]
Social Limitations, no. (%)	189,470 (23%)	53,951 (26%)	52,905 (33%)	0.195[c]
Education Level, no. (%)				
Pre-High School	115,928 (14%)	43,889 (21%)	3,431 (2%)	0.029[c]
High School	258,319 (32%)	45,389 (22%)	61,244 (38%)	
≥ 1 year College	206,757 (25%)	31,968 (15%)	42,833 (27%)	
Poverty Level Category, no (%)				
Poor	65,382 (8%)	17,749 (9%)	11,066 (7%)	0.002[c]
Near Poor	26,229 (3%)	0 (0%)	49,657 (31%)	
Low Income	205,349 (25%)	40,223 (19%)	27,593 (17%)	
Middle Income	301,992 (37%)	59,520 (29%)	54,532 (34%)	
High Income	214,879 (26%)	91,020 (44%)	18,139 (11%)	
Provider and Patient do not Speak Same Language, no (%)	5,542 (0.7%)	5,138 (2%)	0 (0%)	0.005[c]
CCI, mean (95% CI)	1.47 (1.43-1.50)	1.32 (0.83-1.81)	1.53 (1.32-1.75)	0.535[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with hidradenitis suppurativa and rosacea who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[c] Using the χ^2 test of differences between adult patients with hidradenitis suppurativa and rosacea who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 14.4 (95% CI, 14.4-14.8) for hidradenitis suppurativa and rosacea patients with no or mild depression symptoms, 13.6 (95% CI, 12.8-14.4) for hidradenitis suppurativa and rosacea patients with moderate depression symptoms, and 13.3 (95% CI, 12.7-13.9) for hidradenitis suppurativa and rosacea patients with severe depression symptoms (P<0.0001) (Figure 4).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients with no or mild depression symptoms, hidradenitis suppurativa and rosacea patients with moderate or severe depression symptoms had a patient-provider communication quality score decrement of 0.9 and 1.3, respectively (adjusted *B* coefficient, -0.9 [95% CI, -1.4, -0.4]; P=0.001 and -1.3 [-1.8, -0.8]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients with no or mild depression symptoms, hidradenitis suppurativa and rosacea patients with severe depression symptoms were 15.9 times more likely to report low-quality patient-provider communication (AOR], 15.9 [95% CI, 4.0-63.7]; P<0.001) (Table 4).

Vitiligo and Other Pigmentation Disorders: Study Population Characteristics

A weighted total of 32,642,378 US adults with vitiligo and other pigmentation disorders (unweighted, 2,557 US adults with vitiligo and other pigmentation disorders) who reported mental health comorbidities during a 14-year period from the 2004-2017 MEPS database were included in the analysis. The mean (SEM) age was 58.3 (0.4) years and females constituted 58% of the population. The mean patient-provider communication quality score was 14.1 (95% CI, 14.0-14.2).

Vitiligo and Other Pigmentation Disorders: Psychological Distress Symptoms

Regarding the Kessler 6-item psychological distress scale, 74% of vitiligo and other pigmentation disorder patients had no or mild symptoms, 20% had moderate symptoms, and 6% had severe symptoms (Table 13).

Table 13. Sociodemographic and clinical characteristics of us adult patients with vitiligo and other pigmentation disorders by severity of psychological distress symptoms from the Medical Expenditure Panel Survey

	Severity of Psychological Distress Symptoms, No.[a]			
Characteristic	**No or Mild** (Weighted no.= 24,087,721)	**Moderate** (Weighted no.= 6,568,070)	**Severe** (Weighted no.= 1,986,586)	***P* value**
Age, mean (SEM) years	59.6 (0.47)	56.7 (0.75)	59.0 (1.12)	0.006[b]
Gender, female no. (%)	13,987,034 (58%)	4,119,001 (63%)	1,243,465 (63%)	0.242[c]
Unemployed, no (%)	10,940,839 (45%)	3,183,352 (48%)	1,423,374 (72%)	<0.0001[c]
Race, no. (%)				
White	21,096,846 (88%)	5,398,950 (82%)	1,637,427 (82%)	0.005[c]
Black	1,928,965 (8%)	899,292 (14%)	192,386 (10%)	
Asian, Native Hawaiian or Pacific Islander	905,648 (4%)	210,241 (3%)	132,684 (7%)	
American Indian or Alaskan Native	129,246 (0.5%)	34,401 (0.5%)	11,554 (0.6%)	
Multiple races reported	27,017 (0.1%)	25,186 (0.4%)	12,536 (0.6%)	
Ethnicity, Hispanic no. (%)	1,199,418 (5%)	533,217 (8%)	223,235 (11%)	0.001[c]
Marital Status, no. (%)				
Married	15,898,336 (66%)	3,026,596 (46%)	854,604 (43%)	<0.0001[c]
Widowed	2,400,658 (10%)	945,720 (14%)	228,254 (11%)	
Divorced	2,875,716 (12%)	1,161,151 (18%)	529,616 (27%)	
Separated	249,446 (1%)	77,957 (1%)	54,098 (3%)	
Never Married	2,663,566 (11%)	1,356,645 (21%)	320,015 (16%)	
Cognitive Limitations, no. (%)	740,257 (3%)	799,967 (12%)	941,767 (47%)	<0.0001[c]
Social Limitations, no. (%)	1,010,790 (4%)	1,196,311 (18%)	787,718 (40%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	2,448,812 (10%)	1,182,410 (18%)	421,120 (21%)	<0.0001[c]
High School	7,305,518 (30%)	2,255,952 (34%)	1,024,619 (52%)	
≥ 1 year College	14,333,391 (60%)	3,129,708 (48%)	540,847 (27%)	
Poverty Level Category, no (%)				
Poor	1,218,132 (5%)	714,128 (11%)	379,624 (19%)	<0.0001[c]
Near Poor	793,363 (3%)	428,366 (7%)	132,232 (7%)	
Low Income	2,445,005 (10%)	906,819 (14%)	440,286 (22%)	
Middle Income	6,207,366 (26%)	1,881,142 (29%)	451,737 (23%)	
High Income	13,423,856 (56%)	2,637,615 (40%)	582,706 (29%)	
Provider and Patient do not Speak Same Language, no (%)	214,289 (0.9%)	200,569 (3%)	152,911 (8%)	<0.0001[c]
CCI, mean (95% CI)	1.20 (1.18-1.23)	1.20 (1.15-1.24)	1.20 (1.11-1.29)	0.935[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with vitiligo and other pigmentation disorders who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[c] Using the χ^2 test of differences between adult patients with vitiligo and other pigmentation disorders who reported no or mild psychological distress symptoms, moderate psychological distress symptoms, or severe psychological distress symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 14.3 (95% CI, 14.0-14.6 for vitiligo and other pigmentation disorder patients with no or mild psychological distress symptoms, 13.4 (95% CI, 12.9-13.9) for vitiligo and other pigmentation disorder patients with moderate psychological distress symptoms, and 12.8 (95% CI, 11.8-13.8) for vitiligo and other pigmentation disorder patients with severe psychological distress symptoms (P<0.0001) (Figure 3).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients with no or mild psychological distress symptoms, vitiligo and other pigmentation disorder patients with moderate or severe psychological distress symptoms had a patient-provider communication quality score decrement of 0.9 and 1.3, respectively (adjusted *B* coefficient, -0.9 [95% CI, -1.2, -0.6]; P<0.001 and -1.3 [-1.9, -0.7]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients with no or mild psychological distress symptoms, vitiligo and other pigmentation disorder patients with moderate or severe psychological distress symptoms were 3.2 times and 8.3 times more likely to report low-quality patient-provider communication, respectively (AOR, 3.2 [95% CI, 1.8-5.6]; P< 0.001 and 8.3 [3.7-18.6]; P<0.001) (Table 2).

Vitiligo and Other Pigmentation Disorders: Depression Symptoms

Regarding the patient health questionnaire 2 for depression, 79% of vitiligo and other pigmentation disorder patients had no or mild symptoms, 12% had moderate symptoms, and 9% had severe symptoms (Table 14).

Table 14. Sociodemographic and clinical characteristics of US adult patients with vitiligo and other pigmentation disorders by severity of depression symptoms from the Medical Expenditure Panel Survey

Characteristic	**Severity of Depression Symptoms, No.[a]**			***P* value**
	No or Mild (Weighted no.= 25,899,766)	**Moderate** (Weighted no.= 3,747,753)	**Severe** (Weighted no.= 2,994,858)	
Age, mean (SEM) years	59.1(0.47)	58.1 (0.91)	59.3 (0.95)	0.698[b]
Gender, female no. (%)	15,148,086 (58%)	2,263,401 (60%)	1,938,013 (65%)	0.320[c]
Unemployed, no (%)	11,534,807 (45%)	2,053,683 (55%)	1,959,074 (65%)	<0.0001[c]
Race, no. (%)				
White	22,580,624 (87%)	3,111,253 (83%)	2,441,345 (82%)	0.118[c]
Black	2,244,947 (9%)	439,078 (12%)	336,617 (11%)	
Asian, Native Hawaiian or Pacific Islander	927,928 (4%)	144,044 (4%)	176,602 (6%)	
American Indian or Alaskan Native	119,250 (0.5%)	37,929 (1%)	18,022 (0.6%)	
Multiple races reported	27,017 (0.1%)	15,449 (0.4%)	22,273 (0.7%)	
Ethnicity, Hispanic no. (%)	1,271,416 (5%)	343,401 (9%)	341,053 (11%)	<0.0001[c]
Marital Status, no. (%)				
Married	16,843,320 (65%)	1,649,195 (44%)	1,287,021 (43%)	<0.0001[c]
Widowed	2,594,090 (10%)	506,219 (14%)	474,322 (16%)	
Divorced	3,199,772 (12%)	667,758 (18%)	698,953 (23%)	
Separated	258,853 (1%)	60,059 (2%)	62,590 (2%)	
Never Married	3,003,732 (12%)	864,522 (23%)	471,972 (16%)	
Cognitive Limitations, no. (%)	959,104 (4%)	482,031 (13%)	1,040,855 (35%)	<0.0001[c]
Social Limitations, no. (%)	1,243,520 (5%)	769,579 (21%)	981,720 (33%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	2,787,573 (11%)	652,994 (17%)	611,775 (20%)	0.004[c]
High School	7,933,071 (31%)	1,213,878 (32%)	1,439,140 (48%)	
≥ 1 year College	15,179,122 (59%)	1,880,880 (50%)	943,943 (32%)	
Poverty Level Category, no (%)				
Poor	1,490,254 (6%)	455,240 (12%)	366,389 (12%)	<0.0001[c]
Near Poor	875,533 (3%)	221,307 (6%)	257,121 (9%)	
Low Income	2,666,699 (10%)	561,313 (15%)	564,097 (19%)	
Middle Income	6,838,968 (26%)	941,657 (25%)	759,620 (25%)	
High Income	14,028,313 (54%)	1,568,236 (42%)	1,047,630 (35%)	
Provider and Patient do not Speak Same Language, no (%)	220,939 (0.9%)	165,325 (4%)	181,505 (6%)	<0.0001[c]
CCI, mean (95% CI)	1.21 (1.18-1.23)	1.18 (1.12-1.24)	1.16 (1.12-1.25)	0.754[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with vitiligo and other pigmentation disorders who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[c] Using the χ^2 test of differences between adult patients with vitiligo and other pigmentation disorders who reported no or mild depression symptoms, moderate depression symptoms, or severe depression symptoms.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 14.3 (95% CI, 14.0-14.6) for vitiligo and other pigmentation disorder patients with no or mild depression symptoms, 13.4 (95% CI, 12.8-14.0) for vitiligo and other pigmentation disorder patients with moderate depression symptoms, and 13.1 (95% CI, 12.3-13.9) for vitiligo and other pigmentation disorder patients with severe depression symptoms (P<0.0001) (Figure 4).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients with no or mild depression symptoms, vitiligo and other pigmentation disorder patients with moderate or severe depression symptoms had a patient-provider communication quality score decrement of 0.8 and 1.0, respectively (adjusted *B* coefficient, -0.8 [95% CI, -1.2, -0.5]; P<0.001 and -1.0 [-1.4, -0.5]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients with no or mild depression symptoms, vitiligo and other pigmentation disorder patients with moderate or severe depression symptoms were 2.9 times and 3.4 times more likely to report low-quality patient-provider communication (AOR, 2.9 [95% CI, 1.4-5.8]; P=0.003 and 3.4 [1.7-6.9]; P=0.001) (Table 4).

Aim 1 Results: Mental and Physical Health Functioning

<u>Aim 1:</u> To determine the impact of patients' physical and mental health status on patients' perception of patient-provider communication quality.

Acne: Study population characteristics

From a weighted total of 32,643,200 US adults with acne (unweighted, 3,085 US adults with acne) who reported mental and physical health functioning during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 41.4 (0.4) years and females constituted 68% of the population. The mean patient-provider communication quality score was 13.8 (95% CI, 13.7-14.0).

Acne: Mental Health Functioning

Regarding mental health functioning, 16% of acne patients had below average functioning, 74% had average functioning, and 10% had above average functioning (Table 15).

Table 15. Sociodemographic and clinical characteristics of US adult patients with acne by the level of mental health functioning from the Medical Expenditure Panel Survey

Characteristic	Level of Mental Health Functioning[a]			*P* value
	Below Average (Weighted no.= 5,208,487**)**	**Average (Weighted no.=** 24,076,819**)**	**Above Average (Weighted no.=** 3,357,894**)**	
Age, mean (SEM) years	40.7 (0.87)	40.7 (0.50)	47.7 (1.45)	<0.0001[b]
Gender, female no. (%)	3,912,338 (75%)	16,387,843 (68%)	1,898,993 (57%)	<0.0001[c]
Unemployed, no (%)	1,851,467 (36%)	6,137,584 (25%)	1,229,812 (37%)	<0.0001[c]
Race, no. (%)				
White	4,462,467 (86%)	20,420,750 (85%)	2,701,687 (80%)	0.277[c]
Black	448,734 (9%)	2,363,476 (10%)	425,039 (13%)	
Asian, Native Hawaiian or Pacific Islander	234,736 (5%)	1,016,441 (4%)	177,216 (5%)	
American Indian or Alaskan Native	35,536 (0.7%)	239,510 (1%)	53,953 (2%)	
Multiple races reported	27,014 (0.5%)	36,642 (0.2%)	0 (0%)	
Ethnicity, Hispanic no. (%)	359,311 (7%)	1,521,022 (6%)	396,808 (12%)	0.0007[c]
Marital Status, no. (%)				
Married	2,173,069 (42%)	11,911,516 (49%)	1,706,858 (51%)	<0.0001[c]
Widowed	172,040 (3%)	928,124 (4%)	303,396 (9%)	
Divorced	796,308 (15%)	2,182,985 (9%)	286,428 (9%)	
Separated	138,334 (3%)	240,667 (1%)	16,018 (0.5%)	
Never Married	1,928,737 (37%)	8,813,527 (37%)	1,045,194 (31%)	
Cognitive Limitations, no. (%)	668,386 (13%)	644,636 (3%)	36,057 (1%)	<0.0001[c]
Social Limitations, no. (%)	718,819 (14%)	760,778 (3%)	83,040 (2%)	<0.0001[c]
Education Level, , no. (%)				
Pre-High School	395,225 (8%)	2,083,965 (9%)	286,001 (9%)	0.109[c]
High School	1,959,361 (38%)	7,295,112 (30%)	1,144,087 (34%)	
≥ 1 year College	2,853,901 (55%)	14,697,741 (61%)	1,927,806 (57%)	
Poverty Level Category, no (%)				
Poor	867,107 (17%)	1,371,601 (6%)	300,894 (9%)	<0.0001[c]
Near Poor	152,988 (3%)	517,102 (2%)	102,412 (3%)	
Low Income	766,420 (15%)	2,146,021 (9%)	338,148 (10%)	
Middle Income	1,444,956 (28%)	6,667,841 (28%)	864,218 (26%)	
High Income	1,977,017 (38%)	13,374,253 (56%)	1,752,223 (52%)	
Provider and Patient do not Speak Same Language, no (%)	86,109 (2%)	130,724 (0.5%)	64,363 (2%)	0.002[c]
CCI, mean (95% CI)	1.19 (1.15-1.23)	1.19 (1.17-1.21)	1.21 (1.16-1.27)	0.555[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

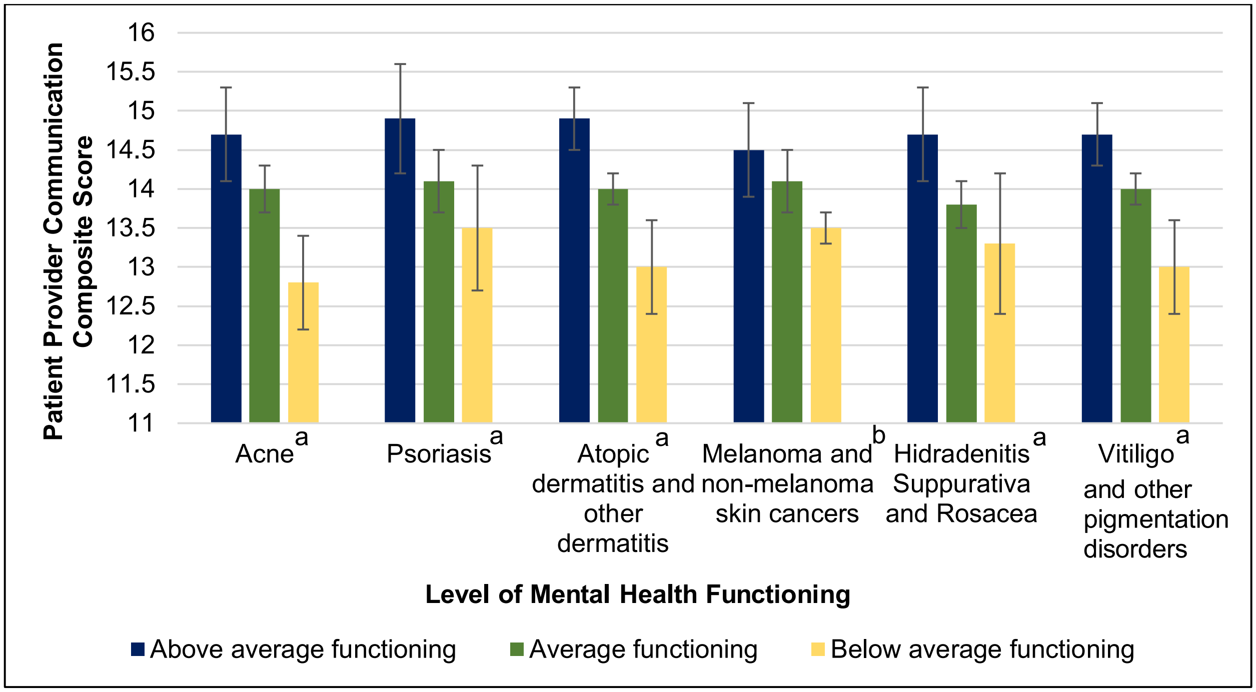
[b] Analysis of variance of differences between adult patients with acne who reported below average, average, or above average mental health functioning.

[c] Using the χ^2 test of differences between adult patients with acne who reported below average, average, or above average mental health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 12.8 (95% CI, 12.2-13.4) for acne patients with below average mental health functioning, 14.0 (95% CI, 13.7-14.3) for acne patients with average mental health functioning, and 14.7 (95% CI, 14.1-15.3) for acne patients with above average mental health functioning (P<0.0001) (Figure 5).

Figure 5: Patient-provider communication quality among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorder patients by the level of mental health functioning from the Medical Expenditure Panel Survey.



Patient-provider communication quality as measured by the patient-provider communication composite score. The vertical lines indicate 95% CIs.

^{a} P<0.0001; ^{b} P=0.0002

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients with above average mental health functioning, acne patients with average and below average mental health functioning had a patient-provider communication quality score decrement of 0.8 and 0.9, respectively (adjusted

B coefficient, -0.8 [95% CI, -1.1, -0.4]; P<0.001 and -0.9 [-1.5, -0.4]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients with above average mental health functioning, acne patients with below average mental health functioning were 2.1 times more likely to report low-quality patient-provider communication (AOR, 2.1 [95% CI, 1.1-3.9]; P=0.02) (Table 16).

Table 16: Association between the level of mental health functioning and patient-provider communication quality among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders from the Medical Expenditure Panel Survey.

Independent Variables*	**Mental Health Functioning (SF-12, MCS)**			
	Dependent Variable: Patient-Provider Communication Quality (B Coef.) / Low-quality patient-provider communication (AOR)			
	Adjusted *B* Coef. (95% CI)	***P* value**	**AOR (95% CI)**	***P* value**
Level of Mental Health Functioning: Acne				
Above average	1[Ref]		1[Ref]	
Average	-0.8 (-1.1, -0.4)	<0.001	1.3 (0.8-2.2)	0.250
Below average	-0.9 (-1.5, -0.4)	<0.001	2.1(1.1-3.9)	0.020
Level of Mental Health Functioning: Psoriasis				
Above average	1[Ref]		1[Ref]	
Average	-0.9 (-1.5, -0.3)	0.003	3.9 (0.9-17.6)	0.070
Below average	-0.5 (-1.2, -0.2)	0.150	2.6 (0.4-16.8)	0.320
Level of Mental Health Functioning: Atopic dermatitis and other dermatitis conditions				
Above average	1[Ref]		1[Ref]	
Average	-0.8 (-1.1, -0.6)	<0.001	3.1 (1.1-8.4)	0.027
Below average	-1.8 (-2.1, -1.4)	<0.001	7.6 (2.7-21.5)	<0.001
Level of Mental Health Functioning: Skin Cancers (Melanoma and Non-Melanoma)				
Above average	1[Ref]		1[Ref]	
Average	-1.1 (-1.6, -0.6)	<0.0001	8.7 (5.2-14.6)	<0.0001
Below average	-0.7 (-1.2, -0.2)	0.005	1.1 (0.4-3.3)	0.890
Level of Mental Health Functioning: Hidradenitis suppurativa and rosacea				
Above average	1[Ref]		1[Ref]	
Average	-0.9 (-1.4, -0.4)	<0.001	0.4 (0.1-1.4)	0.150
Below average	-1.3 (-2.0, -0.7)	<0.001	0.7 (0.2-2.9)	0.660
Level of Mental Health Functioning: Vitiligo and other pigmentation disorders				
Above average	1[Ref]		1[Ref]	
Average	-0.8 (-1.2, -0.5)	<0.001	2.8 (1.4-5.7)	0.004
Below average	-0.9 (-1.3, -0.5)	<0.001	3.4 (1.7-6.9)	0.001

AOR, adjusted odds ratio; CI, confidence interval; MCS, mental component summary; Ref, reference; SF-12, short form 12. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, poverty level category, cognitive limitations, social limitations, and Charlson comorbidity index. *Only level of mental health functioning data shown.

Acne: Physical Health Functioning

Regarding physical health functioning, 16% of acne patients had below average functioning, 76% had average functioning, and 8% had above average functioning (Table 17).

Table 17. Sociodemographic and clinical characteristics of US adult patients with acne by the level of physical health functioning from the Medical Expenditure Panel Survey

	Level of Physical Health Functioning[a]			
Characteristic	**Below Average (Weighted no.=** 5,116,582**)**	**Average (Weighted no.=** 24,647,028**)**	**Above Average (Weighted no.=** 2,879,590**)**	***P* value**
Age, mean (SEM) years	58.2 (0.97)	39.1 (0.43)	31.2 (0.86)	<0.0001[b]
Gender, female no. (%)	3,345,598 (65%)	16,616,238 (67%)	2,237,338 (78%)	0.018[c]
Unemployed, no (%)	3,238,682 (63%)	5,568,378 (23%)	411,804 (14%)	<0.0001[c]
Race, no. (%)				
White	4,155,986 (81%)	20,810,254 (84%)	2,618,663 (91%)	0.031[c]
Black	690,078 (13%)	2,399,360 (10%)	147,811 (5%)	
Asian, Native Hawaiian or Pacific Islander	193,339 (4%)	1,139,479 (5%)	95,575 (3%)	
American Indian or Alaskan Native	74,983 (1%)	247,956 (1%)	6,062 (0.2%)	
Multiple races reported	2,197 (0.04%)	49,980 (0.2%)	11,479 (0.4%)	
Ethnicity, Hispanic, no. (%)	353,865 (7%)	1,779,715 (7%)	143,561 (5%)	0.348[c]
Marital Status no. (%)				
Married	2,771,806 (54%)	11,920,802 (48%)	1,098,835 (38%)	<0.0001[c]
Widowed	713,502 (14%)	680,711 (3%)	9,348 (0.3%)	
Divorced	768,122 (15%)	2,170,945 (9%)	326,654 (11%)	
Separated	80,727 (2%)	262,742 (1%)	51,551 (2%)	
Never Married	782,426 (15%)	9,611,829 (39%)	1,393,202 (48%)	
Cognitive Limitations, no. (%)	860,125 (17%)	488,954 (2%)	0 (0%)	<0.0001[c]
Social Limitations, no. (%)	1,095,095 (21%)	455,380 (2%)	12,161 (0.4%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	724,742 (14%)	1,885,102 (8%)	155,348 (5%)	<0.0001[c]
High School	2,093,216 (41%)	7,622,893 (31%)	682,451 (24%)	
≥ 1 year College	2,298,623 (45%)	15,139,033 (61%)	2,041,792 (71%)	
Poverty Level Category, no (%)				
Poor	825,895 (16%)	1,540,901 (6%)	172,806 (6%)	<0.0001[c]
Near Poor	310,417 (6%)	397,664 (2%)	64,421 (2%)	
Low Income	821,446 (16%)	2,203,839 (9%)	225,304 (8%)	
Middle Income	1,383,398 (27%)	6,654,047 (27%)	939,570 (33%)	
High Income	1,775,426 (35%)	13,850,578 (56%)	1,477,489 (51%)	
Provider and Patient do not Speak Same Language, no (%)	126,201 (2%)	134,335 (0.5%)	20,659 (0.7%)	0.001[c]
CCI, mean (95% CI)	1.20 (1.16-1.25)	1.19 (1.17-1.21)	1.17 (1.11-1.22)	0.562[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

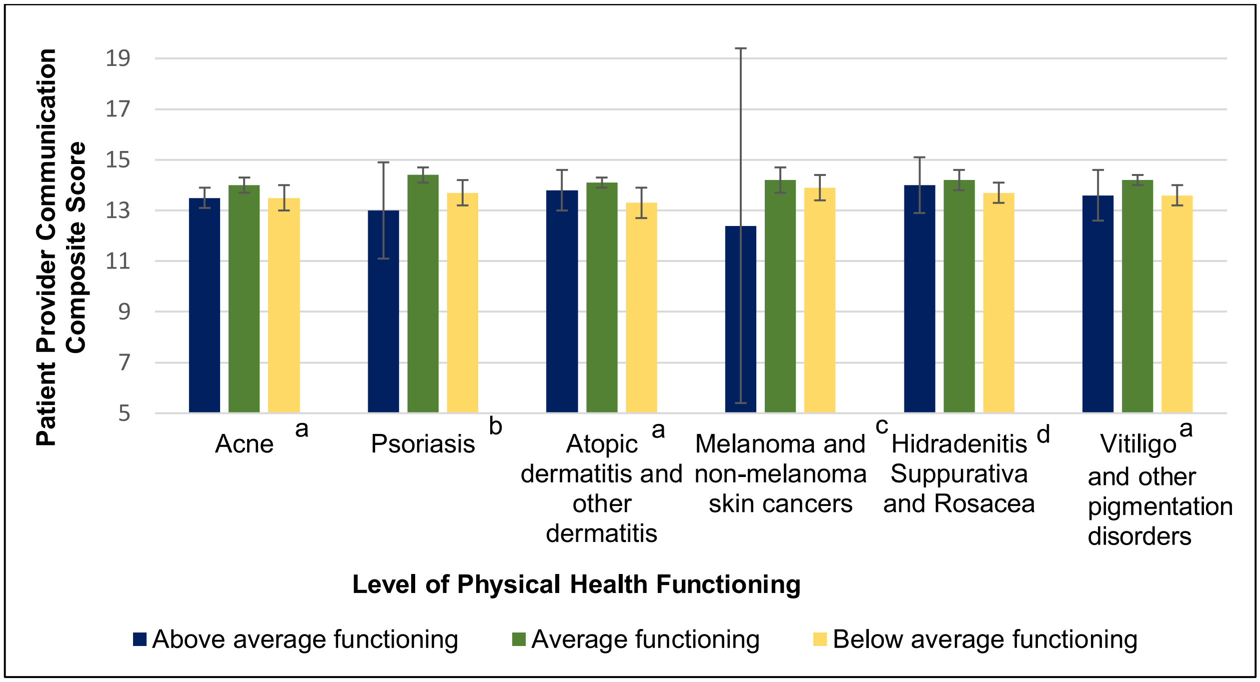
[b] Analysis of variance of differences between adult patients with acne who reported below average, average, or above average physical health functioning.

[c] Using the χ^2 test of differences between adult patients with acne who reported below average, average, or above average physical health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.5 (95% CI, 13.0-14.0) for acne patients with below average physical health functioning, 14.0 (95% CI, 13.7-14.3) for acne patients with average physical health functioning, and 13.5 (95% CI, 13.1-13.9) for acne patients with above average physical health functioning (P<0.0001) (Figure 6).

Figure 6: Patient-provider communication quality among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorder patients by the level of physical health functioning from the Medical Expenditure Panel Survey.



Patient-provider communication quality as measured by the patient-provider communication composite score. The vertical lines indicate 95% CIs.

^{a} P<0.0001; ^{b} P=0.004; ^{c} P=0.142; ^{d} P=0.016

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients with above average physical health functioning, acne patients with average and below average physical health functioning had a patient-provider communication quality score decrement of 0.7 and 1.2, respectively (adjusted *B* coefficient, -0.7 [95% CI, -1.0, -0.4]; P<0.001 and -1.2 [-1.8, -0.6]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients with above average physical health functioning, acne patients with below average physical health functioning were 3.1 times more likely to report low-quality patient-provider communication (AOR, 3.1 [95% CI, 1.6-6.0]; P=0.001) (Table 18).

Table 18: Association between the level of physical health functioning and patient-provider communication quality among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders from the Medical Expenditure Panel Survey.

Independent Variables*	**Physical Functioning (SF-12, PCS)**			
	Dependent Variable: Patient-Provider Communication Quality (B Coef.) / Low-quality patient-provider communication (AOR)			
	Adjusted *B* Coef. (95% CI)	***P* value**	**AOR (95% CI)**	***P* value**
Level of Physical Health Functioning: Acne				
Above average	1[Ref]		1[Ref]	
Average	-0.7 (-1.0, -0.4)	<0.001	1.3 (0.8-2.1)	0.270
Below average	-1.2 (-1.8, -0.6)	<0.001	3.1(1.6-6.0)	0.001
Level of Physical Health Functioning: Psoriasis				
Above average	1[Ref]		1[Ref]	
Average	-0.7 (-1.1, -0.3)	<0.001	2.9 (1.2-6.8)	0.020
Below average	-1.0 (-1.7, -0.2)	0.020	1.4 (0.4-5.1)	0.640
Level of Physical Health Functioning: Atopic dermatitis and other dermatitis conditions				
Above average	1[Ref]		1[Ref]	
Average	0.2 (-0.2, 0.6)	0.350	1.2 (0.6-2.3)	0.590
Below average	-0.9 (-1.4, -0.4)	0.001	4.5 (2.0-10.3)	<0.001
Level of Physical Health Functioning: Skin Cancers (Melanoma and Non-Melanoma)				
Above average	1[Ref]		1[Ref]	
Average	-0.8 (-1.3, -0.3)	0.001	1.8 (0.5-5.6)	0.320
Below average	-0.9 (-1.9, 0.02)	0.060	13.0 (5.4-31.2)	<0.0001
Level of Physical Health Functioning: Hidradenitis suppurativa and rosacea				
Above average	1[Ref]		1[Ref]	
Average	1.5 (0.5-2.5)	0.002	1.3 (0.2-8.6)	0.790
Below average	1.0 (0.01-2.1)	0.050	7.6 (0.4-136.4)	0.170
Level of Physical Health Functioning: Vitiligo and other pigmentation disorders				
Above average	1[Ref]		1[Ref]	
Average	-0.9 (-1.1, -0.6)	<0.001	2.6 (1.5-4.6)	0.001
Below average	-1.3 (-1.8, -0.7)	<0.001	7.9 (3.6-17.5)	<0.001

AOR, adjusted odds ratio; CI, confidence interval; PCS, physical component summary; Ref, reference; SF-12, short form 12. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, poverty level category, cognitive limitations, social limitations, and Charlson comorbidity index. *Only level of physical health functioning data shown.

Atopic dermatitis and other dermatitis: Study population characteristics

A weighted total of 29,023,611 US adults with atopic dermatitis and other dermatitis (unweighted, 2,751 US adults with atopic dermatitis and other dermatitis) who reported mental and physical health functioning during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 48.3 (0.4) years and females constituted 62% of the population. The mean patient-provider communication quality score was 14.0 (95% CI, 13.9-14.1).

Atopic dermatitis and other dermatitis: Mental Health Functioning

Regarding mental health functioning, 13% of atopic dermatitis and other dermatitis patients had below average functioning, 75% had average functioning, and 12% had above average functioning (Table 19).

Table 19. Sociodemographic and clinical characteristics of US adult patients with atopic dermatitis and other dermatitis by the level of mental health functioning from the Medical Expenditure Panel Survey

Characteristic	**Level of Mental Health Functioning**[a]			***P* value**
	Below Average (Weighted no.= 3,773,629)	**Average** (Weighted no.= 21,815,194)	**Above Average** (Weighted no.= 3,434,788)	
Age, mean (SEM) years	46.9(0.59)	47.6 (0.47)	54.7 (0.65)	<0.0001[b]
Gender, female no. (%)	2,345,006 (62%)	13,537,969 (62%)	2,052,417 (60%)	0.803[c]
Unemployed, no (%)	1,449,893 (38%)	5,684,304 (26%)	1,424,880 (41%)	<0.0001[c]
Race, no. (%)				
White	2,977,529 (79%)	18,336,918 (84%)	2,876,424 (84%)	0.090[c]
Black	529,232 (14%)	2,049,366 (9%)	295,202 (9%)	
Asian, Native Hawaiian or Pacific Islander	231,510 (6%)	1,064,001 (5%)	239,821 (7%)	
American Indian or Alaskan Native	25,802 (0.7%)	244,788 (1%)	10,752 (0.3%)	
Multiple races reported	9,557 (0.3%)	120,121 (0.6%)	12,590 (0.4%)	
Ethnicity, Hispanic, no. (%)	381,045 (10%)	1,316,547 (6%)	211,097 (6%)	0.005[c]
Marital Status, no. (%)				
Married	1,844,044 (49%)	13,121,101 (60%)	2,419,873 (70%)	<0.0001[c]
Widowed	173,595 (5%)	1,238,161 (6%)	242,681 (7%)	
Divorced	752,872 (20%)	2,496,485 (11%)	382,720 (11%)	
Separated	78,154 (2%)	334,294 (2%)	3,775 (0.1%)	
Never Married	924,965 (25%)	4,625,153 (21%)	385,739 (11%)	
Cognitive Limitations, no. (%)	753,875 (20%)	506,316 (2%)	21,605 (0.6%)	<0.0001[c]
Social Limitations, no. (%)	654,567 (17%)	968,357 (4%)	95,282 (3%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	354,564 (9%)	1,827,370 (8%)	315,473 (9%)	0.052[c]
High School	1,309,593 (35%)	5,893,855 (27%)	1,131,407 (33%)	
≥ 1 year College	2,109,472 (56%)	14,093,968 (65%)	1,987,908 (58%)	
Poverty Level Category, no (%)				
Poor	539,891 (14%)	1,398,344 (6%)	211,804 (6%)	<0.0001[c]
Near Poor	307,126 (8%)	509,672 (2%)	65,443 (2%)	
Low Income	476,204 (13%)	1,744,248 (8%)	327,123 (10%)	
Middle Income	1,111,201 (29%)	6,277,998 (29%)	957,615 (28%)	
High Income	1,339,207 (35%)	11,884,932 (54%)	1,872,803 (55%)	
Provider and Patient do not Speak Same Language, no (%)	144,670 (4%)	230,560 (1%)	61,167 (2%)	0.0006[c]
CCI, mean (95% CI)	0.09 (0.05-0.14)	0.09 (0.07- 0.10)	0.07 (0.04-0.10)	0.756[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with atopic dermatitis and other dermatitis who reported below average, average, or above average mental health functioning.

[c] Using the χ^2 test of differences between adult patients with atopic dermatitis and other dermatitis who reported below average, average, or above average mental health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.0 (95% CI, 12.4-13.6) for atopic dermatitis and other dermatitis patients with below average mental health functioning, 14.0 (95% CI, 13.8-14.2) for atopic dermatitis and other dermatitis patients with average mental health functioning, and 14.9 (95% CI, 14.5-15.3) for atopic dermatitis and other dermatitis patients with above average mental health functioning (P<0.0001) (Figure 5).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients with above average mental health functioning, atopic dermatitis and other dermatitis patients with average and below average mental health functioning had a patient-provider communication quality score decrement of 0.8 and 1.8, respectively (adjusted *B* coefficient, -0.8 [95% CI, -1.1, -0.6]; P<0.001 and -1.8 [-2.1, -1.4]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients with above average mental health functioning, atopic dermatitis and other dermatitis patients with average or below average mental health functioning were 3.1 times and 7.6 times more likely to report low-quality patient-provider communication (AOR, 3.1 [95% CI, 1.1-8.4]; P=0.027 and 7.6 [2.7-21.5]; P<0.001) (Table 16).

Atopic dermatitis and other dermatitis: Physical Health Functioning

Regarding physical health functioning, 17% of atopic dermatitis and other dermatitis patients had below average functioning, 77% had average functioning, and 6% had above average functioning (Table 20).

Table 20. Sociodemographic and clinical characteristics of US adult patients with atopic dermatitis and other dermatitis by the level of physical health functioning from the Medical Expenditure Panel Survey

Characteristic	**Level of Physical Health Functioning**[a]			***P* value**
	Below Average Functioning (Weighted no.= 4,904,548)	**Average** (Weighted no.= 22,219,146)	**Above Average** (Weighted no.= 1,899,917)	
Age, mean (SEM) years	60.3 (0.60)	46.4 (0.45)	39.7 (0.65)	<0.0001[b]
Gender, female no. (%)	3,318,680 (68%)	13,446,598 (61%)	1,170,114 (62%)	0.055[c]
Unemployed, no (%)	3,143,011 (64%)	5,115,003 (23%)	301,063 (16%)	<0.0001[c]
Race, no. (%)				
White	3,971,329 (81%)	18,575,852 (84%)	1,643,690 (87%)	0.335[c]
Black	625,156 (13%)	2,078,400 (9%)	170,245 (9%)	
Asian, Native Hawaiian or Pacific Islander	217,013 (4%)	1,232,336 (6%)	85,982 (5%)	
American Indian or Alaskan Native	53,666 (1%)	227,675 (1%)	0 (0%)	
Multiple races reported	37,384 (0.8%)	104,883 (0.5%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	367,754 (7%)	1,426,714 (6%)	114,221 (6%)	0.652[c]
Marital Status, no. (%)				
Married	2,684,119 (55%)	13,537,887 (61%)	1,163,012 (61%)	<0.0001[c]
Widowed	790,828 (16%)	857,934 (4%)	5,675 (0.3%)	
Divorced	756,836 (15%)	2,590,045 (12%)	285,195 (15%)	
Separated	136,793 (3%)	265,442 (1%)	13,988 (0.7%)	
Never Married	535,972 (11%)	4,967,837 (22%)	432,048 (23%)	
Cognitive Limitations, no. (%)	733,457 (15%)	500,180 (2%)	48,160 (3%)	<0.0001[c]
Social Limitations, no. (%)	1,115,337 (23%)	555,858 (3%)	47,011 (2%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	693,507 (14%)	1,715,729 (8%)	88,172 (5%)	<0.0001[c]
High School	1,779,416 (36%)	6,150,897 (28%)	404,542 (21%)	
≥ 1 year College	2,431,626 (50%)	14,352,520 (65%)	1,407,203 (74%)	
Poverty Level Category, no (%)				
Poor	728,988 (15%)	1,337,002 (6%)	84,048 (4%)	<0.0001[c]
Near Poor	315,417 (6%)	549,922 (2%)	16,902 (0.9%)	
Low Income	760,209 (16%)	1,623,114 (7%)	164,251 (9%)	
Middle Income	1,315,248 (27%)	6,444,022 (29%)	587,544	
High Income	1,784,686 (36%)	12,265,085 (55%)	1,047,172 (55%)	
Provider and Patient do not Speak Same Language, no (%)	173,822 (4%)	260,783 (1%)	1,792 (0.1%)	0.0003[c]
CCI, mean (95% CI)	0.05 (0.004-0.09)	0.08 (0.06- 0.097)	0.11 (0.07-0.16)	0.053[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with atopic dermatitis and other dermatitis who reported below average, average, or above average physical health functioning.

[c] Using the χ^2 test of differences between adult patients with atopic dermatitis and other dermatitis who reported below average, average, or above average physical health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.3 (95% CI, 12.7-13.9) for atopic dermatitis and other dermatitis patients with below average physical health functioning, 14.1 (95% CI, 13.9-14.3) for atopic dermatitis and other dermatitis patients with average physical health functioning, and 13.8 (95% CI, 13.0-14.6) for atopic dermatitis and other dermatitis patients with above average physical health functioning (P<0.0001) (Figure 6).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients with above average physical health functioning, atopic dermatitis and other dermatitis patients with below average physical health functioning had a patient-provider communication quality score decrement of 0.9 (adjusted *B* coefficient, -0.9 [95% CI, -1.4, -0.4]; P=0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients with above average physical health functioning, atopic dermatitis and other dermatitis patients with below average physical health functioning were 4.5 times more likely to report low-quality patient-provider communication (AOR, 4.5 [95% CI, 2.0-10.3]; P< 0.001) (Table 18).

Psoriasis: Study Population Characteristics

A weighted total of 10,922,351 US adults with psoriasis (unweighted, 939 US adults with psoriasis) who reported mental and physical health functioning during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 52.4 (0.7) years and females constituted 55% of the population. The mean patient-provider communication quality score was 14.1 (95% CI, 13.9-14.3).

Psoriasis: Mental Health Functioning

Regarding mental health functioning, 14% of psoriasis patients had below average functioning, 71% had average functioning, and 15% had above average functioning (Table 21).

Table 21. Sociodemographic and clinical characteristics of US adult patients with psoriasis by the level of mental health functioning from the Medical Expenditure Panel Survey

	Level of Mental Health Functioning[a]			
Characteristic	**Below Average** (Weighted no.= 1,565,785)	**Average** (Weighted no.= 7,694,371)	**Above Average** (Weighted no.= 1,662,195)	***P* value**
Age, mean (SEM) years	52.250 (1.160)	51.11 (16.494)	60.04 (15.401)	<0.0001[b]
Gender, female no. (%)	1,022,590 (65%)	4,162,261 (54%)	859,446 (52%)	0.059[c]
Unemployed, no (%)	873,896 (56%)	2,434,895 (32%)	828,117 (50%)	<0.0001[c]
Race, no. (%)				
White	1,377,502 (88%)	7,029,744 (91%)	1,510,121 (91%)	0.014[c]
Black	129,491 (8%)	295,949 (4%)	64,073 (4%)	
Asian, Native Hawaiian or Pacific Islander	22,156 (1%)	269,265 (3%)	73,863 (4%)	
American Indian or Alaskan Native	27,523 (2%)	32,642 (0%)	14,138 (1%)	
Multiple races reported	9,113 (1%)	66,770 (1%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	176,060 (11%)	516,177 (7%)	105,961 (6%)	0.117[c]
Marital Status, no. (%)				
Married	804,313 (51%)	4,556,861 (59%)	1,137,766 (68%)	0.128[c]
Widowed	146,006 (9%)	682,252 (9%)	132,244 (8%)	
Divorced	280,319 (18%)	959,553 (12%)	164,782 (10%)	
Separated	42,628 (3%)	56,443 (1%)	13,267 (1%)	
Never Married	292,519 (19%)	1,439,263 (19%)	214,136 (13%)	
Cognitive Limitations, no. (%)	307,569 (20%)	270,635 (4%)	34,407 (2%)	<0.0001[c]
Social Limitations, no. (%)	313,527 (20%)	360,625 (5%)	133,894 (8%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	320,234 (20%)	880,737 (11%)	111,074 (7%)	0.0040[c]
High School	543,219 (35%)	2,149,033 (28%)	524,738 (32%)	
≥ 1 year College	702,332 (45%)	4,664,601 (61%)	1,026,383 (62%)	
Poverty Level Category, no (%)				
Poor	300,861 (19%)	396,552 (5%)	73,414 (4%)	<0.0001[c]
Near Poor	60,438 (4%)	157,496 (2%)	53,001 (3%)	
Low Income	289,277 (18%)	512,338 (7%)	119,538 (7%)	
Middle Income	422,061 (27%)	2,207,158 (29%)	445,326 (27%)	
High Income	493,147 (31%)	4,420,826 (57%)	970,916 (58%)	
Provider and Patient do not Speak Same Language, no (%)	34,506 (2%)	38,512 (1%)	0 (0%)	0.007[c]
CCI, mean (95% CI)	1.14 (1.10-1.19)	1.20 (1.15-1.25)	1.13 (1.07-1.18)	0.208[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with psoriasis who reported below average, average, or above average mental health functioning.

[c] Using the χ^2 test of differences between adult patients with psoriasis who reported below average, average, or above average mental health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.5 (95% CI, 12.7-14.3) for psoriasis patients with below average mental health functioning, 14.1 (95% CI, 13.7-14.5) for psoriasis patients with average mental health functioning, and 14.9 (95% CI, 14.2-15.6) for psoriasis patients with above average mental health functioning (P<0.0001) (Figure 5).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients with above average mental health functioning, psoriasis patients with average mental health functioning had a patient-provider communication quality score decrement of 0.9 (adjusted *B* coefficient, -0.9 [95% CI, -1.5, -0.3]; P=0.003).

Psoriasis: Physical Health Functioning

Regarding physical health functioning, 26% of psoriasis patients had below average functioning, 69% had average functioning, and 5% had above average functioning (Table 22).

Table 22. Sociodemographic and clinical characteristics of US adult patients with psoriasis by the level of physical health functioning from the Medical Expenditure Panel Survey

	Level of Physical Health Functioning[a]			
Characteristic	**Below Average** (Weighted no.= 2,847,747)	**Average** (Weighted no.= 7,534,501)	**Above Average** (Weighted no.= 540,103)	***P* value**
Age, mean (SEM) years	61.15 (1.048)	49.83 (0.789)	41.67 (2.605)	<0.0001[b]
Gender, female no. (%)	1,753,206 (62%)	3,898,886 (52%)	392,206 (73%)	0.011[c]
Unemployed, no (%)	2,014,643 (71%)	2,028,872 (27%)	93,392 (17%)	<0.0001[c]
Race, no. (%)				
White	2,581,861 (91%)	6,833,319 (91%)	502,187 (93%)	0.262[c]
Black	146,539 (5%)	311,962 (4%)	31,013 (6%)	
Asian, Native Hawaiian or Pacific Islander	67,987 (2%)	290,394 (4%)	6,903 (1%)	
American Indian or Alaskan Native	42,248 (1%)	32,056 (0%)	0 (0%)	
Multiple races reported	9,113 (0%)	66,770 (1%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	180,413 (6%)	563,778 (7%)	54,007 (10%)	0.526[c]
Marital Status, no (%)				
Married	1,525,401 (54%)	4,754,520 (63%)	219,019 (41%)	<0.0001[c]
Widowed	578,424 (20%)	382,078 (5%)	0 (0%)	
Divorced	494,803 (17%)	875,322 (12%)	34,529 (6%)	
Separated	70,236 (2%)	37,461 (0%)	4,639 (1%)	
Never Married	178,883 (6%)	1,485,119 (20%)	281,916 (52%)	
Cognitive Limitations, no. (%)	449,699 (16%)	162,911 (2%)	0 (0%)	<0.0001[c]
Social Limitations, no. (%)	592,630 (21%)	215,415 (3%)	0 (0%)	<0.0001[c]
Education Level, no (%)				
Pre-High School	323,535 (11%)	909,104 (12%)	79,406 (15%)	0.025[c]
High School	1,150,044 (40%)	1,947,836 (26%)	119,110 (22%)	
≥ 1 year College	1,374,169 (48%)	4,677,561 (62%)	341,587 (63%)	
Poverty Level Category, no (%)				
Poor	411,559 (14%)	337,814 (4%)	21,454 (4%)	<0.0001[c]
Near Poor	151,153 (5%)	113,551 (2%)	6,232 (1%)	
Low Income	395,735 (14%)	487,349 (6%)	38,069 (7%)	
Middle Income	910,167 (32%)	1,983,675 (26%)	180,704 (33%)	
High Income	979,134 (34%)	4,612,112 (61%)	293,643 (54%)	
Provider and Patient do not Speak Same Language, no (%)	34,506 (1%)	38,512 (1%)	0 (0%)	0.347[c]
CCI, mean (95% CI)	1.13 (1.09-1.18)	1.19 (1.14-1.23)	1.36 (1.09-1.63)	0.239[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with psoriasis who reported below average, average, or above average physical health functioning.

[c] Using the χ^2 test of differences between adult patients with psoriasis who reported below average, average, or above average physical health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.7 (95% CI, 13.2-14.2) for psoriasis patients with below average physical health functioning, 14.4 (95% CI, 14.1-14.7) for psoriasis patients with average physical health functioning, and 13.0 (95% CI, 11.1-14.9) for psoriasis patients with above average physical health functioning (P=0.004) (Figure 6).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients with above average physical health functioning, psoriasis patients with average and below average physical health functioning had a patient-provider communication quality score decrement of 0.7 and 1.0, respectively (adjusted *B* coefficient, -0.7 [95% CI, -1.1, -0.3]; P<0.001 and -1.0 [-1.7, -0.2]; P=0.02). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients with above average physical health functioning, psoriasis patients with average physical health functioning were 2.9 times more likely to report low-quality patient-provider communication (AOR, 2.9 [95% CI, 1.2-6.8]; P=0.02) (Table 18).

Melanoma and Non-Melanoma Skin Cancers: Study Population Characteristics

A weighted total of 5,011,076 US adults with melanoma and non-melanoma skin cancers (unweighted, 457 US adults with melanoma and non-melanoma skin cancers) who reported mental and physical health functioning during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 67.7 (0.76) years and females constituted 51% of the population. The mean patient-provider communication quality score was 14.0 (95% CI, 13.9-14.2).

Melanoma and Non-Melanoma Skin Cancers: Mental Health Functioning

Regarding mental health functioning, 17% of melanoma and non-melanoma skin cancer patients had below average functioning, 63% had average functioning, and 20% had above average functioning (Table 23).

Table 23. Sociodemographic and clinical characteristics of US adult patients with melanoma and non-melanoma skin cancers by the level of mental health functioning from the Medical Expenditure Panel Survey

	Level of Mental Health Functioning[a]			
Characteristic	**Below Average** (Weighted no.= 869,125)	**Average** (Weighted no.= 3,150,407)	**Above Average** (Weighted no.= 991,544)	***P* value**
Age, mean (SEM) years	68.0 (1.02)	66.4 (0.74)	72.0 (0.64)	0.003[b]
Gender, female no. (%)	594,882 (68%)	1,591,077 (51%)	369,381 (37%)	0.057[c]
Unemployed, no (%)	767,654 (88%)	2,022,503 (64%)	612,599 (62%)	0.025[c]
Race, no. (%)				
White	833,935 (96%)	2,898,783 (92%)	833,935 (84%)	0.118[c]
Black	16,071 (2%)	162,713 (5%)	16,071 (2%)	
Asian, Native Hawaiian or Pacific Islander	19,119 (2%)	59,924 (2%)	19,119 (2%)	
American Indian or Alaskan Native	0 (0%)	28,987 (1%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	28,140 (3%)	109,149 (3%)	21,916 (2%)	0.347[c]
Marital Status, no. (%)				
Married	532,542 (61%)	1,939,304 (62%)	568,581 (57%)	0.020[c]
Widowed	243,105 (28%)	497,837 (16%)	158,902 (16%)	
Divorced	88,417 (10%)	398,867 (13%)	100,365 (10%)	
Separated	44,973 (5%)	23,716 (0.8%)	25,069 (3%)	
Never Married	82,506 (9%)	290,683 (9%)	16,208 (2%)	
Cognitive Limitations, no. (%)	385,990 (44%)	261,195 (8%)	35,655 (4%)	<0.0001[c]
Social Limitations, no. (%)	431,114 (50%)	380,595 (12%)	80,216 (8%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	216,192 (25%)	278,406 (9%)	151,328 (15%)	0.014[c]
High School	386,750 (44%)	1,185,397 (38%)	313,519 (32%)	
≥ 1 year College	388,602 (45%)	1,686,604 (54%)	404,278 (41%)	
Poverty Level Category, no (%)				
Poor	154,092 (18%)	185,270 (6%)	71,734 (7%)	0.0001[c]
Near Poor	32,574 (4%)	179,306 (6%)	7,897 (0.8%)	
Low Income	184,685 (21%)	535,924 (17%)	167,205 (17%)	
Middle Income	384,404 (44%)	686,885 (22%)	229,400 (23%)	
High Income	235,789 (27%)	1,563,022 (50%)	392,889 (40%)	
Provider and Patient do not Speak Same Language, no (%)	7,877 (0.9%)	29,373 (0.9%)	0 (0%)	0.110[c]
CCI, mean (95% CI)	1.53 (1.41-1.66)	1.33 (1.27-1.38)	1.56 (1.43-1.68)	0.026[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with melanoma and non-melanoma skin cancers who reported below average, average, or above average mental health functioning.

[c] Using the χ^2 test of differences between adult patients with melanoma and non-melanoma skin cancers who reported below average, average, or above average mental health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.5 (95% CI, 13.3-13.7) for melanoma and non-melanoma skin cancer patients with below average mental health functioning, 14.1 (95% CI, 13.7-14.5) for melanoma and non-melanoma skin cancer patients with average mental health functioning, and 14.5 (95% CI, 13.9-15.1) for melanoma and non-melanoma skin cancer patients with above average mental health functioning (P=0.0002) (Figure 5).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients with above average mental health functioning, melanoma and non-melanoma skin cancer patients with average and below average mental health functioning had a patient-provider communication quality score decrement of 1.1 and 0.7, respectively (adjusted *B* coefficient, -1.1 [95% CI, -1.6, -0.6]; P<0.0001 and -0.7 [-1.2, -0.2]; P=0.005). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients with above average mental health functioning, melanoma and non-melanoma skin cancer patients with average mental health functioning were 8.7 times more likely to report low-quality patient-provider communication (AOR, 8.7 [95% CI, 5.2-14.6]; P< 0.001) (Table 16).

Melanoma and Non-Melanoma Skin Cancers: Physical Health Functioning

Regarding physical health functioning, 55% of melanoma and non-melanoma skin cancer patients had below average functioning, 44% had average functioning, and 1% had above average functioning (Table 24).

Table 24. Sociodemographic and clinical characteristics of US adult patients with melanoma and non-melanoma skin cancers by the level of physical health functioning from the Medical Expenditure Panel Survey

	Level of Physical Health Functioning[a]			
Characteristic	**Below Average** (Weighted no.= 2,767,354)	**Average** (Weighted no.= 2,194,364)	**Above Average** (Weighted no.= 49,358)	***P* value**
Age, mean (SEM) years	71.3 (0.61)	63.6 (0.66)	45.2 (12.0)	<0.0001[b]
Gender, female, no. (%)	1,564,231 (57%)	941,750 (43%)	49,358 (100%)	0.022[c]
Unemployed, no (%)	2,339,073 (85%)	1,040,193 (47%)	23,489 (48%)	<0.0001[c]
Race, no. (%)				
White	2,502,477 (90%)	2,048,568 (93%)	49,358 (100%)	0.741[c]
Black	183,261 (7%)	85,175 (4%)	0 (0%)	
Asian, Native Hawaiian or Pacific Islander	66,551 (2%)	46,699 (2%)	0 (0%)	
American Indian or Alaskan Native	15,066 (0.5%)	13,921 (0.6%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	99,161 (4%)	60,043 (3%)	0 (0%)	0.785[c]
Marital Status, no. (%)				
Married	1,589,333 (57%)	1,401,736 (64%)	49,358 (100%)	0.008[c]
Widowed	674,128 (24%)	225,716 (10%)	0 (0%)	
Divorced	284,724 (10%)	302,926 (14%)	0 (0%)	
Separated	63,357 (2%)	30,401 (1%)	0 (0%)	
Never Married	155,812 (6%)	233,586 (11%)	0 (0%)	
Cognitive Limitations, no. (%)	579,538 (21%)	103,302 (5%)	0 (0%)	0.0008[c]
Social Limitations, no. (%)	766,132 (28%)	125,793 (6%)	0 (0%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	494,557 (18%)	127,879 (6%)	23,489 (48%)	<0.0001[c]
High School	1,271,352 (46%)	588,445 (27%)	25,869 (52%)	
≥ 1 year College	1,001,444 (36%)	1,478,040 (67%)	0 (0%)	
Poverty Level Category, no (%)				
Poor	332,937 (12%)	78,159 (4%)	0 (0%)	<0.0001[c]
Near Poor	109,805 (4%)	109,972 (5%)	0 (0%)	
Low Income	726,924 (26%)	160,890 (7%)	0 (0%)	
Middle Income	776,395 (28%)	498,425 (23%)	25,869 (52%)	
High Income	821,293 (30%)	1,346,917 (61%)	23,489 (48%)	
Provider and Patient do not Speak Same Language, no (%)	16,330 (0.6%)	20,921 (1%)	0 (0%)	0.803[c]
CCI, mean (95% CI)	1.49 (1.41-1.56)	1.31 (1.24-1.37)	1.48 (0.77-2.18)	0.121[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with melanoma and non-melanoma skin cancers who reported below average, average, or above average physical health functioning.

[c] Using the χ^2 test of differences between adult patients with melanoma and non-melanoma skin cancers who reported below average, average, or above average physical health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.9 (95% CI, 13.4-14.4) for melanoma and non-melanoma skin cancer patients with below average physical health functioning, 14.2 (95% CI, 13.7-14.7) for melanoma and non-melanoma skin cancer patients with average physical health functioning, and 12.4 (95% CI, 8.8-15.9) for melanoma and non-melanoma skin cancer patients with above average physical health functioning (P=0.142) (Figure 6).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients with above average physical health functioning, melanoma and non-melanoma skin cancer patients with average physical health functioning had a patient-provider communication quality score decrement of 0.8 (adjusted *B* coefficient, -0.8 [95% CI, -1.3, -0.3]; P=0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients with above average physical health functioning, melanoma and non-melanoma skin cancer patients with below average physical health functioning were 13.0 times more likely to report low-quality patient-provider communication (AOR, 13.0 [95% CI, 5.4-31.2]; P< 0.0001) (Table 18).

Hidradenitis Suppurativa and Rosacea: Study Population Characteristics

A weighted total of 1,527,261 US adults with hidradenitis suppurativa and rosacea (unweighted, 147 US adults with hidradenitis suppurativa and rosacea) who reported mental and physical health functioning during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 70.6 (0.6) years and females constituted 54% of the population. The mean patient-provider communication quality score was 14.3 (95% CI, 14.2-14.4).

Hidradenitis Suppurativa and Rosacea: Mental Health Functioning

Regarding mental health functioning, 18% of hidradenitis suppurativa and rosacea patients had below average functioning, 64% had average functioning, and 18% had above average functioning (Table 25).

Table 25. Sociodemographic and clinical characteristics of US adult patients with other adnexal diseases (hidradenitis suppurativa and rosacea) by the level of mental health functioning from the Medical Expenditure Panel Survey

	Level of Mental Health Functioning[a]			
Characteristic	**Below Average** (Weighted no.= 278,870)	**Average** (Weighted no.= 972,870)	**Above Average** (Weighted no.= 275,521)	***P* value**
Age, mean (SEM) years	66.0 (0.28)	71.5 (0.63)	72.0 (0.51)	0.584[b]
Gender, female no. (%)	172,777 (62%)	525,685 (54%)	131,706 (48%)	0.252[c]
Unemployed, no (%)	218,466 (78%)	695,932 (72%)	239,039 (87%)	0.0005[c]
Race, no. (%)				
White	188,246 (68%)	762,425 (78%)	249,648 (91%)	0.026[c]
Black	62,702 (22%)	177,510 (18%)	21,139 (8%)	
Asian, Native Hawaiian or Pacific Islander	27,922 (10%)	19,663 (2%)	0 (0%)	
American Indian or Alaskan Native	0 (0%)	13,272 (1%)	4,735 (2%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	8,506 (3%)	36,116 (4%)	0 (0%)	0.008[c]
Marital Status, no. (%)				
Married	116,530 (42%)	530,053 (54%)	188,816 (69%)	0.002[c]
Widowed	61,276 (22%)	277,723 (29%)	44,525 (16%)	
Divorced	26,559 (10%)	124,880 (13%)	18,727 (7%)	
Separated	33,602 (12%)	3,071 (0.3%)	0 (0%)	
Never Married	40,904 (15%)	37,143 (4%)	23,452 (9%)	
Cognitive Limitations, no. (%)	93,226 (33%)	87,394 (9%)	7,860 (3%)	<0.0001[c]
Social Limitations, no. (%)	118,860 (43%)	114,528 (12%)	80,202 (29%)	0.0002[c]
Education Level, no. (%)				
Pre-High School	40,896 (15%)	86,115 (9%)	46,022 (17%)	0.010[c]
High School	92,160 (33%)	256,258 (26%)	105,144 (38%)	
≥ 1 year College	145,814 (52%)	630,497 (65%)	124,355 (45%)	
Poverty Level Category, no (%)				
Poor	28,621 (10%)	50,442 (5%)	27,104 (10%)	0.0002[c]
Near Poor	66,220 (24%)	74,746 (8%)	0 (0%)	
Low Income	22,556 (8%)	195,790 (20%)	113,523 (41%)	
Middle Income	57,464 (21%)	309,387 (32%)	91,760 (33%)	
High Income	104,009 (37%)	342,504 (35%)	43,135 (16%)	
Provider and Patient do not Speak Same Language, no (%)	5,138 (2%)	5,542 (0.6%)	0 (0%)	0.0004[c]
CCI, mean (95% CI)	1.32 (1.29-1.34)	1.51 (1.36-1.65)	1.39 (1.28-1.50)	0.527[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with hidradenitis suppurativa and rosacea who reported below average, average, or above average mental health functioning.

[c] Using the χ^2 test of differences between adult patients with hidradenitis suppurativa and rosacea who reported below average, average, or above average mental health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.3 (95% CI, 12.4-14.2) for hidradenitis suppurativa and rosacea patients with below average mental health functioning, 13.8 (95% CI, 13.5-14.1) for hidradenitis suppurativa and rosacea patients with average mental health functioning, and 14.7 (95% CI, 14.1-15.3) for hidradenitis suppurativa and rosacea patients with above average mental health functioning (P<0.0001) (Figure 5).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients with above average mental health functioning, hidradenitis suppurativa and rosacea patients with average and below average mental health functioning had a patient-provider communication quality score decrement of 0.9 and 1.3, respectively (adjusted *B* coefficient, -0.9 [95% CI, -1.4, -0.4]; P<0.001 and -1.3 [-2.0, -0.7]; P<0.001).

Hidradenitis Suppurativa and Rosacea: Physical Health Functioning

Regarding physical health functioning, 60% of hidradenitis suppurativa and rosacea patients had below average functioning, 40% had average functioning, and 0% had above average functioning (Table 26).

Table 26. Sociodemographic and clinical characteristics of US adult patients with other adnexal diseases (hidradenitis suppurativa and rosacea) by the level of physical health functioning from the Medical Expenditure Panel Survey

Characteristic	Level of Physical Health Functioning[a]			*P* value
	Below Average (Weighted no.= 923,423)	**Average** (Weighted no.= 603,837)	**Above Average** (Weighted no.= 0)	
Age, mean (SEM) years	73.2 (0.41)	66.7 (0.48)	0 (--)	0.005[b]
Gender, female no. (%)	612,216 (66%)	217,952 (36%)	0 (0%)	0.010[c]
Unemployed, no (%)	800,193 (87%)	353,244 (58%)	0 (0%)	0.0001[c]
Race, no. (%)				
White	808,440 (88%)	391,879 (65%)	0 (0%)	0.0015[c]
Black	77,182 (8%)	184,168 (30%)	0 (0%)	
Asian, Native Hawaiian or Pacific Islander	32,780 (4%)	14,805 (2%)	0 (0%)	
American Indian or Alaskan Native	5,022 (0.5%)	12,985 (2%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	30,901 (3%)	13,721 (2%)	0 (0%)	0.024[c]
Marital Status, no. (%)				
Married	456,187 (49%)	379,213 (63%)	0 (0%)	0.0004[c]
Widowed	287,428 (31%)	96,096 (16%)	0 (0%)	
Divorced	104,830 (11%)	65,336 (11%)	0 (0%)	
Separated	36,673 (4%)	0 (0%)	0 (0%)	
Never Married	38,306 (4%)	63,193 (10%)	0 (0%)	
Cognitive Limitations, no. (%)	173,675 (19%)	14,805 (2%)	0 (0%)	<0.0001[c]
Social Limitations, no. (%)	274,361 (30%)	39,229 (6%)	0 (0%)	0.003[c]
Education Level, no. (%)				
Pre-High School	128,560 (14%)	44,473 (7%)	0 (0%)	0.002[c]
High School	325,313 (35%)	128,248 (21%)	0 (0%)	
≥ 1 year College	469,550 (51%)	431,116 (71%)	0 (0%)	
Poverty Level Category, no (%)				
Poor	93,922 (10%)	12,245 (2%)	0 (0%)	0.0014[c]
Near Poor	140,967 (15%)	0 (0%)	0 (0%)	
Low Income	280,967 (30%)	50,902 (8%)	0 (0%)	
Middle Income	251,703 (27%)	206,908 (34%)	0 (0%)	
High Income	155,865 (17%)	333,783 (55%)	0 (0%)	
Provider and Patient do not Speak Same Language, no (%)	10,680 (1%)	0 (0%)	0 (0%)	0.0004[c]
CCI, mean (95% CI)	1.43 (1.37-1.49)	1.49 (1.28-1.69)	0 (--)	0.423[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with hidradenitis suppurativa and rosacea who reported below average, average, or above average physical health functioning.

[c] Using the χ^2 test of differences between adult patients with hidradenitis suppurativa and rosacea who reported below average, average, or above average physical health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.7 (95% CI, 13.3-14.1) for hidradenitis suppurativa and rosacea patients with below average physical health functioning, 14.2 (95% CI, 13.8-14.6) for hidradenitis suppurativa and rosacea patients with average physical health functioning, and 14.0 (95% CI, 12.9-15.1) for hidradenitis suppurativa and rosacea patients with above average physical health functioning (P=0.016) (Figure 6).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients with above average physical health functioning, hidradenitis suppurativa and rosacea patients with average and below average physical health functioning had a patient-provider communication quality score increment of 1.5 and 1.0, respectively (adjusted *B* coefficient, 1.5 [95% CI, 0.5-2.5]; P=0.002 and 1.0 [0.01-2.1]; P=0.05) (Table 18).

Vitiligo and Other Pigmentation Disorders: Study Population Characteristics

From a weighted total of 38,327,947 US adults with vitiligo and other pigmentation disorders (unweighted, 3,590 US adults with vitiligo and other pigmentation disorders) who reported mental and physical health functioning during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 58.8 (0.4) years and females constituted 59% of the population. The mean patient-provider communication quality score was 14.0 (95% CI, 13.9-14.1).

Vitiligo and Other Pigmentation Disorders: Mental Health Functioning

Regarding mental health functioning, 14% of vitiligo and other pigmentation disorder patients had below average functioning, 71% had average functioning, and 15% had above average functioning (Table 27).

Table 27. Sociodemographic and clinical characteristics of US adult patients with vitiligo and other pigmentation disorders by mental health functioning from the Medical Expenditure Panel Survey

	Level of Mental Health Functioning[a]			
Characteristic	**Below Average** (Weighted no.= 5,184,634)	**Average** (Weighted no.= 27,233,531)	**Above Average** (Weighted no.= 5,909,782)	***P* value**
Age, mean (SEM) years	55.1 (0.94)	58.3 (0.50)	64.6 (0.66)	<0.0001[b]
Gender, female, no. (%)	3,419,379 (66%)	16,150,993 (59%)	3,077,767 (52%)	0.006[c]
Unemployed, no (%)	2,605,687 (50%)	11,972,866 (44%)	3,758,771 (64%)	<0.0001[c]
Race, no. (%)				
White	4,221,195 (81%)	23,777,948 (87%)	5,155,313 (87%)	0.002[c]
Black	616,626 (12%)	2,240,469 (8%)	532,993 (9%)	
Asian, Native Hawaiian or Pacific Islander	286,056 (6%)	952,665 (3%)	218,147 (4%)	
American Indian or Alaskan Native	23,034 (0.4%)	235,432 (0.9%)	3,329 (0.1%)	
Multiple races reported	37,722 (0.7%)	27,017 (0.1%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	505,475 (10%)	1,386,953 (5%)	324,367 (5%)	0.0006[c]
Marital Status, no. (%)				
Married	2,361,735 (46%)	16,917,939 (62%)	3,643,054 (62%)	<0.0001[c]
Widowed	618,165 (12%)	3,078,898 (11%)	912,487 (15%)	
Divorced	1,141,154 (22%)	3,475,660 (13%)	667,691 (11%)	
Separated	108,609 (2%)	249,698 (1%)	67,487 (1%)	
Never Married	954,970 (18%)	3,511,336 (13%)	619,062 (10%)	
Cognitive Limitations, no. (%)	1,338,047 (26%)	1,203,796 (4%)	232,014 (4%)	<0.0001[c]
Social Limitations, no. (%)	1,344,107 (26%)	1,682,390 (6%)	460,033 (8%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	888,258 (17%)	2,886,560 (11%)	710,222 (12%)	0.0002[c]
High School	2,069,132 (40%)	8,503,646 (31%)	2,088,067 (35%)	
≥ 1 year College	2,227,243 (43%)	15,843,324 (58%)	3,111,492 (53%)	
Poverty Level Category, no (%)				
Poor	778,409 (15%)	1,688,399 (6%)	307,672 (5%)	<0.0001[c]
Near Poor	304,579 (6%)	849,670 (3%)	331,167 (6%)	
Low Income	786,798 (15%)	2,827,387 (10%)	648,195 (11%)	
Middle Income	1,393,615 (27%)	6,950,694 (26%)	1,861,360 (31%)	
High Income	1,921,232 (37%)	14,917,382 (55%)	2,761,389 (47%)	
Provider and Patient do not Speak Same Language, no (%)	256,716 (5%)	358,429 (1%)	56,034 (0.9%)	<0.0001[c]
CCI, mean (95% CI)	1.21 (1.16-1.26)	1.20 (1.17-1.22)	1.21 (1.16-1.25)	0.795[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with vitiligo and other pigmentation disorders who reported below average, average, or above average mental health functioning.

[c] Using the χ^2 test of differences between adult patients with vitiligo and other pigmentation disorders who reported below average, average, or above average mental health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.0 (95% CI, 12.4-13.6) for vitiligo and other pigmentation disorder patients with below average mental health functioning, 14.0 (95% CI, 13.8-14.2) for vitiligo and other pigmentation disorder patients with average mental health functioning, and 14.7 (95% CI, 14.3-15.1) for vitiligo and other pigmentation disorder patients with above average mental health functioning (P<0.0001) (Figure 5).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients with above average mental health functioning, vitiligo and other pigmentation disorder patients with average and below average mental health functioning had a patient-provider communication quality score decrement of 0.8 and 0.9, respectively (adjusted *B* coefficient, -0.8 [95% CI, -1.2, -0.5]; P<0.001 and -0.9 [-1.3, -0.5]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients with above average mental health functioning, vitiligo and other pigmentation disorder patients with average or below average mental health functioning were 2.8 times and 3.4 times more likely to report low-quality patient-provider communication (AOR, 2.8 [95% CI, 1.4-5.7]; P=0.004 and 3.4 [1.7-6.9]; P=0.001) (Table 16).

Vitiligo and other pigmentation disorders: Physical Health Functioning

Regarding physical health functioning, 29% of vitiligo and other pigmentation disorder patients had below average functioning, 67% had average functioning, and 4% had above average functioning (Table 28).

Table 28. Sociodemographic and clinical characteristics of US adult patients with vitiligo and other pigmentation disorders by physical health functioning from the Medical Expenditure Panel Survey

Characteristic	Level of Physical Health Functioning[a]			*P* value
	Below Average (Weighted no.= 11,107,409)	**Average** (Weighted no.= 25,649,792)	**Above Average** (Weighted no.= 1,570,745)	
Age, mean (SEM) years	66.6 (0.61)	56.6 (0.46)	39.9 (0.50)	<0.0001[b]
Gender, female, no. (%)	6,668,622 (60%)	14,881,889 (58%)	1,097,630 (70%)	0.139[c]
Unemployed, no (%)	8,439,361 (76%)	9,616,331 (37%)	281,632 (18%)	<0.0001[c]
Race, no. (%)				
White	9,488,593 (85%)	22,273,470 (87%)	1,392,394 (89%)	0.322[c]
Black	1,154,553 (10%)	2,087,526 (8%)	148,011 (9%)	
Asian, Native Hawaiian or Pacific Islander	332,340 (3%)	1,094,188 (4%)	30,340 (2%)	
American Indian or Alaskan Native	94,202 (0.8%)	167,592 (0.7%)	0 (0%)	
Multiple races reported	37,722 (0.3%)	27,017 (0.1%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	637,654 (6%)	1,447,946 (6%)	131,193 (8%)	0.524[c]
Marital Status, no. (%)				
Married	5,605,109 (50%)	16,476,074 (64%)	841,546 (54%)	<0.0001[c]
Widowed	2,322,430 (21%)	2,229,291 (9%)	57,828 (4%)	
Divorced	1,801,943 (16%)	3,236,284 (13%)	246,279 (16%)	
Separated	121,557 (1%)	304,237 (1%)	0 (0%)	
Never Married	1,256,370 (11%)	3,403,906 (13%)	425,092 (27%)	
Cognitive Limitations, no. (%)	1,998,940 (18%)	735,673 (3%)	39,244 (2%)	<0.0001[c]
Social Limitations, no. (%)	2,932,846 (26%)	526,249 (2%)	27,436 (2%)	<0.0001[c]
Education Level, no. (%)				
Pre-High School	2,195,454 (20%)	2,198,918 (9%)	90,669 (6%)	<0.001[c]
High School	4,717,272 (42%)	7,544,989 (29%)	398,585 (25%)	
≥ 1 year College	4,194,683 (38%)	15,905,886 (62%)	1,081,491 (69%)	
Poverty Level Category, no (%)				
Poor	1,515,112 (14%)	1,173,845 (5%)	85,523 (5%)	<0.0001[c]
Near Poor	828,448 (7%)	586,743 (2%)	70,225 (4%)	
Low Income	1,905,513 (17%)	2,204,239 (9%)	152,628 (8%)	
Middle Income	3,069,906 (28%)	6,709,403 (26%)	426,359 (27%)	
High Income	3,788,431 (34%)	14,975,563 (58%)	836,009 (53%)	
Provider and Patient do not Speak Same Language, no (%)	315,249 (3%)	323,479 (1%)	32,452 (2%)	0.128[c]
CCI, mean (95% CI)	1.19 (1.15-1.230	1.20 (1.18-1.23)	1.21 (1.12-1.30)	0.216[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with vitiligo and other pigmentation disorders who reported below average, average, or above average physical health functioning.

[c] Using the χ^2 test of differences between adult patients with vitiligo and other pigmentation disorders who reported below average, average, or above average physical health functioning.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

The mean patient-provider communication composite score was 13.6 (95% CI, 13.2-14.0) for vitiligo and other pigmentation disorder patients with below average physical health functioning, 14.2 (95% CI, 14.0-14.4) for vitiligo and other pigmentation disorder patients with average physical health functioning, and 13.6 (95% CI, 12.6-14.6) for vitiligo and other pigmentation disorder patients with above average physical health functioning (P<0.0001) (Figure 6).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients with above average physical health functioning, vitiligo and other pigmentation disorder patients with average and below average physical health functioning had a patient-provider communication quality score decrement of 0.9 and 1.3, respectively (adjusted *B* coefficient, -0.9 [95% CI, -1.1, -0.6]; P<0.001 and -1.3 [-1.8, -0.7]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients with above average physical health functioning, vitiligo and other pigmentation disorder patients with average or below average physical health functioning were 2.6 times and 7.9 times more likely to report low-quality patient-provider communication (AOR, 2.6 [95% CI, 1.5-4.6]; P=0.001 and 7.9 [3.6-17.5]; P<0.001) (Table 16).

Aim 2 Results: Healthcare Resource Utilisation

Aim 2: *To determine the impact of patients' perception of patient-provider communication quality on healthcare resource utilisation.*

Acne: Study Population Characteristics

A weighted total of 36,673,237 US adults with acne (unweighted, 3,436 US adults with acne) who reported patient-provider communication quality during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 40.7 (0.4) years and females constituted 69% of the population. The mean number of emergency room visits was 0.25 (95% CI, 0.22-0.28). The mean number of overnight hospitalisation visits was 0.5 (95% CI, 0.35-0.63). The mean number of outpatient visits was 11.0 (95% CI, 10.5-11.6). The mean total expenditure per person per year was $6,565 (95% CI, $5,993-$7,138).

Regarding healthcare resource utilisation, 38% of acne patients reported high-quality patient-provider communication, 56% reported medium-quality patient-provider communication, and 6% reported low-quality patient-provider communication (Table 29).

Table 29. Sociodemographic and clinical characteristics of US adult patients with acne by patient-provider communication quality from the Medical Expenditure Panel Survey

Characteristic	Patient-Provider Communication Quality[a]			*P* value
	High-Quality (Weighted no.= 13,824,745)	**Medium-Quality** (Weighted no.= 20,461,977)	**Low-Quality** (Weighted no.= 2,386,515)	
Age, mean (SEM) years	41.9 (0.64)	41.7 (0.55)	37.0 (0.49)	0.0005[b]
Gender, female no. (%)	9,098,975 (66%)	14,151,963 (69%)	1,789,859 (75%)	0.076[c]
Unemployed, no (%)	4,076,522 (29%)	5,784,708 (28%)	657,707 (28%)	0.807[c]
Race, no. (%)				
White	11,320,824 (82%)	17,521,965 (86%)	1,992,676 (83%)	0.372[c]
Black	1,692,806 (12%)	1,815,714 (9%)	214,718 (9%)	
Asian, Native Hawaiian or Pacific Islander	588,327 (4%)	829,770 (4%)	155,187 (7%)	
American Indian or Alaskan Native	181,973 (1%)	211,470 (1%)	23,935 (1%)	
Multiple races reported	40,814 (0.3%)	83,057 (0.4%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	940,395 (7%)	1,456,950 (7%)	178,339 (7%)	0.910[c]
Marital Status, no. (%)				
Married	6,696,750 (48%)	9,772,109 (48%)	996,164 (42%)	0.298[c]
Widowed	683,475 (5%)	1,054,614 (5%)	30,706 (1%)	
Divorced	1,399,678 (10%)	1,984,778 (10%)	336,456 (14%)	
Separated	146,115 (1%)	264,627 (1%)	30,432 (1%)	
Never Married	4,898,727 (35%)	7,385,848 (36%)	992,758 (42%)	
Cognitive Limitations, no. (%)	501,688 (4%)	817,937 (4%)	251,629 (11%)	0.0003[c]
Social Limitations, no. (%)	565,336 (4%)	1,129,444 (6%)	118,226 (5%)	0.296
Education Level, no. (%)				
Pre-High School	1,235,913 (9%)	1,927,570 (9%)	167,127 (7%)	0.211[c]
High School	4,607,468 (33%)	6,245,733 (31%)	966,707 (41%)	
≥ 1 year College	7,981,364 (58%)	12,288,674 (60%)	1,252,681 (52%)	
Poverty Level Category, no (%)				
Poor	1,102,215 (8%)	1,476,466 (7%)	390,841 (16%)	0.0003[c]
Near Poor	387,222 (3%)	506,601 (2%)	77,461 (3%)	
Low Income	1,095,078 (8%)	2,308,742 (11%)	360,531 (15%)	
Middle Income	3,705,399 (27%)	5,600,090 (27%)	748,768 (31%)	
High Income	7,534,831 (55%)	10,570,077 (52%)	808,914 (34%)	
Insurance, no. (%)				
Private	10,883,015 (79%)	15,759,879 (77%)	1,682,658 (71%)	0.026[c]
Public	2,077,388 (15%)	2,878,978 (14%)	478,891 (20%)	
Uninsured	864,341 (6%)	1,823,119 (9%)	224,966 (9%)	
Provider and Patient do not Speak Same Language, no (%)	105,115 (0.8%)	180,116 (9%)	32,746 (1%)	0.789[c]
CCI, mean (95% CI)	1.19 (1.12-1.26)	1.20 (1.17-1.23)	1.17 (1.14-1.20)	0.309[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with acne who reported high, medium, and low-quality patient-provider communication.

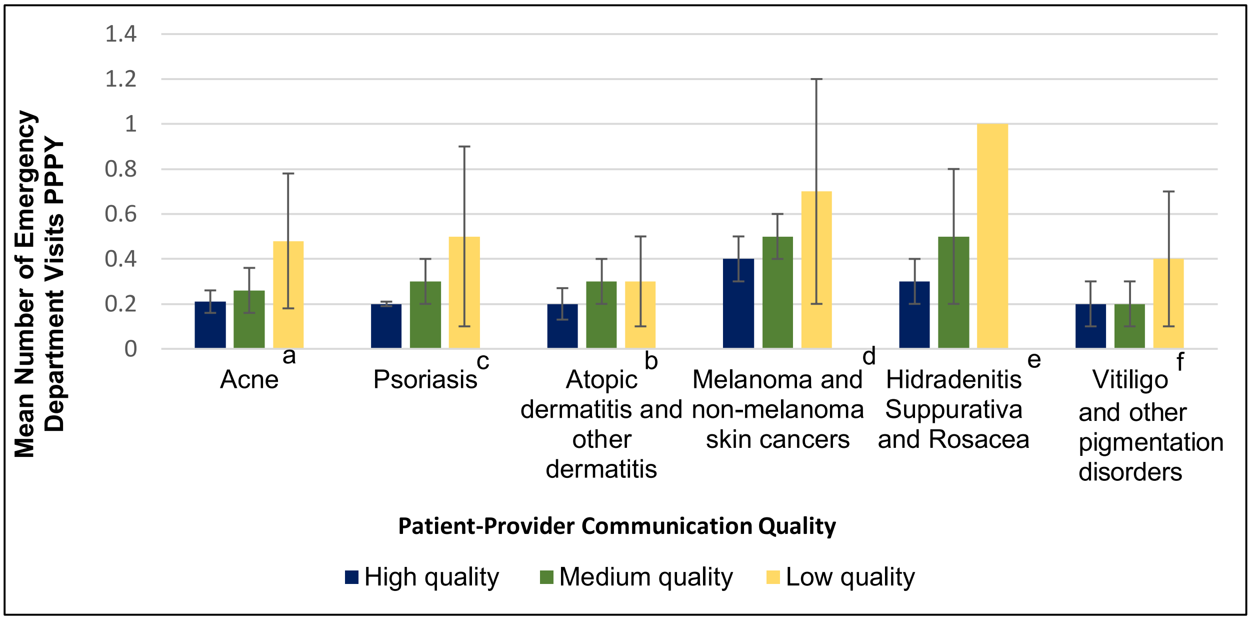
[c] Using the χ^2 test of differences between adult patients with acne who reported high, medium, and low-quality patient-provider communication.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

Acne: Emergency Room Visits

The mean emergency room visit frequency was 0.2 (95% CI, 0.15-0.25 for acne patients who reported high-quality patient-provider communication, 0.3 (95% CI, 0.2-0.4) for acne patients who reported medium-quality patient-provider communication, and 0.5 (95% CI, 0.2-0.8) for acne patients who reported low-quality patient-provider communication ($P<0.0001$) (Figure 7).

Figure 7. Mean number of emergency room visits per person per year among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders by the quality of patient-provider communication from the Medical Expenditure Panel Survey.



Patient-provider communication quality as measured by the patient-provider communication composite score. The vertical lines indicate 95% CIs. PPPY, per person per year

[a] P<0.0001; [b] P=0.001; [c] P=0.004; [d] P=0.173; [e] P=0.07; [f] P=0.01

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients who reported high-quality patient-provider communication, acne patients who reported low-quality patient-provider communication had an emergency room visit frequency increment of 0.2 (adjusted *B* coefficient, 0.2 [95% CI, 0.1-0.4]; P=0.008). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients who reported high-quality patient-provider communication, acne patients who reported low-quality patient-provider communication were 2.0 times more likely to have at least two emergency room visits (AOR, 2.0 [95% CI, 1.3-3.0]; P=0.001) (Table 30).

Table 30. Association between the quality of patient-provider communication and emergency room visit frequency among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorder patients from the Medical Expenditure Panel Survey.

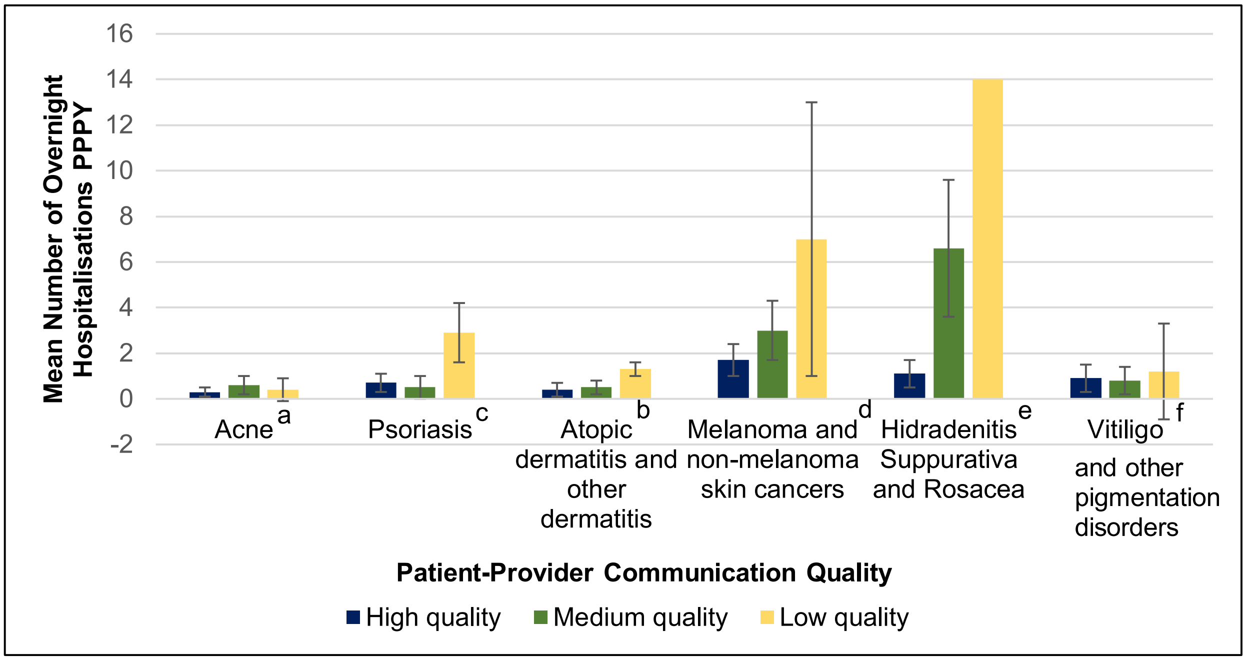
Independent Variables*	**ER Visits**			
	Dependent Variable: ER Visits			
	Adjusted *B* Coef. (95% CI)	***P* value**	**AOR (95% CI)**	***P* value**
Patient-Provider Communication Quality: Acne				
High	1[Ref]		1[Ref]	
Medium	0.02 (-0.04, 0.08)	0.47	1.2 (0.9-1.5)	0.28
Low	0.21 (0.06-0.37)	0.008	2.0 (1.3-3.0)	0.001
Patient-Provider Communication Quality: Psoriasis				
High	1[Ref]		1[Ref]	
Medium	0.08 (0.03-0.2)	0.15	1.6 (0.10- 2.54)	0.05
Low	0.3 (-0.04-0.6)	0.08	3.0 (1.2-7.7)	0.03
Patient-Provider Communication Quality: Atopic dermatitis and other dermatitis conditions				
High	1[Ref]		1[Ref]	
Medium	0.04 (-0.01, 0.1)	0.08	1.3 (1.02-1.7)	0.03
Low	0.1 (-0.1, 0.2)	0.350	1.3 (0.7-2.1)	0.400
Patient-Provider Communication Quality: Skin Cancers (Melanoma and Non-Melanoma)				
High	1[Ref]		1[Ref]	
Medium	0.1 (-0.04, 0.2)	0.19	1.4 (0.9-2.1)	0.09
Low	0.4 (0.2-0.6)	<0.001	3.4 (1.6-7.2)	0.002
Patient-Provider Communication Quality: Hidradenitis suppurativa and Rosacea				
High	1[Ref]		1[Ref]	
Medium	0.1 (-0.1-0.4)	0.21	1.6 (0.9-2.9)	0.08
Low	1.0 (0.8-1.1)	<0.001	4.8 (2.5-9.3)	0.002
Patient-Provider Communication Quality: Vitiligo and other pigmentation disorders				
High	1[Ref]		1[Ref]	
Medium	-0.02 (-0.06, 0.03)	0.44	0.9 (0.7-1.1)	0.37
Low	0.08 (-0.07, 0.2)	0.29	1.4 (0.8-2.5)	0.21

AOR, adjusted odds ratio; CI, confidence interval; ER, emergency room; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, poverty level category, insurance status, cognitive limitations, social limitations, and Charlson comorbidity index. *Only patient-provider communication quality data shown.

Acne: Overnight Hospitalisations

The mean overnight hospitalisation frequency was 0.3 (95% CI, 0.1-0.5 for acne patients who reported high-quality patient-provider communication, 0.6 (95% CI, 0.2-1.0) for acne patients who reported medium-quality patient-provider communication, and 0.4 (95% CI, -0.1, 0.9) for acne patients who reported low-quality patient-provider communication (P=0.102) (Figure 8).

Figure 8. Mean number of overnight hospitalizations per person per year among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders by the quality of patient-provider communication from the Medical Expenditure Panel Survey.



Patient-provider communication quality as measured by the patient-provider communication composite score. The vertical lines indicate 95% CIs. PPPY, per person per year

^{a} P=0.102; ^{b} P=0.008; ^{c} P=0.07; ^{d} P=0.0003; ^{e} P<0.0001; ^{f} P=0.369

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients who reported high-quality patient-provider communication, acne patients who reported medium-quality patient-provider communication had an overnight hospitalisation frequency increment of 0.3 (adjusted *B* coefficient, 0.3 [95% CI, 0.04-0.5]; P=0.02) (Table 31).

Table 31. Association between the quality of patient-provider communication and overnight hospitalisations among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders from the Medical Expenditure Panel Survey.

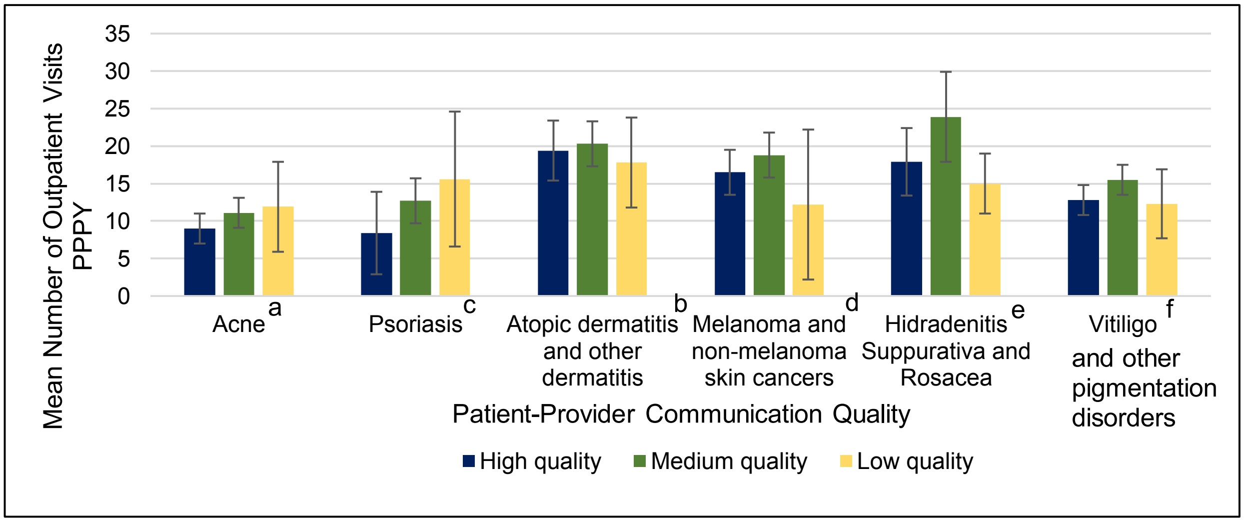
Independent Variables*	**Overnight Hospitalisations**			
	Dependent Variable: Overnight Hospitalisations			
	Adjusted *B* Coef. (95% CI)	***P* value**	**AOR (95% CI)**	***P* value**
Patient-Provider Communication Quality: Acne				
High	1[Ref]		1[Ref]	
Medium	0.3 (0.04-0.5)	0.02	1.2 (0.8-1.7)	0.37
Low	0.08 (-0.3, 0.4)	0.65	0.9 (0.5-1.5)	0.64
Patient-Provider Communication Quality: Psoriasis				
High	1[Ref]		1[Ref]	
Medium	0.1 (-0.3, -0.5)	0.59	0.9 (0.5-1.5)	0.59
Low	1.2 (0.3-2.1)	0.01	6.2 (2.1-17.8)	0.001
Patient-Provider Communication Quality: Atopic dermatitis and other dermatitis conditions				
High	1[Ref]		1[Ref]	
Medium	0.09 (-0.1, 0.3)	0.41	1.2 (0.8-1.7)	0.39
Low	-0.09 (-0.4-0.2)	0.56	1.1 (0.5-2.4)	0.85
Patient-Provider Communication Quality: Skin Cancers (Melanoma and Non-Melanoma)				
High	1[Ref]		1[Ref]	
Medium	1.3 (0.5-2.1)	0.002	1.4 (0.9-2.3)	0.14
Low	5.6 (2.8-8.5)	<0.001	3.4 (1.4-8.4)	0.007
Patient-Provider Communication Quality: Hidradenitis suppurativa and Rosacea				
High	1[Ref]		1[Ref]	
Medium	6.5 (4.6-8.3)	<0.001	4.4 (2.6-7.6)	0.001
Low	14.0 (12.5-15.5)	<0.001	17.9 (8.7-36.8)	<0.001
Patient-Provider Communication Quality: Vitiligo and other pigmentation disorders				
High	1[Ref]		1[Ref]	
Medium	-0.09 (-0.5, 0.3)	0.67	1.0 (0.8-1.3)	0.99
Low	0.3 (-0.8, 1.4)	0.62	1.3 (0.7-2.4)	0.40

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, poverty level category, insurance status, cognitive limitations, social limitations, and Charlson comorbidity index. *Only patient-provider communication quality data shown.

Acne: Outpatient Visits

The mean outpatient visit frequency was 9.0 (95% CI, 7.0-11.0) for acne patients who reported high-quality patient-provider communication, 11.1 (95% CI, 9.1-13.1) for acne patients who reported medium-quality patient-provider communication, and 11.9 (95% CI, 5.9-17.9) for acne patients who reported low-quality patient-provider communication (P=0.011) (Figure 9).

Figure 9. Mean number of outpatient visits per person per year among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders by the quality of patient-provider communication from the Medical Expenditure Panel Survey.



Patient-provider communication quality as measured by the patient-provider communication composite score. The vertical lines indicate 95% CIs. PPPY, per person per year

[a] P=0.011; [b] P=0.537; [c] P<0.001; [d] P=0.07; [e] P=0.149; [f] P=0.0003

Table 32. Association between the quality of patient-provider communication and outpatient visits among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders from the Medical Expenditure Panel Survey.

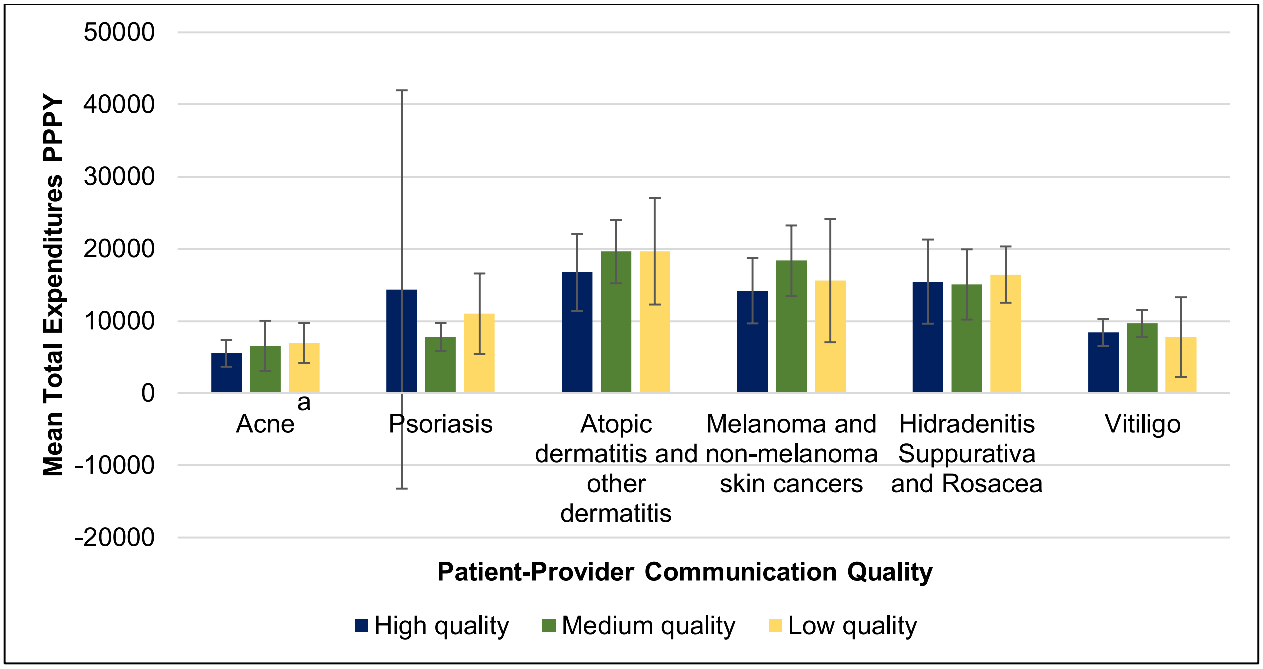
Independent Variables*	**Outpatient Visits**			
	Dependent Variable: Outpatient Visits			
	Adjusted *B* Coef. (95% CI)	***P* value**	**AOR (95% CI)**	***P* value**
Patient-Provider Communication Quality: Acne				
High	1[Ref]		1[Ref]	
Medium	0.5 (-0.9, 2.0)	0.46	1.7 (0.7-3.9)	0.23
Low	2.0 (-1.0, 5.1)	0.19	0.3 (0.1-1.1)	0.06
Patient-Provider Communication Quality: Psoriasis				
High	1[Ref]		1[Ref]	
Medium	-1.6 (-4.8, 1.6)	0.32	2.9 (1.2-6.8)	0.02
Low	-7.8 (-14.2, -1.41)	0.02	1.4 (0.4-5.1)	0.64
Patient-Provider Communication Quality: Atopic dermatitis and other dermatitis conditions				
High	1[Ref]		1[Ref]	
Medium	-0.9 (-3.8, 1.9)	0.53	10.3 (1.9-56.6)	0.009
Low	-6.3 (-11.1, -1.4)	0.01	--	--
Patient-Provider Communication Quality: Skin Cancers (Melanoma and Non-Melanoma)				
High	1[Ref]		1[Ref]	
Medium	1.4 (-1.4, 4.3)	0.32	--	--
Low	-7.6 (-11.1, -4.2)	<0.001	--	--
Patient-Provider Communication Quality: Hidradenitis suppurativa and Rosacea				
High	1[Ref]		1[Ref]	
Medium	2.0 (-0.7, 4.7)	0.14	--	--
Low	6.7 (-3.3,16.7)	0.181	--	--
Patient-Provider Communication Quality: Vitiligo and other pigmentation disorders				
High	1[Ref]		1[Ref]	
Medium	1.3 (-0.1, 2.7)	0.06	0.5 (0.2-1.2)	0.14
Low	-0.5 (-3.0, 1.9)	0.67	0.6 (0.1-2.8)	0.50

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, poverty level category, insurance status, cognitive limitations, social limitations, and Charlson comorbidity index. *Only patient-provider communication quality data shown.

Acne: Total Expenditure

The mean total expenditure was \$5,534 (95% CI, \$3,674-\$7,395) for acne patients who reported high-quality patient-provider communication, \$6,553 (95% CI, \$3,062-\$10,044) for acne patients who reported medium-quality patient-provider communication, and \$6,984 (95% CI, \$4,208-\$9,759) for acne patients who reported low-quality patient-provider communication (P=0.580) (Figure 10).

Figure 10. Mean total expenditure per person per year among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders by the quality of patient-provider communication from the Medical Expenditure Panel Survey.



Patient-provider communication quality as measured by the patient-provider communication composite score. The vertical lines indicate 95% CIs. PPPY=per person per year

^{a} P=0.580; ^{b} P=0.165; ^{c} P=0.132; ^{d} P<0.001; ^{e} P=0.797; ^{f} P=0.355

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with acne patients who reported high-quality patient-provider communication, acne patients who reported medium and low-quality patient-provider communication had a non-significant total expenditure decrement of $691 (P=0.33) and $1,450 (P=0.05), respectively (Table 33).

Table 33. Association between the quality of patient-provider communication and total expenditure among adults with acne, psoriasis, atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders from the Medical Expenditure Panel Survey.

Independent Variables*	**Total Expenditure**	
	Dependent Variable: Total Expenditure	
	Adjusted *B* Coef. (95% CI)	***P* value**
Patient-Provider Communication Quality: Acne		
Mean Total Expenditure: $6,565 (95% CI, $5,993-$7,138)		
High	1[Ref]	
Medium	-691 (-2082, 701)	0.33
Low	-1450 (-3001, 1.5)	0.05
Patient-Provider Communication Quality: Psoriasis		
Mean Total Expenditure: $10,680 (95% CI, $9,667-$11,692)		
High	1[Ref]	
Medium	-3090 (-6280, 95.5)	0.06
Low	7102 (-7639, 21847)	0.34
Patient-Provider Communication Quality: Atopic dermatitis and other dermatitis conditions		
Mean Total Expenditure: $20,070 (95% CI, $18,503-$21,634)		
High	1[Ref]	
Medium	1541 (-2158, 5241)	0.41
Low	9160 (585-17735)	0.04
Patient-Provider Communication Quality: Skin Cancers (Melanoma and Non-Melanoma)		
Mean Total Expenditure: $16,988 (95% CI, $15,668-$18,307)		
High	1[Ref]	
Medium	1681 (-1561, 4923)	0.31
Low	1638 (-2721, 5996)	0.46
Patient-Provider Communication Quality: Hidradenitis suppurativa and Rosacea		
Mean Total Expenditure: $17,489 (95% CI, $14,887-$20,090)		
High	1[Ref]	
Medium	77 (-4206, 4360)	0.97
Low	-10276 (-33056, 12504)	0.36
Patient-Provider Communication Quality: Vitiligo and other pigmentation disorders		
Mean Total Expenditure: $10,538 (95% CI, $9,542-$11,535)		
High	1[Ref]	
Medium	277 (-1139, 1694)	0.70
Low	-547 (-3421, 2327)	0.71

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, poverty level category, insurance status, cognitive limitations, social limitations, and Charlson comorbidity index. *Only patient-provider communication quality data shown.

Atopic dermatitis and other dermatitis: Study population characteristics

A weighted total of 30,468,129 US adults with atopic dermatitis and other dermatitis (unweighted, 2,881 US adults with atopic dermatitis and other dermatitis) who reported patient-provider communication quality during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 48.4 (0.41) years and females constituted 62% of the population. The mean number of emergency room visits was 0.24 (95% CI, 0.22-0.27). The mean number of overnight hospitalisation visits was 0.43 (95% CI, 0.33-0.53). The mean number of outpatient visits was 21.0 (95% CI, 19.1-22.0). The mean total expenditure per person per year was $20,070 (95% CI, $18,503-$21,634).

Regarding healthcare resource utilisation, 39% of atopic dermatitis and other dermatitis patients reported high-quality patient-provider communication, 56% reported medium-quality patient-provider communication, and 5% reported low-quality patient-provider communication (Table 34).

Table 34. Sociodemographic and clinical characteristics of US adult patients with atopic dermatitis and other dermatitis by patient-provider communication quality from the Medical Expenditure Panel Survey

Characteristic	**Patient-Provider Communication Quality**[a]			***P* value**
	High-Quality (Weighted no.= 11,996,212)	**Medium-Quality** (Weighted no.= 16,901,855)	**Low-Quality** (Weighted no.= 1,570,062)	
Age, mean (SEM) years	48.6 (0.61)	48.6 (0.47)	43.3 (0.65)	<0.0001[b]
Gender, female no. (%)	7,378,801 (62%)	10,596,607 (63%)	909,758 (58%)	0.612[c]
Unemployed, no (%)	3,673,482 (31%)	4,925,921 (29%)	422,317 (27%)	0.630[c]
Race, no. (%)				
White	9,804,739 (82%)	14,121,341 (84%)	1,316,509 (84%)	0.767[c]
Black	1,293,799 (11%)	1,655,332 (10%)	164,814 (10%)	
Asian, Native Hawaiian or Pacific Islander	672,478 (6%)	892,487 (5%)	86,181 (5%)	
American Indian or Alaskan Native	128,131 (1%)	150,651 (0.9%)	2,559 (0.2%)	
Multiple races reported	97,064 (0.8%)	82,044 (0.5%)	0 (0%)	
Ethnicity, Hispanic no. (%)	614,436 (5%)	1,241,866 (7%)	138,007 (9%)	0.014[c]
Marital Status, no (%)				
Married	7,357,441 (61%)	9,982,063 (59%)	754,643 (48%)	0.008[c]
Widowed	769,599 (6%)	852,318 (5%)	87,736 (6%)	
Divorced	1,489,684 (12%)	2,158,287 (13%)	162,384 (10%)	
Separated	161,315 (1%)	254,266 (2%)	6,372 (0.4%)	
Never Married	2,218,173 (18%)	3,654,921 (22%)	558,927 (36%)	
Cognitive Limitations, no. (%)	127,747 (1%)	706,912 (4%)	511,009 (33%)	0.062[c]
Social Limitations, no. (%)	138,702 (1%)	1,114,285 (7%)	622,524 (40%)	0.245[c]
Education Level, no (%)				
Pre-High School	975,481 (8%)	1,472,027 (9%)	76,671 (5%)	0.129[c]
High School	3,738,261 (31%)	4,632,471 (27%)	413,286 (26%)	
≥ 1 year College	7,282,470 (61%)	10,797,358 (64%)	1,080,105 (69%)	
Poverty Level Category, no (%)				
Poor	752,348 (6%)	1,315,158 (8%)	229,527 (15%)	0.005[c]
Near Poor	344,139 (3%)	574,227 (3%)	32,524 (2%)	
Low Income	1,185,758 (10%)	1,398,515 (8%)	139,604 (9%)	
Middle Income	3,054,667 (25%)	5,131,425 (30%)	510,537 (33%)	
High Income	6,659,301 (56%)	8,482,529 (50%)	657,870 (42%)	
Insurance, no. (%)				
Private	9,857,094 (82%)	13,365,799 (79%)	1,118,390 (71%)	0.004[c]
Public	1,672,023 (14%)	2,475,671 (15%)	278,355 (18%)	
Uninsured	467,095 (4%)	1,060,386 (6%)	173,316 (11%)	
Provider and Patient do not Speak Same Language, no (%)	137,956 (1%)	277,331 (2%)	22,959 (1%)	0.722[c]
CCI, mean (95% CI)	0.09 (0.03-0.15)	0.13 (0.11-0.16)	0.14 (0.11-0.16)	0.524[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with atopic dermatitis and other dermatitis who reported high, medium, and low-quality patient-provider communication.

[c] Using the χ^2 test of differences between adult patients with atopic dermatitis and other dermatitis who reported high, medium, and low-quality patient-provider communication.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

Atopic Dermatitis and Other Dermatitis: Emergency Room Visits

The mean emergency room visit frequency was 0.2 (95% CI, 0.13-0.27 for atopic dermatitis and other dermatitis patients who reported high-quality patient-provider communication, 0.3 (95% CI, 0.2-0.4) for atopic dermatitis and other dermatitis patients who reported medium-quality patient-provider communication, and 0.3 (95% CI, 0.1-0.5) for atopic dermatitis and other dermatitis patients who reported low-quality patient-provider communication (P=0.001) (Figure 7).

Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients who reported high-quality patient-provider communication, atopic dermatitis and other dermatitis patients who reported medium-quality patient-provider communication were

1.3 times more likely to have at least two emergency room visits (AOR, 1.3 [95% CI, 1.02-1.7]; P=0.03) (Table 30).

Atopic Dermatitis and Other Dermatitis: Overnight Hospitalisations

The mean overnight hospitalisation frequency was 0.4 (95% CI, 0.1-0.7) for atopic dermatitis and other dermatitis patients who reported high-quality patient-provider communication, 0.5 (95% CI, 0.2-0.8) for atopic dermatitis and other dermatitis patients who reported medium-quality patient-provider communication, and 1.3 (95% CI, 1.0-1.6) for atopic dermatitis and other dermatitis patients who reported low-quality patient-provider communication (P=0.008) (Figure 8).

Atopic Dermatitis and Other Dermatitis: Outpatient Visits

The mean outpatient visit frequency was 19.4 (95% CI, 15.4-23.4 for atopic dermatitis and other dermatitis patients who reported high-quality patient-provider communication, 20.3 (95% CI, 17.3-23.3) for atopic dermatitis and other dermatitis patients who reported medium-quality patient-provider communication, and 17.8 (95% CI, 11.8-23.8) for atopic dermatitis and other dermatitis patients who reported low-quality patient-provider communication (P=0.537) (Figure 9).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients who reported high-quality patient-provider communication, atopic dermatitis and other dermatitis patients who reported medium and low-quality patient-provider communication had an outpatient visit frequency decrement of 6.3 (adjusted *B* coefficient, -6.3 [95% CI, -11.1, -1.4]; P=0.01). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients who reported high-quality patient-provider communication, atopic dermatitis and other dermatitis patients who reported medium-quality patient-provider communication were 10 times more likely to have at least two outpatient visits (AOR, 10.3 [95% CI, 1.9-56.6]; P< 0.001) (Table 32).

Atopic Dermatitis and Other Dermatitis: Total Expenditure

The mean total expenditure was $16,746 (95% CI, $11,397-$22,095 for atopic dermatitis and other dermatitis patients who reported high-quality patient-provider communication, $19,624 (95% CI, $15,227-$24,021) for atopic dermatitis and other dermatitis patients who reported medium-quality patient-provider communication, and $19,668 (95% CI, $12,286 -$27,051) for atopic dermatitis and other dermatitis patients who reported low-quality patient-provider communication (P=0.165) (Figure 10).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with atopic dermatitis and other dermatitis patients who reported high-quality patient-provider communication, atopic dermatitis and other dermatitis patients who reported medium and low-quality patient-provider communication had a total expenditure increment of $1,541 (P=0.41) and $9,160 (P=0.04), respectively (Table 33).

Psoriasis: Study Population Characteristics

A weighted total of 10,013,506 US adults with psoriasis (unweighted, 750 US adults with psoriasis) who reported patient-provider communication quality during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 52.9 (0.60) years and females constituted 55% of the population. The mean number of emergency room visits was 0.25 (95% CI, 0.21-0.30). The mean number of overnight hospitalisation visits was 0.56 (95% CI, 0.39-0.74). The mean number of outpatient visits was 13.6 (95% CI, 12.6-14.7). The mean total expenditure per person per year was $10,680 (95% CI, $9,667-$11,692).

Regarding healthcare resource utilisation, 39% of psoriasis patients reported high-quality patient-provider communication, 57% reported medium-quality patient-provider communication, and 4% reported low-quality patient-provider communication (Table 35).

Table 35. Sociodemographic and clinical characteristics of US adult patients with psoriasis by patient-provider communication quality from the Medical Expenditure Panel Survey

Characteristic	**Patient-Provider Communication Quality[a]**			***P* value**
	High-Quality (Weighted no.= 3,911,550**)**	**Medium-Quality (Weighted no.=** 5,673,170**)**	**Low-Quality (Weighted no.=** 428,786**)**	
Age, mean (SEM) years	53.52 (0.935)	53.07 (0.771)	44.97 (1.431)	0.001[b]
Gender, female, no. (%)	2,002,220 (51%)	3,190,381 (56%)	273,175 (64%)	0.140[c]
Unemployed, no (%)	1,506,461 (39%)	2,057,398 (36%)	121,101 (28%)	0.389[c]
Race, no. (%)				
White	3,404,316 (87%)	4,945,516 (87%)	405,650 (95%)	0.007[c]
Black	332,327 (8%)	433,628 (8%)	4,785 (1%)	
Asian, Native Hawaiian or Pacific Islander	83,691 (2%)	241,886 (4%)	5,099 (1%)	
American Indian or Alaskan Native	65,526 (2%)	14,240 (0%)	0 (0%)	
Multiple races reported	25,691 (1%)	37,900 (1%)	13,252 (3%)	
Ethnicity, Hispanic, no. (%)	286,613 (7%)	393,078 (7%)	57,380 (13%)	0.140[c]
Marital Status, no. (%)				
Married	2,578,108 (66%)	3,532,101 (62%)	229,562 (54%)	0.212[c]
Widowed	369,646 (9%)	460,007 (8%)	28,293 (7%)	
Divorced	359,026 (9%)	635,660 (11%)	72,791 (17%)	
Separated	42,018 (1%)	29,644 (1%)	6,036 (1%)	
Never Married	562,752 (14%)	1,015,758 (18%)	92,104 (21%)	
Cognitive Limitations, no. (%)	161,603 (4%)	382,528 (7%)	64,954 (15%)	0.018[c]
Social Limitations, no. (%)	260,949 (7%)	438,651 (8%)	38,612 (9%)	0.682[c]
Education Level				
Pre-High School	644,260 (16%)	423,853 (7%)	15,472 (4%)	<0.001[c]
High School	1,157,842 (30%)	1,649,967 (29%)	141,925 (33%)	
≥ 1 year College	2,109,448 (54%)	3,599,350 (63%)	271,388 (63%)	
Poverty Level Category, no (%)				
Poor	285,337 (7%)	334,758 (6%)	67,352 (16%)	0.073[c]
Near Poor	84,300 (2%)	113,032 (2%)	11,483 (3%)	
Low Income	307,178 (8%)	521,635 (9%)	69,576 (16%)	
Middle Income	999,301 (26%)	1,351,314 (24%)	78,579 (18%)	
High Income	2,235,435 (57%)	3,352,431 (59%)	201,797 (47%)	
Insurance Coverage, no. (%)				
Private	3,051,652 (78%)	4,653,166 (82%)	292,184 (68%)	0.149[c]
Public	665,190 (17%)	784,147 (14%)	101,718 (24%)	
Uninsured	194,708 (5%)	235,857 (4%)	34,883 (8%)	
Provider and Patient do not Speak Same Language, no (%)	56,586 (1%)	37,852 (1%)	0 (0%)	0.108[c]
CCI, mean (95% CI)	0.929 (0.867-0.992)	0.916 (0.845-0.987)	0.873 (0.692-1.055)	0.925[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with psoriasis who reported high, medium, and low-quality patient-provider communication.

[c] Using the χ^2 test of differences between adult patients with psoriasis who reported high, medium, and low-quality patient-provider communication.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

Psoriasis: Emergency Room Visits

The mean emergency room visit frequency was 0.2 (95% CI, 0.19-0.21 for psoriasis patients who reported high-quality patient-provider communication, 0.3 (95% CI, 0.2-0.4) for psoriasis patients who reported medium-quality patient-provider communication, and 0.5 (95% CI, 0.1-0.9) for psoriasis patients who reported low-quality patient-provider communication (P=0.004) (Figure 7).

Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients who reported high-quality patient-provider communication, psoriasis patients who reported low-quality patient-provider communication were 3.0 times more likely to have at least two emergency room visits (AOR, 3.0 [95% CI, 1.2-7.7]; P=0.03) (Table 30).

Psoriasis: Overnight Hospitalisations

The mean overnight hospitalisation frequency was 0.7 (95% CI, 0.3-1.1) for psoriasis patients who reported high-quality patient-provider communication, 0.5 (95% CI, 0.0-1.0) for psoriasis patients who reported medium-quality patient-provider communication, and 2.9 (95% CI, 1.6-4.2) for psoriasis patients who reported low-quality patient-provider communication (P=0.07) (Figure 8).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients who reported high-quality patient-provider communication, psoriasis patients who reported low-quality patient-provider communication had an overnight hospitalisation frequency increment of 1.2 (adjusted *B* coefficient, 1.2 [95% CI, 0.3-2.1]; P=0.01). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients who reported high-quality patient-provider communication, psoriasis patients who reported low-quality patient-provider communication were 6.2 times more likely to have at least two overnight hospitalisations (AOR, 6.2 [95% CI, 2.1-17.8]; P=0.001) (Table 31).

Psoriasis: Outpatient Visits

The mean outpatient visit frequency was 8.4 (95% CI, 2.9-13.9 for psoriasis patients who reported high-quality patient-provider communication, 12.7 (95% CI, 9.7-15.7) for psoriasis patients who reported medium-quality patient-provider communication, and 15.6 (95% CI, 6.6-24.6) for psoriasis patients who reported low-quality patient-provider communication (P<0.001) (Figure 9).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients who reported high-quality patient-provider communication, psoriasis patients who reported low-quality patient-provider communication had an outpatient visit frequency decrement of 7.8 (adjusted *B* coefficient, 7.8 [95% CI, -14.2, -1.4; P=0.02). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients who reported high-quality patient-provider communication, psoriasis patients who reported medium-quality patient-provider communication were 2.9 times more likely to have at least two outpatient visits (AOR, 2.9 [95% CI, 1.2-6.8]; P=0.02) (Table 32).

Psoriasis: Total Expenditure

The mean total expenditure was $14,375 (95% CI, $-13,221-$41,972 for psoriasis patients who reported high-quality patient-provider communication, $7,791 (95% CI, $5,839-$9,743) for psoriasis patients who reported medium-quality patient-provider communication, and $11,004 (95% CI, $5,417-$26,590) for psoriasis patients who reported low-quality patient-provider communication (P=0.132) (Figure 10).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with psoriasis patients who reported high-quality patient-provider communication, psoriasis patients who reported medium-quality had a non-significant total expenditure decrement of $3,090 (P=0.06) and low-quality patient-provider communication had a non-significant total expenditure increment of $7,102 (P=0.34) (Table 33).

Melanoma and Non-Melanoma Skin Cancers: Study Population Characteristics

A weighted total of 5,102,003 US adults with melanoma and non-melanoma skin cancers (unweighted, 464 US adults with melanoma and non-melanoma skin cancers) who reported patient-provider communication quality during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was

67.9 (0.65) years and females constituted 51% of the population. The mean number of emergency room visits was 0.43 (95% CI, 0.37-0.49). The mean number of overnight hospitalisation visits was 2.7 (95% CI, 2.3-3.1). The mean number of outpatient visits was 19.1 (95% CI, 18.2-20.0). The mean total expenditure per person per year was $16,988 (95% CI, $15,668-$18,307).

Regarding healthcare resource utilisation, 36% of melanoma and non-melanoma skin cancer patients reported high-quality patient-provider communication, 61% reported medium-quality patient-provider communication, and 3% reported low-quality patient-provider communication (Table 36).

Table 36. Sociodemographic and clinical characteristics of US adult patients with melanoma and non-melanoma skin cancers by patient-provider communication quality from the Medical Expenditure Panel Survey

Characteristic	Patient-Provider Communication Quality[a]			*P* value
	High-Quality (Weighted no.= 1,813,820)	**Medium-Quality** (Weighted no.= 3,115,796)	**Low-Quality** (Weighted no.= 172,387)	
Age, mean (SEM) years	68.5 (0.57)	68.1 (0.69)	59.2 (2.30)	0.103[b]
Gender, female, no. (%)	781,497 (43%)	1,718,772 (55%)	78,650 (46%)	0.029[c]
Unemployed, no (%)	1,185,454 (65%)	2,233,087 (72%)	75,142 (44%)	0.004[c]
Race, no. (%)				
White	1,643,886 (91%)	2,872,472 (92%)	160,835 (93%)	0.154[c]
Black	86,842 (5%)	190,477 (6%)	5,253 (3%)	
Asian, Native Hawaiian or Pacific Islander	69,171 (4%)	37,781 (1%)	6,298 (4%)	
American Indian or Alaskan Native	13,921 (0.8%)	15,066 (0.5%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	10,779 (0.6%)	93,733 (3%)	58,488	0.422[c]
Marital Status, no (%)				
Married	1,079,126 (59%)	1,896,738 (61%)	86,956 (50%)	0.018[c]
Widowed	388,947 (21%)	545,496 (18%)	24,237 (14%)	
Divorced	231,748 (13%)	350,180 (11%)	15,420 (9%)	
Separated	1,912 (0.1%)	87,991 (3%)	3,855 (2%)	
Never Married	112,088 (6%)	235,391 (8%)	41,919 (24%)	
Cognitive Limitations, no. (%)	237,997 (13%)	410,323 (13%)	34,520 (20%)	0.621[c]
Social Limitations, no. (%)	249,899 (14%)	619,951 (20%)	22,076 (13%)	0.086[c]
Education Level, no (%)				
Pre-High School	241,382 (13%)	430,698 (14%)	18,800 (11%)	0.941[c]
High School	652,641 (36%)	1,195,365 (38%)	61,239 (36%)	
≥ 1 year College	919,798 (51%)	1,489,732 (48%)	92,347 (54%)	
Poverty Level Category, no (%)				
Poor	159,623 (9%)	228,527 (7%)	54,759 (32%)	0.002[c]
Near Poor	43,778 (2%)	171,731 (6%)	4,269 (2%)	
Low Income	352,080 (19%)	562,756 (18%)	0 (0%)	
Middle Income	388,816 (21%)	865,413 (28%)	46,460 (27%)	
High Income	869,524 (48%)	1,287,369 (41%)	66,899 (39%)	
Insurance, no. (%)				
Private	1,072,066 (59%)	2,095,876 (67%)	114,786 (67%)	0.060[c]
Public	682,519 (38%)	872,537 (28%)	57,601 (33%)	
Uninsured	59,236 (2%)	147,383 (5%)	0 (0%)	
Provider and Patient do not Speak Same Language, no (%)	16,330 (0.9%)	20,921 (0.7%)	0 (0%)	0.504[c]
CCI, mean (95% CI)	1.45 (1.36-1.53)	1.40 (1.33-1.47)	1.30 (1.17-1.44)	0.536[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with melanoma and non-melanoma skin cancers who reported high, medium, and low-quality patient-provider communication.

[c] Using the χ^2 test of differences between adult patients with melanoma and non-melanoma skin cancers who reported high, medium, and low-quality patient-provider communication.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

Melanoma and Non-Melanoma Skin Cancers: Emergency Room Visits

The mean emergency room visit frequency was 0.4 (95% CI, 0.3-0.5) for melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, 0.5 (95% CI, 0.4-0.6) for melanoma and non-melanoma skin cancer patients who reported medium-quality patient-provider communication, and 0.7 (95% CI, 0.2-1.2) for melanoma and non-melanoma skin cancer patients who reported low-quality patient-provider communication (P=0.173) (Figure 7).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, melanoma and non-melanoma skin cancer patients who reported low-quality patient-provider communication had an emergency room visit frequency increment of 0.4 (adjusted *B* coefficient, 0.4 [95% CI, 0.2-0.6; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, melanoma and non-melanoma skin cancer patients who reported low-quality patient-provider communication were 3.4 times more likely to have at least two emergency room visits (AOR, 3.4 [95% CI, 1.6-7.2]; P=0.002) (Table 30).

Melanoma and Non-Melanoma Skin Cancers: Overnight Hospitalisations

The mean overnight hospitalisation frequency was 1.7 (95% CI, 1.0-2.4 for melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, 3.0 (95% CI, 1.7-4.3) for melanoma and non-melanoma skin cancer patients who reported medium-quality patient-provider communication, and 7.0 (95% CI, 1.0-13.0) for melanoma and non-melanoma skin cancer patients who reported low-quality patient-provider communication (P=0.0003) (Figure 8).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, melanoma and non-melanoma skin cancer patients who reported medium and low-quality patient-provider communication had an overnight hospitalisation frequency increment of 1.3 and 5.6, respectively (adjusted *B* coefficient, 1.3 [95% CI, 0.5-2.1; P=0.002 and 5.6 [2.8-8.5]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, melanoma and non-melanoma skin cancer patients who reported medium and low-quality patient-provider communication were 3.4 times more likely to have at least two overnight hospitalisations (AOR, 3.4 [95% CI, 1.4-8.4]; P=0.007) (Table 31).

Melanoma and Non-Melanoma Skin Cancers: Outpatient Visits

The mean outpatient visit frequency was 16.5 (95% CI, 13.5-19.5) for melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, 18.8 (95% CI, 15.8-21.8) for melanoma and non-melanoma skin cancer patients who reported medium-quality patient-provider communication, and 12.2 (95% CI, 2.2-22.2) for melanoma and non-melanoma skin cancer patients who reported low-quality patient-provider communication (P=0.07) (Figure 9).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, melanoma and non-melanoma skin cancer patients who reported low-quality patient-provider communication had an outpatient visit frequency decrement of 7.6 (adjusted *B* coefficient, -7.6 [95% CI, -11.1, -4.2; P<0.001) (Table 32).

Melanoma and Non-Melanoma Skin Cancers: Total Expenditure

The mean total expenditure was $14,218 (95% CI, $9,669-$18,767 for melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, $18,357 (95% CI, $13,468-$23,246) for melanoma and non-melanoma skin cancer patients who reported medium-quality patient-provider communication, and $15,582 (95% CI, $7,054-$24,109) for melanoma and non-melanoma skin cancer patients who reported low-quality patient-provider communication (P<0.001) (Figure 10).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with melanoma and non-melanoma skin cancer patients who reported high-quality patient-provider communication, melanoma and non-melanoma skin cancer patients who reported medium and low-quality patient-provider communication had a non-significant total expenditure increment of $1,681 (P=0.31) and $1,638 (P=0.46), respectively (Table 33).

Hidradenitis Suppurativa and Rosacea: Study Population Characteristics

A weighted total of 1,369,261 US adults with hidradenitis suppurativa and rosacea (unweighted, 138 US adults with hidradenitis suppurativa and rosacea) who reported patient-provider communication quality during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 71.2 (0.46) years and females constituted 63% of the population. The mean number of emergency room visits was 0.41 (95% CI, 0.31-0.51). The mean number of overnight hospitalisation visits was 4.8 (95% CI, 4.1-5.5). The mean number of outpatient visits was 19.7 (95% CI, 18.0-21.5). The mean total expenditure per person per year was $17,489 (95% CI, $14,887-$20,090).

Regarding healthcare resource utilisation, 37% of hidradenitis suppurativa and rosacea patients reported high-quality patient-provider communication, 60% reported medium-quality patient-provider communication, and 3% reported low-quality patient-provider communication (Table 37).

Table 37. Sociodemographic and clinical characteristics of US adult patients with other adnexal diseases (hidradenitis suppurativa and rosacea) by patient-provider communication quality from the Medical Expenditure Panel Survey

Characteristic	**Patient-Provider Communication Quality**[a]			***P* value**
	High-Quality (Weighted no.= 509,102)	**Medium-Quality** (Weighted no.= 815,142)	**Low-Quality** (Weighted no.= 45,017)	
Age, mean (SEM) years	73.8 (0.24)	69.7 (0.82)	70.2 (--)	0.275[b]
Gender, female, no. (%)	241,316 (47%)	495,460 (61%)	28,194 (63%)	0.027[c]
Unemployed, no (%)	418,027 (82%)	583,704 (72%)	45,017 (100%)	0.0009[c]
Race, no. (%)				
White	431,056 (85%)	636,962 (78%)	45,017 (100%)	0.003[c]
Black	73,312 (14%)	106,718 (13%)	0 (0%)	
Asian, Native Hawaiian or Pacific Islander	0 (0%)	56,397 (7%)	0 (0%)	
American Indian or Alaskan Native	4,735 (0.9%)	15,066 (2%)	0 (0%)	
Multiple races reported	0 (0%)	0 (0%)	0 (0%)	
Ethnicity, Hispanic, no. (%)	24,195 (5%)	22,445 (3%)	0 (0%)	0.013[c]
Marital Status, no (%)				
Married	296,287 (58%)	394,372 (48%)	0 (0%)	0.0007[c]
Widowed	152,593 (30%)	169,311 (21%)	28,194 (63%)	
Divorced	19,113 (4%)	134,283 (16%)	0 (0%)	
Separated	0 (0%)	36,673 (4%)	0 (0%)	
Never Married	41,109 (8%)	80,503 (10%)	16,823 (37%)	
Cognitive Limitations, no. (%)	64,071 (13%)	163,008 (20%)	19,677 (44%)	0.0008[c]
Social Limitations, no. (%)	84,415 (17%)	231,865 (28%)	20,780 (46%)	<0.0001[c]
Education Level, no (%)				
Pre-High School	63,650 (13%)	116,040 (14%)	0 (0%)	<0.0001[c]
High School	178,064 (35%)	224,360 (28%)	41,060 (91%)	
≥ 1 year College	267,388 (53%)	474,742 (58%)	3,957 (9%)	
Poverty Level Category, no (%)				
Poor	30,231 (6%)	103,236 (13%)	16,823 (37%)	0.0012[c]
Near Poor	13,662 (3%)	118,970 (15%)	0 (0%)	
Low Income	155,739 (31%)	127,250 (16%)	0 (0%)	
Middle Income	167,307 (33%)	185,187 (23%)	28,194 (63%)	
High Income	142,162 (28%)	280,499 (34%)	0 (0%)	
Insurance, no. (%)				
Private	293,126 (58%)	451,109 (55%)	28,746 (64%)	0.090[c]
Public	212,575 (42%)	354,506 (43%)	16,271 (36%)	
Uninsured	3,402 (0.7%)	9,527 (1%)	0 (0%)	
Provider and Patient do not Speak Same Language, no (%)	5,542 (1%)	5,138 (0.6%)	0 (0%)	<0.0001[c]
CCI, mean (95% CI)	1.51 (1.42-1.60)	1.52 (1.39-1.65)	1.91 (--)	0.131[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with hidradenitis suppurativa and rosacea who reported high, medium, and low-quality patient-provider communication.

[c] Using the χ^2 test of differences between adult patients with hidradenitis suppurativa and rosacea who reported high, medium, and low-quality patient-provider communication.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

Hidradenitis Suppurativa and Rosacea: Emergency Room Visits

The mean emergency room visit frequency was 0.3 (95% CI, 0.2-0.4) for hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, 0.5 (95% CI, 0.2-0.8) for hidradenitis suppurativa and rosacea patients who reported medium-quality patient-provider communication, and 1.0 (95% CI, --) for hidradenitis suppurativa and rosacea patients who reported low-quality patient-provider communication (P=0.07) (Figure 7).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, hidradenitis suppurativa and rosacea patients who reported low-quality patient-provider communication had an emergency room visit frequency increment of 1.0 (adjusted *B* coefficient, 1.0 [95% CI, 0.8-1.1];

P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, hidradenitis suppurativa and rosacea patients who reported low-quality patient-provider communication were 4.8 times more likely to have at least two emergency room visits (AOR, 4.8 [95% CI, 2.5-9.3]; P=0.002) (Table 30).

Hidradenitis Suppurativa and Rosacea: Overnight Hospitalisations

The mean overnight hospitalisation frequency was 1.1 (95% CI, 0.5-1.7) for hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, 6.6 (95% CI, 3.6-9.6) for hidradenitis suppurativa and rosacea patients who reported medium-quality patient-provider communication, and 14.0 (95% CI, --) for hidradenitis suppurativa and rosacea patients who reported low-quality patient-provider communication (P<0.0001) (Figure 8).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, hidradenitis suppurativa and rosacea patients who reported medium and low-quality patient-provider communication had an overnight hospitalisation frequency increment of 6.5 and 14.0, respectively (adjusted *B* coefficient, 6.5 [95% CI, 4.6-8.3]; P<0.001 and 14.0 [12.5-15.5]; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, hidradenitis suppurativa and rosacea patients who reported medium and low-quality patient-provider communication were 4.4 times and 17.9 times more likely to have at least two overnight hospitalisations (AOR, 4.4 [95% CI, 2.6-7.6]; P=0.001 and 17.9 [8.7-36.8]; P<0.001) (Table 31).

Hidradenitis Suppurativa and Rosacea: Outpatient Visits

The mean outpatient visit frequency was 17.9 (95% CI, 13.4-22.4) for hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, 23.9 (95% CI, 17.9-29.9) for hidradenitis suppurativa and rosacea patients who reported medium-quality patient-provider communication, and 15.0 (95% CI, 11.0-19.0) for hidradenitis suppurativa and rosacea patients who reported low-quality patient-provider communication (P=0.149) (Figure 9).

Hidradenitis Suppurativa and Rosacea: Total Expenditure

The mean total expenditure was $15,467 (95% CI, $9,641-$21,292) for hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, $15,069 (95% CI, $10,204-$19,935) for hidradenitis suppurativa and rosacea patients who reported medium-quality patient-provider communication, and $16,440 (95% CI, $12,544-$20,336) for hidradenitis suppurativa and rosacea patients who reported low-quality patient-provider communication (P=0.797) (Figure 10).

Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with hidradenitis suppurativa and rosacea patients who reported high-quality patient-provider communication, hidradenitis suppurativa and rosacea patients who reported medium-quality patient-provider communication had a non-significant total expenditure increment of $77 (P=0.97) and patients who reported low-quality patient-provider communication had a non-significant total expenditure decrement of $10,276 (P=0.36) (Table 33).

Vitiligo and Other Pigmentation Disorders: Study Population Characteristics

A weighted total of 38,976,794 US adults with vitiligo and other pigmentation disorders (unweighted, 3,656 US adults with vitiligo and other pigmentation disorders) who reported patient-provider communication quality during an 18-year period from the 2000-2017 MEPS database were included in the analysis. The mean (SEM) age was 58.9 (0.41) years and females constituted 59% of the population. The mean number of emergency room visits was 0.24 (95% CI, 0.21-0.26). The mean number of overnight hospitalisation visits was 0.87 (95% CI, 0.65-1.08). The mean number of outpatient visits was 15.4 (95% CI, 14.5-16.2). The mean total expenditure per person per year was $10,538 (95% CI, $9,542-$11,535).

Regarding healthcare resource utilisation, 38% of vitiligo and other pigmentation disorder patients reported high-quality patient-provider communication, 57% reported medium-quality patient-provider communication, and 5% reported low-quality patient-provider communication (Table 38).

Table 38. Sociodemographic and clinical characteristics of US adult patients with vitiligo and other pigmentation disorders by patient-provider communication quality from the Medical Expenditure Panel Survey

Characteristic	Patient-Provider Communication Quality[a]			*P* value
	High-Quality (Weighted no.= 14,812,340)	**Medium-Quality** (Weighted no.= 22,360,541)	**Low-Quality** (Weighted no.= 1,803,913)	
Age, mean (SEM) years	59.6 (0.48)	58.9 (0.55)	53.8 (0.52)	0.0001[b]
Gender, female, no. (%)	8,501,533 (57%)	13,376,458 (60%)	1,236,479 (69%)	0.104[c]
Unemployed, no (%)	6,950,055 (47%)	10,973,360 (49%)	799,632 (44%)	0.470[c]
Race, no. (%)				
White	12,691,328 (86%)	19,524,393 (87%)	1,510,955 (84%)	0.003[c]
Black	1,598,592 (11%)	1,647,215 (7%)	171,764 (10%)	
Asian, Native Hawaiian or Pacific Islander	397,370 (3%)	1,022,117 (5%)	86,526 (5%)	
American Indian or Alaskan Native	95,173 (0.6%)	147,402 (0.7%)	19,219 (1%)	
Multiple races reported	29,877 (0.2%)	19,414 (0.1%)	15,449 (0.9%)	
Ethnicity, Hispanic, no. (%)	910,949 (6%)	1,268,506 (6%)	91,606 (5%)	0.756[c]
Marital Status, no. (%)				
Married	9,208,951 (62%)	13,140,917 (59%)	918,092 (51%)	0.028[c]
Widowed	1,923,462 (13%)	2,504,537 (11%)	278,120 (15%)	
Divorced	1,618,559 (11%)	3,579,757 (16%)	255,543 (14%)	
Separated	212,827 (1%)	184,501 (0.8%)	30,340 (2%)	
Never Married	1,848,540 (12%)	2,950,829 (13%)	321,818 (18%)	
Cognitive Limitations, no. (%)	831,871 (6%)	1,769,986 (8%)	259,489 (14%)	0.018[c]
Social Limitations, no. (%)	1,106,476 (7%)	2,339,507 (10%)	149,594 (8%)	0.073[c]
Education Level, no. (%)				
Pre-High School	1,894,301 (13%)	2,450,176 (11%)	166,790 (9%)	0.481[c]
High School	4,760,400 (32%)	7,423,581 (33%)	712,073 (39%)	
≥ 1 year College	8,157,639 (55%)	12,486,784 (56%)	925,050 (51%)	
Poverty Level Category, no (%)				
Poor	1,171,502 (8%)	1,556,021 (7%)	167,016 (9%)	0.159[c]
Near Poor	583,432 (4%)	863,401 (4%)	65,110 (4%)	
Low Income	1,535,771 (10%)	2,708,646 (12%)	175,426 (10%)	
Middle Income	3,999,551 (27%)	5,688,205 (25%)	693,475 (38%)	
High Income	7,522,083 (51%)	11,544,269 (52%)	702,885 (39%)	
Insurance, no. (%)				
Private	10,670,293 (72%)	16,629,036 (74%)	1,238,529 (69%)	0.445[c]
Public	3,400,472 (23%)	4,537,055 (20%)	456,582 (25%)	
Uninsured	741,575 (5%)	1,194,451 (5%)	108,802 (6%)	
Provider and Patient do not Speak Same Language, no (%)	168,628 (1%)	434,774 (2%)	76,066 (4%)	0.053[c]
CCI, mean (95% CI)	1.20 (1.17-1.24)	1.20 (1.17-1.22)	1.22 (1.13-1.31)	0.301[b]

Abbreviations: CCI, Charlson Comorbidity Index

[a] Percentages of weighted population.

[b] Analysis of variance of differences between adult patients with vitiligo and other pigmentation disorders who reported high, medium, and low-quality patient-provider communication.

[c] Using the χ^2 test of differences between adult patients with vitiligo and other pigmentation disorders who reported high, medium, and low-quality patient-provider communication.

[d] Poverty level category was measured as percentage of federal poverty level: poor (≤100% of federal poverty level), near poor (100% to <125%), low income (125% to <200%), middle income (200% to <400%), and high income (≥400%).

Vitiligo and Other Pigmentation Disorders: Emergency Room Visits

The mean emergency room visit frequency was 0.2 (95% CI, 0.1-0.3) for vitiligo and other pigmentation disorder patients who reported high-quality patient-provider communication, 0.2 (95% CI, 0.1-0.3) for vitiligo and other pigmentation disorder patients who reported medium-quality patient-provider communication, and 0.4 (95% CI, 0.1-0.7) for vitiligo and other pigmentation disorder patients who reported low-quality patient-provider communication (P=0.01) (Figure 7).

Vitiligo and Other Pigmentation Disorders: Overnight Hospitalisations

The mean overnight hospitalisation frequency was 0.9 (95% CI, 0.3-1.5 for vitiligo and other pigmentation disorder patients who reported high-quality patient-provider communication, 0.8 (95% CI, 0.2-1.4) for vitiligo and other pigmentation disorder patients who reported medium-quality patient-provider communication, and 1.2 (95% CI, -0.9, 3.3) for vitiligo and other pigmentation disorder patients who reported low-quality patient-provider communication (P=0.369) (Figure 8).

Vitiligo and Other Pigmentation Disorders: Outpatient Visits

The mean outpatient visit frequency was 12.8 (95% CI, 10.8-14.8) for vitiligo and other pigmentation disorder patients who reported high-quality patient-provider communication, 15.5 (95% CI, 13.5-17.5) for vitiligo and other pigmentation disorder patients who reported medium-quality patient-provider communication, and 12.3 (95% CI, 7.7-16.9) for vitiligo and other pigmentation disorder patients who reported low-quality patient-provider communication (P=0.0003) (Figure 9).

Vitiligo and Other Pigmentation Disorders: Total Expenditure

The mean total expenditure was $8,426 (95% CI, $6,541-$10,311 for vitiligo and other pigmentation disorder patients who reported high-quality patient-provider communication, $9,658 (95% CI, $7,760-$11,556) for vitiligo and other pigmentation disorder patients who reported medium-quality patient-provider communication, and

$7,756 (95% CI, $2,224-$13,288) for vitiligo and other pigmentation disorder patients who reported low-quality patient-provider communication (P=0.355) (Figure 10). Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that, compared with vitiligo and other pigmentation disorder patients who reported high-quality patient-provider communication, vitiligo and other pigmentation disorder patients who reported medium-quality patient-provider communication had a non-significant total expenditure increment of $277 (P=0.70) and patients who reported low-quality patient-provider communication had a non-significant total expenditure decrement of $547 (P=0.71) (Table 33).

Aim 3 Results

<u>Aim 3:</u> *To determine the effect of tailored delivery of education on patient engagement, disease severity, and clinical trial recruitment as compared to non-tailored delivery of education.*

Study Population Characteristics

We conducted a 3-month randomized controlled study to evaluate the impact of tailored delivery of education on patient engagement and disease severity among U.S. adult patients with psoriasis. 134 patients were randomized 1:1 to receive either tailored or non-tailored delivery of education and associated questionnaires every 1.5 months (Figure 11). Patients were recruited between February 2021 and August 2021 from the Department of Dermatology at USC and LA County+USC Medical Centre and the USC Electronic Health Records (EHR)-enabled database. There was a follow-up of 4 weeks.

From the 134 enrolled patients, the average age was 48.8, 52% were male, and 63% were white. Analysis was performed based on a complete dataset. There was no statistically significant difference in the sociodemographic characteristics of patients the tailored and non-tailored communication groups (Table 39). 65% reported a preference to receive education via SMS, 34% via e-mail, 1% via WhatsApp, and 0% via Facebook.

25% of patient's enrolled were patients of the physician who delivered education in the educational videos.

Figure 11. Consort flow diagram for participants enrolled into aim 3 study

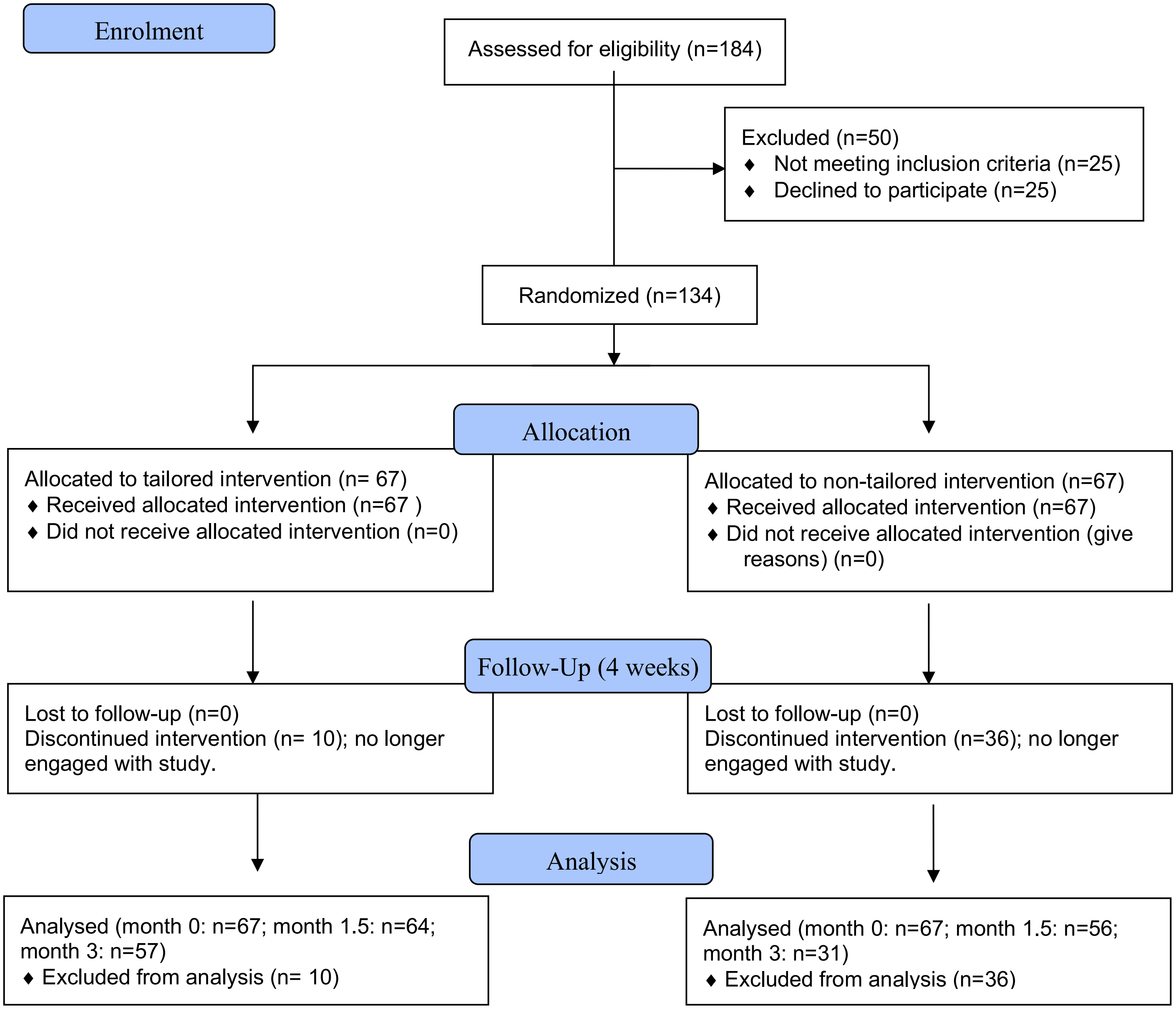


Table 39: Study population characteristics of psoriasis patients enrolled into aim 3 study.

Characteristic	**Type of Communication to Deliver Education, No[a]**	
	Tailored (no.= 67)	**Non-Tailored (no.= 67)**
Age, Mean (SEM) y	46.9 (1.76)	50.6 (2.05)
Gender, female	37 (55%)	36 (54%)
Race		
Asian	10 (15%)	9 (13.5%)
Black	4 (6%)	2 (3%)
Native Hawaiian or Pacific Islander	3 (4.5%)	3 (4.5%)
White	40 (60%)	45 (67%)
Multiple races reported	5 (7.5%)	6 (9%)
Unknown	5 (7.5%)	2 (3%)
Hispanic ethnicity	17 (25%)	18 (27%)
Marital Status		
Single	29 (43%)	29 (43%)
Married	7 (10.5%)	10 (15%)
Partnered	8 (12%)	8 (12%)
Divorced	20 (30%)	19 (28%)
Widowed	3 (4.5%)	1 (2%)
Employment Status		
Full time	35 (52%)	30 (45%)
Part time	13 (19%)	6 (9%)
Not working outside home with pay	5 (8%)	8 (12%)
Retired	9 (13.5%)	12 (18%)
Disabled	3 (4.5%)	8 (12%)
Student	2 (3%)	3 (4%)
Disease Severity		
Mild	45 (67%)	42 (63%)
Moderate	19 (28%)	16 (24%)
Severe	3 (5%)	9 (13%)
Education Level		
Grades 1-8	0 (0%)	0 (0%)
Some high school	1 (2%)	1 (2%)
High school diploma	11 (16%)	9 (13%)
Some college, no degree	12 (18%)	14 (21%)
College degree	30 (45%)	27 (40%)
Graduate/doctoral degree	13 (19%)	16 (24%)
Income		
$43,500 or less	23 (34%)	18 (27%)
$43,500-86,999	14 (21%)	22 (33%)
$87,000-173,999	14 (21%)	16 (24%)
$174,000 and above	16 (24%)	11 (16%)
Insurance Status		
Private/HMO	46 (69%)	40 (60%)
Medicare	12 (18%)	23 (34%)
Medicaid	6 (9%)	2 (3%)
No insurance	0 (4%)	2 (3%)

Abbreviations; HMO, health maintenance organization SEM, standard error of mean

[a] Percentages of population.

[b] T-test of differences between adult patients with psoriasis who received tailored or non-tailored communication

[c] Using the χ^2 test of differences between adult patients with psoriasis who received tailored or non-tailored communication

Primary endpoint: Click rate

Compared to patients in the non-tailored delivery group, patients in the tailored delivery group clicked on a greater number of weblinks throughout the study (94% vs. 77%; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the non-tailored delivery group, patients in the tailored delivery group were 1.8 times more likely to click on at least 1 weblink during the study (P<0.001) (Table 40).

Table 40. Association between the delivery method of communication and click rates and responses speeds among psoriasis patients enrolled into aim 3 study.

Independent Variables*	**Primary Outcome: Click rate and response speed**			
	Adjusted *B* Coef. (95% CI)	***P* value**	**AOR (95% CI)**	***P* value**
Click rate				
Non-Tailored Communication	1[Ref]	1[Ref]	1[Ref]	1[Ref]
Tailored communication	N/A	N/A	1.79 (1.0-4-2.53)	<0.001
Response speed				
Non-Tailored Communication	1[Ref]	1[Ref]	1[Ref]	1[Ref]
Tailored communication	-121 (-144, -99)	<0.001	150 (46-493)	<0.001

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, income level, employment status, and insurance status. *Only primary endpoint data (click rate and response speeds) shown.

Compared to patients in the non-tailored delivery group, patients in the tailored delivery group clicked on links at a greater speed (28 hours vs. 149 hours; P<0.0001). Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the non-tailored delivery group, patients in the tailored delivery had a response time decrement of 121 (P<0.001) (Table 40). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the non-tailored delivery group, patients in the tailored delivery group were 150 times more likely to click on weblinks in less than 24 hours (P<0.001) (Table 40).

Secondary endpoint: Patient engagement

Regarding the patient activation measure, compared to patients in the non-tailored delivery group, patients in the tailored delivery group had a greater proportion of patients with high level activation (level 3 or 4) (90% vs. 58%; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the non-tailored delivery group, patients in the tailored delivery group were 10 times more likely have a high level of activation (P<0.001) (Table 41).

Table 41. Association between the delivery method of communication and patient engagement measures among psoriasis patients enrolled into aim 3 study.

Independent Variables*	Secondary Outcomes: Patient engagement	
	AOR (95% CI)	*P* value
Patient activation measure		
Non-Tailored Communication	1[Ref]	1[Ref]
Tailored communication	10.5 (3.8-28.8)	<0.001
Patient experience		
Non-Tailored Communication	1[Ref]	1[Ref]
Tailored communication	4.3 (1.6-11.2)	0.003
Patients drop out		
Tailored Communication	1[Ref]	1[Ref]
Non-Tailored communication	9.9 (5.4-18.1)	<0.001

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, income level, employment status, and insurance status. *Only secondary endpoint data (patient engagement) shown.

Regarding patient experience, compared to patients in the non-tailored delivery group, patients in the tailored delivery group had a greater proportion of patients report a patient experience of good or very good (85% vs. 67%; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the non-tailored delivery group, patients in the tailored delivery group were 4 times more likely report a good or very good experience (P=0.003) (Table 41).

Regarding patient drop out, compared to patients in the non-tailored delivery group, patients in the tailored delivery group had a lower proportion of patients drop out (54% vs. 15%; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the tailored delivery group, patients in the non-tailored delivery group were 10 times more likely to drop out (P<0.001) (Table 41).

Secondary endpoint: Disease severity

Regarding disease severity as measured using the Physician Global Assessment (PGA), Body Surface Area (BSA), and the Psoriasis Area and Severity Index (PASI), at baseline, 68% of patients who received tailored delivery of education had mild disease, 28% had moderate disease, and 4% had severe disease and 63% of patients who received non-tailored delivery of education had mild disease, 24% had moderate disease, and 13% had severe disease; P=0.186 (Table 39).

Compared to patients in the non-tailored delivery group, patients in the tailored delivery group had no significant difference in the percentage change in the PASI score from baseline to month 3 (8.86 vs 5.70; p=0.13). Using a linear mixed effects model, adjusting for baseline (month 1) values and sociodemographic factors, we found that compared to patients in the non-tailored delivery group, patients in the tailored delivery group had no significant difference in their BSA (-0.20 [95% CI: -0.63, 0.22]), PGA (-0.1 [95% CI: -0.24, 0.06]), and PASI scores (0.41 [95% CI: -0.83, 1.65]) at month 3.

Secondary endpoint: Medication adherence

Compared to patients in the non-tailored delivery group, patients in the tailored delivery group had a greater proportion of patients that were treatment adherent (63% vs. 39%; P<0.001). Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the non-tailored delivery group, patients in the tailored delivery group were 1.5 times more likely to be treatment adherent (P=0.018) (Table 42).

Table 42. Association between the delivery method of communication and medication adherence among psoriasis patients enrolled into aim 3 study.

Independent Variables*	Secondary Outcomes: Medication adherence	
	AOR (95% CI)	***P* value**
Medication adherence		
Non-Tailored Communication	1[Ref]	1[Ref]
Tailored communication	1.5 (0.3-2.8)	0.018

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, income level, employment status, and insurance status. *Only secondary endpoint data (medication adherence) shown.

Secondary Endpoint: Clinical Trial Recruitment

Compared to patients in the non-tailored delivery group, patients in the tailored delivery group had a greater proportion of patients that were recruited into clinical trials (22% vs. 10%; P=0.001). Of note, 8% of patients in the tailored delivery group and 5% of patients in the non-tailored delivery group were interested in participating in a clinical trial but were ineligible. Multivariate logistic regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the non-tailored delivery group, patients in the tailored delivery group were 4 times more likely to be recruited into a clinical trial (P=0.008) (Table 43).

Table 43. Association between the delivery method of communication and clinical trial recruitment among psoriasis patients enrolled into aim 3 study.

Independent Variables*	Secondary outcome: Clinical trial recruitment	
	AOR (95% CI)	***P* value**
Clinical trial recruitment		
Non-Tailored Communication	1[Ref]	1[Ref]
Tailored communication	3.9 (1.4-10.6)	0.008

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, income level, employment status, and insurance status. *Only secondary endpoint data (clinical trial recruitment) shown.

Secondary Endpoint: Patient Knowledge

Compared to patients in the non-tailored delivery group, patients in the tailored delivery group had a greater mean knowledge score (85% vs. 72%; P<0.001). Multivariate linear regression adjusting for sociodemographic and clinical characteristics found that compared to patients in the non-tailored delivery group, patients in the tailored delivery group had a patient knowledge score increment of 13 (P=0.001) (Table 44).

Table 44. Association between the delivery method of communication and clinical trial recruitment among psoriasis patients enrolled into aim 3 study.

Independent Variables*	**Secondary outcome: Patient Knowledge**	
	Adjusted *B* Coef. (95% CI)	***P* value**
Clinical trial recruitment		
Non-Tailored Communication	1[Ref]	1[Ref]
Tailored communication	12.6 (5.3-19.9)	0.001

AOR, adjusted odds ratio; CI, confidence interval; Ref, reference. Multivariable linear and logistic regression adjusted for: age, gender, race, ethnicity, marital status, education level, income level, employment status, and insurance status. *Only secondary endpoint data (patient knowledge) shown.

Chapter IV: Discussion and Conclusion

Discussion and Conclusion

Aim 1: Discussion

Aim 1: *To determine the impact of patients' physical and mental health status on patients' perception of patient-provider communication quality.*

Aim 1: Summary of Results

Using data from the MEPS, we were able to collate, analyse, and interpret the impact of patients' physical and mental health status on their perception of patient-provider communication among dermatology patients in the US (Tables 2, 4, 16, and 18); Figures 3 to 6). This study studied an important gap in the association between the mental and physical health of patients with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders and their perception of the quality of patient-provider communication. Overall, we found that symptoms of psychological distress and depression as well lower levels of mental and physical health functioning were associated with the perception of low-quality patient-provider communication among patients with dermatology conditions.

Regarding psychological distress symptoms, based on nationally representative populations of adults with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders spanning 14 years, compared with patients with no or mild psychological distress symptoms, patients with psychological distress symptoms were more likely to report low-quality patient-provider communication. Specifically, patients with all studied dermatological conditions who reported moderate psychological distress symptoms perceived a significant patient-provider communication quality decrement. Additionally, patients with all studied dermatological conditions, excluding patients with melanoma and non-melanoma skin cancers, who reported severe psychological distress symptoms perceived a significant patient-provider communication quality decrement. Furthermore, patients with atopic dermatitis and other dermatitis conditions, psoriasis, and vitiligo and other pigmentation disorders who reported moderate psychological distress symptoms were more likely to report low-quality patient-provider communication. Additionally, patients with all studied dermatological conditions who reported severe psychological distress symptoms were more likely to report low-quality patient-provider communication. These findings were regardless of sociodemographic factors or comorbidities.

Regarding depression symptoms, based on nationally representative populations of adults with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders spanning 14 years, compared with patients with no or mild depression symptoms, patients with depression symptoms were more likely to report low-quality patient-provider communication. Specifically, patients with all studied dermatological conditions who reported moderate depression symptoms perceived a significant patient-provider communication quality decrement. Additionally, patients with all studied dermatological conditions, excluding patients with melanoma or non-melanoma skin cancers, who reported severe depression symptoms perceived a significant patient-provider communication quality decrement. Furthermore, patients with all studied dermatological conditions, excluding patients with acne and other adnexal diseases (hidradenitis suppurativa and rosacea), who reported moderate depression symptoms were more likely to report low-quality patient-provider communication. Additionally, patients with all studied dermatological conditions, excluding patients with psoriasis and melanoma or non-melanoma skin cancers, who reported severe depression symptoms were more likely to report low-quality patient-provider communication. These findings were regardless of sociodemographic factors or comorbidities.

Regarding mental health functioning, based on nationally representative populations of adults with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders spanning 18 years, compared with patients with above average mental health functioning, patients with lower mental health functioning symptoms were more likely to report low-quality patient-provider communication. Specifically, patients with all studied dermatological conditions who reported average mental health functioning perceived a significant patient-provider communication quality decrement. Additionally, patients with all studied dermatological conditions, excluding patients with psoriasis, who reported below average mental health functioning perceived a significant patient-provider communication quality decrement. Furthermore, patients with atopic dermatitis and other dermatitis conditions, melanoma and non-melanoma skin cancers, and vitiligo and other pigmentation disorders who reported average mental health functioning were more likely to report low-quality patient-provider communication. Additionally, patients with acne, atopic dermatitis and other dermatitis conditions, and vitiligo and other pigmentation disorders who reported below average mental health functioning were more likely to report low-quality patient-provider communication. These findings were regardless of sociodemographic factors or comorbidities.

Regarding physical health functioning, based on nationally representative populations of adults with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders spanning 18 years, compared with patients with above average physical health functioning, patients with lower physical health functioning symptoms were more likely to report low-quality patient-provider communication. Specifically, patients with all studied dermatological conditions, excluding patients with atopic dermatitis and other dermatitis conditions, who reported average physical health functioning perceived a significant patient-provider communication quality decrement. Additionally, patients with all studied dermatological conditions, excluding patients with melanoma or non-melanoma skin cancers and other adnexal diseases (hidradenitis suppurativa and rosacea), who reported below average physical health functioning perceived a significant patient-provider communication quality decrement. Furthermore, patients with psoriasis and vitiligo and other pigmentation disorders who reported average physical health functioning were more likely to report low-quality patient-provider communication. Additionally, patients with all studied dermatological conditions, excluding patients with psoriasis and other adnexal diseases (hidradenitis suppurativa and rosacea) who reported below average physical health functioning were more likely to report low-quality patient-provider communication. These findings were regardless of sociodemographic factors or comorbidities.

Aim 1: Importance of Results

It is important to recognize the association between a patient's baseline mental and physical health status and a patient's perception of the patient-provider interaction because patients with dermatological conditions have a significant mental and physical health illness burden. For example, in psoriasis patients, symptoms of depression and anxiety are found in one third of psoriasis patients.[230–232] In acne, patients are around three times more likely to experience anxiety or depression.[233] In atopic dermatitis, patients are around two times more likely to experience anxiety or depression.[234] In melanoma, patients are 1.24 times more likely to have mental health comorbidities.[235] In hidradenitis suppurativa, patients are over 1.7 times more likely to report mental health comorbidities.[236] In rosacea, patients were 2.4 times more likely to report depression and 2.2 times more likely to report anxiety.[237] In vitiligo, more than one-third of patients report anxiety and are more than 5 times likely to report depression than those without vitiligo.[238,239] Additionally, physical dysfunction is found in many dermatological conditions. In psoriasis, up to 83% of patients report pain which increases the risk of difficulty in performing daily tasks.[240–244] In acne, pain can be reported in more severe cases with a study citing around 13% of patients experiencing pain.[245] In atopic dermatitis, itch, and to a lesser extent pain, are features of atopic dermatitis which can significantly impact sleep and performance at work.[246,247] In skin cancers such as melanoma, patients have reported experiencing more pain and less energy pre-operatively as well as poorer physical functioning post-operatively.[248,249] In hidradenitis suppurativa, the greatest impact on quality of life is observed compared to any other skin disease and young patients report a physical and mental health status similar to that of elderly people in the general population.[250,251] In rosacea, patients report worse health-related quality of life measurements including relating to physical functioning.[252]

Improving the quality of the patient-provider interaction experienced by patients is important because this may be associated with greater treatment adherence and better health outcomes.[4,76,253–256] This is important in dermatological conditions where treatment adherence is often cited as an issue. For example, in psoriasis, atopic dermatitis, hidradenitis suppurativa, and vitiligo patients, adherence is around 30%.[257–259] Furthermore, management plan adherence is around 50% in acne patients, 18% in rosacea patients, and 58% in melanoma patients (relating to skin check surveillance).[257,260,261]

Aim 1: Implications of Results

With regards to mental health comorbidities such as symptoms of psychological distress or depression, these findings could be explained by the following reasons.[74,262–265] First, mental health comorbidities can be considered to be “pervasive” leading to a general negative outlook on life that can make affected individuals to have a heightened negative response to less desirable aspects of their patient-provider interactions. Second, patients with mental health comorbidities can be associated with cognitive impairments that can impact a patient’s ability to engage with their provider or their ability to understand or remember information from the encounter.

With regards to physical health comorbidities such as pain, these findings could be explained by the following reasons.[266–273] First, similar to mental health comorbidities, physical health dysfunction can be associated with cognitive impairments such as attention deficits, memory, learning, and decision making which could impair a patient’s ability to engage with their provider or recall information provided. Second, physical health dysfunction is often interconnected with and can lead to the development of mental health illness which could then lead to a general negative outlook on life, as described above. [274,275]

Our findings show that it is possible that patients' mental and physical health status may be associated with their perception of the quality of interactions with health care professionals. Furthermore, these results suggest that even if consistent high-quality care is provided by healthcare professionals, some patients may perceive such care to be subpar secondary, at least in part, to their baseline mental or physical health status. For example, a patient who has anxiety, depression, or physical symptoms such as pain or itch at baseline is more likely than another patient without such symptoms to experience a lower quality interaction with their provider.

Our results corroborate and extend those from studies of other non-dermatological and dermatological diseases.[276–278] For example, for patients with chronic coronary disease and hepatobiliary disease, mental and physical health dysfunction were strongly associated with a negative perception of their clinicians.[24] Additionally, patients with alopecia who had greater mental health symptoms were found to experience a lower quality patient-provider interaction. Furthermore, patients with mental and physical health comorbidities are also more likely to report overall dissatisfaction with other aspects of health care regardless of disease severity or comorbidities.[276–280]

Given these findings, it is important for providers to be adaptable and supportive in their communication style for affected patients.[76,281,282] For example, the concept of a patient's overall well-being as an entity within a holistic therapeutic approach for patients is being advocated for among dermatology and non-dermatology patients. This includes obtaining screening tools for mental and physical health prior to a patient-physical interaction in order to adapt treatment goals and improve patient outcomes such as patient empowerment and satisfaction.[283–285] Provider knowledge of a patient's baseline and mental health state may also prompt different an alternative style of communication with the patient which may help to improve a patient's experience of the interaction.[286]

Aim 1: Conclusion

Aim 1: *To determine the impact of patients' physical and mental health status on patients' perception of patient-provider communication quality.*

Symptoms of psychological distress and depression as well lower levels of mental health functioning are associated with the perception of low-quality patient-provider communication among patients with dermatology conditions. Additionally, lower levels of physical health functioning are associated with the perception of low-quality patient-provider communication among patients with dermatology conditions. These findings suggest that a patient's baseline mental or physical health status may, at least in part, be associated with their perception of the patient-provider interaction. Therefore, it is important for providers to be adaptable and supportive in their communication style for affected patients.[76,281,282]

Aim 2: Discussion

<u>Aim 2:</u> *To determine the impact of patients' perception of patient-provider communication quality on healthcare resource utilisation.*

Aim 2: Summary of Results

Using data from the MEPS, we were able to collate, analyse, and interpret the impact of patients' perception of patient-provider communication and their healthcare resource utilisation among dermatology patients in the US (Tables 30 to 33); Figures 7 to 10). This study studied an important gap in the association between the perception of the quality of patient-provider communication and the utilization of healthcare resource utilization among patients with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders. Overall, we found that the perception of lower quality patient-provider communication was associated with greater healthcare utilisation and total annual expenditures per person per year among patients with certain dermatology conditions.

Regarding emergency room visits, based on nationally representative populations of adults with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders spanning 18 years, compared with patients who reported high-quality patient-provider communication, patients who reported lower quality patient-provider communication were more likely to have had emergency room visits. Specifically, patients with acne, melanoma and non-melanoma skin cancers, and other adnexal diseases (hidradenitis suppurativa and rosacea) who reported low-quality patient-provider communication had a significant increment in the number of emergency room visits. Furthermore, patients with atopic dermatitis and other dermatitis conditions who reported medium-quality patient-provider communication were more likely to have at least two emergency room visits. Additionally, patients with all studied dermatological conditions, excluding patients with atopic dermatitis and other dermatitis conditions and vitiligo and other pigmentation disorders, who reported low-quality patient-provider communication were more likely to have at least two emergency room visits. These findings were regardless of sociodemographic factors or comorbidities.

Regarding overnight hospitalisations, based on nationally representative populations of adults with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders spanning 18 years, compared with patients who reported high-quality patient-provider communication, patients who reported lower quality patient-provider communication were more likely to have had overnight hospitalisations. Specifically, patients with acne, melanoma and non-melanoma skin cancers, and other adnexal diseases (hidradenitis suppurativa and rosacea) who reported medium-quality patient-provider communication had a significant increment in the number of overnight hospitalisations. Additionally, patients with psoriasis, melanoma and non-melanoma skin cancers, and other adnexal diseases (hidradenitis suppurativa and rosacea) who reported low-quality patient-provider communication had a significant increment in the number of overnight hospitalisations. Furthermore, patients with other adnexal diseases (hidradenitis suppurativa and rosacea) who reported medium-quality patient-provider communication were more likely to have at least two overnight hospitalisations. Additionally, patients with psoriasis, melanoma or non-melanoma skin cancers, and other adnexal diseases (hidradenitis suppurativa and rosacea) who reported low-quality patient-provider communication were more likely to have at least two overnight hospitalisations. These findings were regardless of sociodemographic factors or comorbidities.

Regarding outpatient visits, based on nationally representative populations of adults with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma or non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders spanning 18 years, compared with patients who reported high-quality patient-provider communication, patients who reported lower quality patient-provider communication were more likely to have had outpatient visits. Specifically, patients with atopic dermatitis and other dermatitis conditions, psoriasis, and melanoma or non-melanoma skin cancers who reported low-quality patient-provider communication had a significant increment in the number of outpatient visits. Furthermore, patients with atopic dermatitis and other dermatitis conditions and psoriasis who reported medium-quality patient-provider communication were more likely to have at least two outpatient visits. These findings were regardless of sociodemographic factors or comorbidities.

Regarding total expenditures, based on nationally representative populations of adults with acne, atopic dermatitis and other dermatitis conditions, psoriasis, melanoma and non-melanoma skin cancers, other adnexal diseases (hidradenitis suppurativa and rosacea), and vitiligo and other pigmentation disorders spanning 18 years, compared with patients who reported high-quality patient-provider communication, patients who reported lower quality patient-provider communication were more likely to have had greater total expenditures. Specifically, patients with atopic dermatitis and other dermatitis conditions who reported low-quality patient-provider communication had a significant increment in the total expenditures. These findings were regardless of sociodemographic factors or comorbidities.

Aim 2: Importance of Results

It is important to recognize the association between a patient’s perception of the quality of patient-provider communication experienced and their healthcare utilisation because patients with dermatological conditions have a significant healthcare resource and expenditure burden. For example, acne is the most common reason to visit a dermatologist especially in women aged 20-34 years and its total annual cost in the USA has been estimated at $3.1 billion.[287,288] Severe forms of acne such as acne fulminans or acne conglobata may result in patients requiring systemic treatment or even surgery in acute care settings, although there is limited data on the frequency of such visits.[289,290] Atopic dermatitis adult and paediatric patients make up around 1.25 million visits annually and have a mean annual incidence of emergency room visits of up to 3,553 case/1 million persons.[291,292] Patients with atopic dermatitis may seek acute care services due to a flare, intractable pruritus, and comorbid health conditions.[293] The total annual cost of atopic dermatitis is estimated at over $5 billion annually in the US. Psoriasis patients have around 6 outpatient visits per person per year and the total direct cost of psoriasis is around $6.75 billion in the US.[294,295] In psoriasis, there is limited data on the frequency of emergency room or inpatient hospitalisations but the reasons for more acute level care often relate to a psoriasis flare as well as the many associated comorbidities including psoriatic arthritis and infection.[296] Melanoma and non-melanoma skin cancer patients have increasing healthcare resource utilisation as their incidence increases.[297] For example, non-melanoma skin cancer, is the most common skin cancer and represents one third of all malignancies owing to an ageing population and melanoma cases have nearly quadrupled and tripled over the last three to four decades in men and women, respectively.[298–303] The increasing incidence of skin cancers is reflected in the increasing total costs for these diseases which rose by 126% from $3.6 billion to $8.1 billion from 2002-2006 and 2007-2011, respectively in the

US.[304] Hidradenitis suppurativa patients have been found to have represent 2.33 million outpatient visits over an 11 year period.[305] Additionally, up to 15.8% and 27.1% of hidradenitis suppurativa patients have been found to be hospitalised or use emergency room services, respectively.[306,307] The total direct costs for hidradenitis suppurativa has been found to be $6,783 higher than controls over a three year period in the US and are often associated with infections such as cellulitis.[307,308] Rosacea patients in Korea have been found to have a mean annual number of outpatient visits of almost 7,000 and this has been increasing over time.[309] The mean annual cost of rosacea has been found to be $735 more than matched controls.[310] Finally, in 2013, 150,000 US patients across all ages were treated for vitiligo.[311] This resulted in a cost to the healthcare system that was more than $328 per patient, around three times more than rosacea and two times as much as acne that year.[311] Furthermore, a study in 2004 found that the estimated annual direct cost of vitiligo was $15 million in the US.[288]

Decreasing healthcare resource utilisation is important because this may improve wait times and increase access to healthcare including for individuals with greater financial or geographical constraints. This is important in dermatological conditions where access to a healthcare provider can be limited, and patients may have to wait several months for an appointment with a Dermatology specialist. This can result in patients seeking acute care services such as urgent care or the emergency room in order to address the physical and psychological burden of their disease. For example, a report by the Greater Access for Patients Partnership discussed that between 2005 and 2011 there was a 17% increase in the number of hospitalisations for skin infections and found that 58% of dermatology patients reported that they worried that their condition would worsen while they waited for an appointment.[312,313]

Aim 2: Implications of Results

With regards to healthcare resource utilisation relating to emergency room visits, overnight hospitalisations, and outpatient visits as well as total expenditures, these findings could be explained by the following reasons. First, patients who perceive a lower quality of patient-provider communication may not feel that the provider listened carefully to their concerns or explained their diagnoses and management in a way that they could understand.[76] If a patient does not feel listened to, it is possible that the provider will be unable to fully ascertain their beliefs, values, expectations, culture, and personality traits and be able to take these factors into consideration.[314] This is important to ensure that management options are tailored to the patient and are discussed along with the diagnosis in ways that recognise that patient's health literacy and cultural belief system.[76,315] Furthermore, if a patient feels that their opinion and point of view has been taken into account, this could increase the likelihood of that patient committing to a treatment plan and being able to cope with potential side effects.[314,316] Additionally, patients who perceive a lower quality of patient-provider communication may not feel that the provider showed respect or empathy for their perspective or spent enough time with them.[76,315] If a patient does not feel respected by their provider then they are unlikely able to develop sufficient rapport necessary to offer their questions and concerns and are also less likely able to trust the provider.[317–323] Furthermore, if a patient does not feel that they have had enough time with their provider they are unlikely able to engage in the discussion with the provider in a way that is meaningful for them.[76] In all of these scenarios, patients may not feel that their needs are addressed and so these patients may try and seek healthcare or advice from another healthcare professional who they hope they will have a better interaction with.[324–327] Second, patients who perceive a lower quality of patient-provider communication may be more likely to non-adhere to the treatments recommended and therefore their condition may not be appropriately treated, necessitating additional healthcare.[328]

Our findings show that it is possible that patients' perception of the quality of interactions with health care professionals may be associated with their utilization of healthcare resources. Furthermore, these results suggest that even if patients have regular and accessible healthcare provided, some patients may opt to utilize more healthcare resources secondary, at least in part, to their perception of the quality of patient-provider communication experienced. For example, a patient who perceives a lower quality of patient-provider communication is more likely than another patient who perceives a higher quality of patient-provider communication to utilise more healthcare resources.

Our results corroborate and extend those from studies of other diseases. For example, for patients with chronic coronary disease and hepatobiliary disease, the perception of low-quality patient-provider communication was strongly associated with greater healthcare utilisation.[24,25] Specifically, patients with cardiovascular disease that reported lower quality patient-provider communication were 1.4 times more likely to have emergency room visits or hospitalisations and had an estimated $1,243 greater annual healthcare expenditure.[25] Furthermore, patients with hepatobiliary disease that reported lower quality patient-provider communication were almost two times more likely to have emergency room visits or hospitilisations.[24] Additionally, patients older than 65 years who experienced stronger communication with their provider were less likely to be hospitalised and incurred less Medicare costs.[325] Furthermore, a cross-sectional study of 8,140 chronically patients found that those who reported higher levels of patient-centered care had fewer emergency room visits.[326] Moreover, in adolescent and young adult cancer survivors, it was found that those who reported poor shared decision making, had $3,037 in additional annual medical expenses and 4.9 additional office visits compared to those who reported optimal shared decision making.[329]

Given these findings, it is important for providers to develop strategies to increase their awareness of patient dissatisfaction which in turn may minimize the unnecessary overutilisation of healthcare resources. For example, real-time patient feedback to providers with peer comparison has been shown to lead to improved patient perception of the patient-provider communication interaction.[330] Additionally, it is important for providers to consider novel methods to improve patient experience with the patient-provider interaction to potentially minimize the unnecessary overutilisation of healthcare resources. For example, patient experience can be improved through the use of personalized treatment tools, pre-interaction questionnaires to understand patient goals and expectations, as well as adapting our communication style to suit individual patients.[284,286,331–334]

Aim 2: Conclusion

<u>Aim 2:</u> To determine the impact of patients' perception of patient-provider communication quality on healthcare resource utilisation.

The perception of lower quality patient-provider communication is associated with greater healthcare utilisation among patients with certain dermatology conditions. Furthermore, in atopic dermatitis and other dermatitis conditions, the perception of lower quality patient-provider communication is associated with greater total annual expenditures per person per year. These findings suggest that a patient's perception of the quality of patient-provider communication may, at least in part, be associated with their healthcare utilisation. Therefore, it is important for providers to develop strategies to increase their awareness of patient dissatisfaction as well as novel methods to improve patient experience with the patient-provider interaction to minimize the unnecessary overutilisation of healthcare resources.

Aim 3: Discussion

<u>Aim 3:</u> *To determine the effect of tailored delivery of education on patient engagement, disease severity, and clinical trial recruitment as compared to non-tailored delivery of education.*

Aim 3: Summary of Results

From our 3-month randomized controlled study, we were able to evaluate the impact of tailored patient-provider communication, specifically the tailored delivery of education, on patient engagement and disease severity among 134 U.S. adult patients with psoriasis (Tables 40 to 44). This study studied an important gap in the association between tailored delivery of education and patient outcomes including patient engagement and disease severity. Overall, we found that tailored delivery of education was associated with greater patient engagement, medication adherence, clinical trial recruitment, and patient knowledge but not disease severity between patients who received tailored delivery of education and patients who received non-tailored delivery of education.

Regarding patient engagement, based on a diverse psoriasis patient population in demographic, socioeconomic, and disease state severity, spanning 3 months, compared with patients who received non-tailored delivery of education, patients who received tailored delivery of education were more likely to click on at least one weblink during the study. Additionally, patients who received tailored delivery of education were more likely to click on weblinks within 24 hours. Furthermore, patients who received tailored delivery of education were more likely to have a high level of activation and report a high level of experience with the education received. Moreover, compared to patients who received tailored delivery of education, patients who received non-tailored delivery of education were more likely to drop out of the study. These findings were regardless of sociodemographic or clinical factors.

Regarding medication adherence, based on a diverse psoriasis patient population in demographic, socioeconomic, and disease state severity, spanning 3 months, compared with patients who received non-tailored delivery of education, patients who received tailored delivery of education were more likely to be treatment adherent. These findings were regardless of sociodemographic or clinical factors.

Regarding clinical trial recruitment, based on a diverse psoriasis patient population in demographic, socioeconomic, and disease state severity, spanning 3 months, compared with patients who received non-tailored delivery of education, patients who received tailored delivery of education were more likely to be recruited into a clinical trial. These findings were regardless of sociodemographic or clinical factors.

Regarding patient knowledge, based on a diverse psoriasis patient population in demographic, socioeconomic, and disease state severity, spanning 3 months, compared with patients who received non-tailored delivery of education, patients who received tailored delivery of education had a greater knowledge score. These findings were regardless of sociodemographic or clinical factors.

Regarding disease severity, based on a diverse psoriasis patient population in demographic, socioeconomic, and disease state severity, spanning 3 months, there was no difference found in disease severity at baseline and month three between tailored and non-tailored delivery of education groups.

Aim 3: Importance of Results

It is important to recognize the association between tailored patient-provider communication and patient outcomes such as patient engagement, clinical trial recruitment, and patient knowledge as well as medication adherence because dermatology patients can report deficiencies in these outcome measures. For example, the Multinational Assessment of Psoriasis and Psoriatic Arthritis (MAPP) survey found that less than 60% of patients had seen a healthcare provider within 12 months and despite 70% rating their disease as moderate or severe, only 10% of patients reported treatment with a conventional oral or biologic therapy.[335,336] This can be explained by patients expressing frustration and dissatisfaction with current management options and for those receiving systemic therapies, concern regarding long-term safety, lab monitoring, and effectiveness.[335,336] For some psoriasis patients, lack of access to specialist care and prohibitive costs may also limit their ability to engage with their disease management.[337] Additionally, in psoriasis patients, medication adherence has been found to be as low as 27% for topical therapies alone and as low as 46% for both topical and systemic therapies.[105,106] Treatment non-adherence in psoriasis can be explained by greater psychological distress, low patient motivation, and low satisfaction with provider care or therapy for example due to treatment vehicle or efficacy.[338–341] Furthermore, while it is unknown how challenging it is to specifically recruit psoriasis patients, in general it is known that clinical trial recruitment can be challenging among dermatology patient populations.[342] Clinical trial recruitment barriers include a lack of adequate patient populations, the demands of the trial, apprehension surrounding possible adverse events, and concerns regarding consent.[343–345] Finally, in psoriasis patients, patient knowledge has been found to be lacking regarding the disease and its treatment with studies reporting that only around 17% of psoriasis patients have a good level of knowledge for example relating to treatment options.[346–349] Lower patient knowledge has been associated with male gender, younger age, lower educational levels, milder disease severity, and a lack of participation in a clinical trial previously.[346,350]

Improving patient outcomes in psoriasis is important to improve overall standards of care and disease control. Specifically, improving patient engagement can lead to the attendance of necessary visits with their outpatient provider and greater adherence to their treatment regimen. Improving medication adherence can lead to improved disease severity and quality of life as well as less frequent visits to acute care services. Improving clinical trial recruitment can lead to greater understanding of disease and treatment options including in minority populations which are often underrepresented in clinical trials. Improving patient knowledge may lead to an increase in patients' perception of control, a greater attention to aggravating factors, greater participation in shared decision making, greater patient satisfaction, greater treatment adherence, and positive lifestyle habits.[346,348]

Aim 3: Implications of Results

With regards to patient engagement, medication adherence, clinical trial recruitment, and patient knowledge these findings could be explained by the following reasons. First, tailored delivery of education ensures that the content is more likely to be received and therefore the patient has a greater chance of observing the education and obtaining the intended benefit of the materials. For example, if a patient who expresses a preference to receive information via text message receives information on how and why to take their medications via text, it can be reasonably deduced that this patient may have greater medication adherence than if they had received this information through another channel. This is because a patient who receives information via a non-customized communication channel may not even be able to receive the content via such a channel. Second, even if the education is received via a non-tailored communication channel, patients may be more motivated to view information received via their preferred communication channel because this has respected their preferences and the information may be viewed as more “personally relevant”.[351] This idea follows the elaboration likelihood model of persuasion which includes the theory that patients are more likely to carefully and extensively think about a message that is personally relevant to them.[352] Information that is shared in a personally relevant way would then be expected to result in greater engagement, greater consideration of the content, greater recall of the information, and as a result, greater incentive to change health behaviours and attitudes.[352–355] Third, tailored communication channels may allow for information to be observed more time-efficiently because the information is received through a channel that the patient likes to use. This is important in the context of receiving education following a provider visit because it is known that we can retain information more easily if you are encouraged to recall information that you have recently learned.[356] In the context of patient education, it could therefore be deduced that following a patient visit where the patient has received information about diagnosis and management, a follow-up educational video that is observed shortly after the visit could encourage the education to be retained. The reinforcement of patient education could, at least in part, explain why studies have shown patients have reduced emergency room readmissions within a week if they received follow-up phone calls following their visit.[357,358]

With regards to disease severity, these findings could be explained by the following reasons. First, psoriasis patients can expect to see significant reduction in disease severity after up to 6 months of making changes to their treatment plan especially when relating to systemic treatments such as biologic therapies.[359–361] However, this time frame relates to patients who will be treatment-responsive and, in psoriasis, around 6.5% are treatment-resistant to at least three different biologics that target at least two different pathways.[362] Second, psoriasis patients can experience delays in treatments. One study in France found that 50% of patients with moderate to severe psoriasis experienced delays of at least 3 years before starting systemic therapies.[363] This was found to be because of patient factors such as patient anxiety and low utilisation of specialist care, as well as disease severity discrepancies between patients and providers.[363,364] In the USA, undertreatment in psoriasis is known and this is also, in addition to aforementioned factors, often due to insurance coverage issues with up to almost one fifth of prior authorisations being denied in 2014.[336,365,366]

Our findings show that it is possible that tailored patient-provider communication, specifically tailored delivery of education, may be associated with greater patient engagement, medication adherence, clinical trial recruitment, and patient knowledge. However, there was no difference found in disease severity between the two communication groups. Furthermore, these results suggest that even if high-quality education is received, some patients may be less engaged with their health and with the materials, less medication adherent, less willing to participate in clinical trials, and have lower knowledge of the educational content if the education is not shared via their preferred communication channel. For example, a patient who does not receive education via their preferred communication channel is less likely than a patient who does receive education via their preferred communication channel to report greater patient engagement.

Our results corroborate and extend those from studies of other diseases. For example, a systematic review in 2013 found that 53% of tailored patient-provider communication, including those relating to delivery, demonstrated significant increases in health-promoting effects such as medication adherence, health promotion, and preventive screening. [44] Similarly, a meta-analysis of web-delivered tailored patient-provider communication found that tailored interventions resulted in greater improvement of patient outcomes as compared to non-tailored interventions.[367] Additionally, in smoking cessation programs, patients were found to be more engaged with tailored patient-provider communication than non-tailored patient-provider communication, and the tailored patient-provider communication was found to be more cost-effective.[368–374] Furthermore, a meta-analysis of patients with type two diabetes mellitus, found that those who received tailored text messaging interventions had significantly improved glycaemic control than those who received non-tailored text messaging interventions.[375]

Given these findings, it is important for providers to consider how we disseminate educational materials to optimise patient outcomes. For example, communication can be tailored by the delivery channel but also in other ways such as the content.[376–379] Other more novel methods of education dissemination for maximal physician outreach could also include machine learning, the use of smartwatches, and other forms of artificial intelligence like ChatGPT.[380–382] Additionally, it is important for providers to be adaptable in their approach to educating patients to optimise patient outcomes. For example, video-based education can be used to improve patient knowledge, alleviate stress, and could also encourage clinical trial recruitment. [383–386]

Aim 3: Conclusion

Aim 3: *To determine the effect of tailored delivery of education on patient engagement, disease severity, and clinical trial recruitment as compared to non-tailored delivery of education.*

From our 3-month randomized clinical trial, tailored delivery of education was associated with greater patient engagement, medication adherence, clinical trial recruitment, and patient knowledge. However, there was no difference in disease severity between patients who received tailored delivery of education and patients who received non-tailored delivery of education. These findings suggest that tailoring the communication channel through which patients receive education may, at least in part, be associated with greater patient engagement, medication adherence, clinical trial recruitment, and patient knowledge. Therefore, it is important for providers to consider how we disseminate educational materials and to be adaptable in their approach to educating patients in order to optimise patient outcomes.

Strengths and Limitations of the Study

Part 1 (Aims 1 and 2)

For part 1 (aims 1 and 2) that utilised the MEPS database, the strengths and limitations can be summarized together. Regarding the strengths, first, the MEPS covers several cross sections of US citizens to provide nationally representative results. Second, the MEPS collected data from a multitude of dermatology conditions allowing for a variety of diseases to be studied and reported on. Third, the MEPS is the most complete source of data in the US on the cost and use of healthcare. Fourth, the MEPS allows for explorations over time since this survey has been collected annually since 1996.

Regarding the limitations, first, the MEPs database does not collect information on the providers' perception of the quality of the patient-provider communication experienced. This, therefore, does not allow for a comparison of the patient and provider perceptions of patient-provider communication quality. Additionally, the MEPs does not capture other factors that may be associated with mental and physical health and healthcare resource utilisation and their perception of the quality of patient-provider communication such as disease severity and treatment responses. An inability to adjust for disease severity is an important consideration because it may be expected that with greater disease severity, there will be greater likelihood of mental health symptoms. However, while some diseases like acne and atopic dermatitis demonstrate a dose-related association with mental health, others such as psoriasis and hidradenitis suppurativa do not seem to demonstrate the same association.[387–391] Because the MEPs methods allow for national estimate calculations, the results can be generalised to dermatology patients in the United States. However, the data is collected from a noninstitutionalised population and so the findings may not be entirely generalisable to include this cohort. Additionally, the cohort of patients studied only included adults which, therefore, limits our understanding of the associations that may be seen in the paediatric and adolescent populations. Finally, the MEPs relies on self-reported measures of patient experiences and outcomes that have high internal validity but are subject to recall bias especially since patients do not immediately report their experiences following the provider interaction.[392]

Part 2 (Aim 3)

For part 2 (aim 3), there were some strengths and limitations. Regarding strengths, first, a conservative sample size was calculated. Second, this study was able to report of patients of multiple races. Third, this study was able to offer multiple social messaging platforms. Fourth, patients were engaged in the development of the educational materials provided.

Regarding, limitations, first, given that our population was of psoriasis patients in Southern California, it is unknown how generalisable the results would be to the national psoriasis population in the United States and the international psoriasis population beyond. Additionally, while there was overall good racial diversity of participants, the majority were white and the data may be lacking, in particular, for Asian and Black patients who have 2.5% and 1.5% of their populations diagnosed with psoriasis, respectively. However, Hispanic patients were well-represented. Additionally, while the tailored group provided multiple communication channels for patients to choose from, social media platforms such as Instagram, Twitter, and Snapchat were not included. However, our data suggest that these platforms may not have been a popular choice since no patients in our study opted to receive the educational weblinks via Facebook. Furthermore, the non-tailored patient-provider communication group received weblinks via mail which was not an option provided to the tailored patient-provider communication group. This was because the non-tailored patient-provider communication group was intended to represent current practices and our preliminary studies demonstrated that patients would not opt to choose weblinks provided via mail. Moreover, the educational topics were limited in number given that only three videos could be shared over the course of the study. However, these were selected based on the needs assessment questionnaires collected. The duration of the study itself was 3 months and it is unknown how patient outcomes and response rates would have changed over time as the case may be in real practice where patient-provider relationships can span years. Additionally, while participants were blinded to the communication arms that they could be randomised to, the researchers conducting the study including the providers assessing disease severity in-person and via photographs were not blinded. It is unclear whether this may have led to bias especially given the lack of significant difference found between disease severity at baseline and at month 3. With regards to handling missing data, analysis was based on a complete case dataset given that the actual drop out was less that the expected drop out and the drop out rate was discussed and accounted for through our logistical analyses. Finally, a quarter of patients included in the study were patients of the physician who delivered education in the educational videos provided. While there was not a significant difference in the proportions of this physician’s patients in each study group, these patients could have been more likely to report positive outcomes including experience of the video and engagement with their healthcare because the provider was familiar and trusted to them.

Future Work

Part 1 (Aims 1 and 2)

For part 1 (aims 1 and 2), the future work that could expand upon the results and address the limitations of the current study can be summarized as follows. To address the results, the following could be considered in future research and practice. First, this research helps us further understand of the patient-provider interaction and can contribute to the overall movement towards patient-centred holistic care such more than just disease severity as perceived by the provider is addressed. This can lead to the development of novel strategies to provide more holistic and tailored care. For example, in psoriasis, experts recommend a more holistic approach to a patient's overall wellbeing that encompasses more than their disease severity and also considers patient reported outcomes including mental health and quality of life in order to improve patient satisfaction with their disease and provider.[283] Additionally, in acne, a personalized treatment tool developed by experts takes into consideration individual patient features in addition to disease severity in order to improve patient outcomes including satisfaction.[331] Moreover, studies have demonstrated that questionnaires sent prior to a visit to better understand a patient's needs, expectations, preferences, and baseline mental and physical status can improve patient outcomes and experience.[284,332,333] Second, this research brings awareness to the possibility that we may be able to improve the quality of the communication that is delivered. For example, in Dermatology, research has shown that we providers may get frustrated with more complex cases that have greater functional and emotional needs because they may not be equipped to handle the psychosocial aspects of the disease.[393,394]This can lead to reduced patient trust and rapport as well as dissatisfaction with providers.[393] Therefore, in order to improve patient-provider communication, especially in patients with greater needs, it will be important for providers to increase their awareness of their own possible feelings and prejudices towards their patients. In fact, some research suggests that real-time patient feedback given to providers with peer comparison can lead to improved patient perception of the patient-provider communication interaction.[330] Finally, taking the patient as an individual is important in order to improve the patient-provider interaction. For example, research has shown that while most patients appreciate smiling and active listening, unique satisfaction drivers in younger patients included being fun and conveying a caring demeanour, whereas unique satisfaction drivers in older patients included building a long-term relationship and seeking patient input.[334]

To address the limitations, first, while we included a breadth of dermatological conditions that can possibly be more widely implicated for other non-dermatological conditions, it would be important to conduct this study for other dermatological conditions such as alopecia as well as determine whether there may be important associations between mental and physical health as well as healthcare utilisation in non-dermatological conditions. Additionally, it would be important to conduct research into other ways that the perception of quality of patient-provider communication can be influenced including through the communication style of the provider. Second, it would be important to study the providers' perception of the quality of patient-provider communication experienced. This information could allow for a comparison of patient and provider perceptions and provide insight into areas of communication where providers may be able to improve upon such as calling attention to non-verbal communication cues. For example, if a patient does not verbalise their dissatisfaction with their patient-provider communication experience and the provider does not notice changes in body language that indicate this dissatisfaction, the provider may not be able to improve upon the interaction in real-time or at future visits. While this data is not collected in the MEPs, this is information that can be ascertained in real-life interactions to improve upon on the care delivered and collected as a study to provide a formal comparison. For example, providers could be provided patients' evaluation of their satisfaction with the interaction in addition to information regarding their mental and physical health before or after the visit which may then lead to an awareness of what may be causing the communication breakdown and improved patient interactions.[283,284,330] Third, it would be important to determine whether factors such as disease severity and treatment responses may be associated with mental and physical health and healthcare resource utilisation and their perception of the quality of patient-provider communication. While this information can be difficult to ascertain with the MEPs due to access limitations for some patients and incomplete data collection, for some conditions, the use of systemic medications such as biologics, may be possible to adjust for as a marker of disease severity. Finally, while the MEPs can be described as a prospective study in that it follows patient groups for two consecutive years during each year of data collection, patients are not asked to evaluate their patient-provider communication experience immediately after each interaction and so there is chance for recall bias. Therefore, it would be helpful to conduct studies where patient and provider data is collected shortly after the interaction to limit the potential influence for non-related experiences to confound the recollection.

Part 2 (Aim 3)

For part 2 (aim 3), the future work that could expand upon the results and address the limitations of the current study can be summarized as follows. To address the results, the following could be considered in future research and practice. First, this research helps to bring greater awareness of novel ways to tailor our communication with patients to potentially impact their outcomes. This can contribute to the field of patient education which is critical in Dermatology where health literacy can be low, and we now have access to novel technologies to increase patient reach. Providing high-quality information to patients is especially important in an era where medical misinformation is commonplace, and patients are known to have difficulty differentiating between high- and low-quality information.[395–397] In addition to tailoring the delivery channel[376–378], examples of novel, tailored patient-provider communication strategies that can be used to change patient behaviour includes tailored visual versus tailored stock images whereby tailored images led to increased fear and decreased appearance and norms and benefits of tanning.[379] Second, the use of video-based education is an ongoing area of research that is being explored in specialties beyond dermatology.[383–386] For example, in cancer patients, following a video-based intervention, patients had significantly reduced fear of progression, depression, and fatigue as compared to their baseline.[386] Additionally, video-based education could be used to improve communication with physicians regarding clinical trials.[385] Finally, even more technologically advanced methods to tailor our communication, increase physician outreach, and disseminate education for patients could include machine learning, the use of smartwatches, and other forms of artificial intelligence like ChatGPT.[380–382]

To address the limitations, first, to provide more generalisable results, it would be important to conduct this study in different settings (for example, in other regions of the US as well as internationally) and patient groups (for example, atopic dermatitis and acne). Additionally, to understand how patient outcomes including disease severity and response rates may change over time, it would be important to follow patients over a longer period of at least 6 months. Second, to improve upon the racial diversity of patients recruited, targeted efforts can be made to increase the numbers of Asian and Black patients who participate, for example, by approaching such patients when seen in clinic. Third, to provide patients with greater choice so that communication be more tailored to suit patient preferences, future studies should include additional communication channels for patients to choose from. While this was not an important issue in this study since no patients opted to receive weblinks via Facebook, providing additional options such as Instagram and Twitter may become more relevant for the younger generation of patients recruited in the future. Fourth, given that current practices tend to provide educational information via mail, it may be helpful to include mail as an option for the tailored patient-provider communication group to formally demonstrate our preliminary findings that patients do not prefer to receive educational information this way. Finally, while it was important to understand whether tailored delivery of education may improve patient outcomes, future studies should also study other methods of tailored patient-provider communication such as tailored content.

Overall Conclusion

Our study has two primary conclusions. First, we found that factors such as mental and physical health as well as healthcare resource utilisation were associated with the perception of high-quality patient-provider communication. The implication for practice is that it is important for providers to be adaptable and supportive in their communication style for affected patients and for providers to develop strategies to increase their awareness of patient dissatisfaction as well as novel methods to improve patient experience with the patient-provider interaction to minimize the unnecessary overutilisation of healthcare resources. Second, we found that tailored delivery of education as compared to non-tailored delivery of education was an effective communication strategy to improve patient outcomes such as engagement and patient knowledge. The implication for practice is that it is important for providers to consider how we disseminate educational materials and to be adaptable in their approach to educating patients to optimise patient outcomes.

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doi:10.7759/cureus.33720

Appendices

Appendix 1. Kessler 6 Questionnaire

The Kessler 6 questionnaire is a measure of psychological distress and asks how often, during the past 30 days, the respondent felt:

- So sad that nothing could cheer you up?
- Nervous?
- Restless or fidgety?
- Hopeless?
- That everything was an effort?
- Worthless?

Respondents can select the following options in response to these questions: none of the time (0), a little of the time (1) , some of the time (2), most of the time (3), or all of the time (4). The score ranges from 0 to 24 with 0 suggesting the lowest level of psychological distress, and 24 suggesting the highest level of psychological distress.

Appendix 2. Patient Health Questionnaire 2

The Patient Health Questionnaire 2 is a screening measure for depression and asks respondents two questions:

- During the past two weeks, how often have you been bothered by having little interest or pleasure in doing things?

- During the past two weeks, how often have you been bothered by feeling down, depressed, or hopeless?

These questions are rated on a scale of 0 to 3 (range from 0 to 6) with a positive score being 3 or greater.

Appendix 3. Short Form-12

The Short Form 12 is a 12-item measure of physical and mental functioning. The physical component summary (PCS) evaluates physical function, general health, bodily pain, and role limitations due to physical health. The mental component summary (MCS) evaluates social function, mental health, vitality, and role limitations due to emotional health. For both subscales, a weighted global score, ranging from 0 to 100 is calculated.

- In general, would you say your health is: excellent, very good, good, fair, or poor?
- Does your health now limit you in these activities in a typical day (Yes, limited a lot; Yes, limited a little; No, not limited at all):
    - Moderate activities such as moving a table, pushing a vacuum cleaner, bowling, or playing golf
    - Climbing several flights of stairs

- During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health? (Yes or No):
    - Accomplished less than you would like
    - Were limited in the kind of work or other activities
- During the past 4 weeks, how much did pain interfere with your normal work (including work outside the home and housework)? (Not at all; A little bit; Moderately; Quite a bit; or Extremely)
- How much of the time during the past 4 weeks (All of the time; Most of the time; A good bit of the time; Some of the time; A little of the time; None of the time):
    - Have you felt calm and peaceful?
    - Did you have a lot of energy?
    - Have you felt downhearted and blue?
- During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)? (All of the time; Most of the time; Some of the time; A little of the time; None of the time)

Appendix 4. Educational videos

Psoriasis Treatment Overview:

https://www.youtube.com/watch?v=s5wrUEsJvNY

Psoriasis and Diet:

https://www.youtube.com/watch?v=n0-WtWhuPL8

Skin research:

https://www.youtube.com/watch?v=_GaXPxfpUm0

Appendix 5. Patient Activation Measurement (PAM-13) Measurement

The PAM-13 score is a validated scale consisting of 13 questions that can determine patient 'activation', or 'empowerment' of a patient to participate in their healthcare.[216]The higher the score, the higher the activation level.

Please answer the following questions (strongly disagree, disagree, agree, or strongly agree):

When all is said and done, I am the person who is responsible for managing my health condition.

- Taking an active role in my own health care is the most important factor in determining my health and ability to function
- I am confident that I can take actions that will help prevent or minimize some symptoms or problems associated with my health condition.
- I know what each of my prescribed medications does.

- I am confident that I can tell when I need to go get medical care and when I can handle a health problem myself.
- I am confident I can tell my health care provider concerns I have even when he or she does not ask.
- I am confident that I can follow through on medical treatments I need to do at home.
- I understand the nature and causes of my health condition.
- I know the different medical treatment options available for my health condition.
- I have been able to maintain the lifestyle changes for my health that I have made.
- I know how to prevent further problems with my health condition.
- I am confident I can figure out solutions when new situations or problems arise with my health condition.
- I am confident that I can maintain lifestyle changes, like diet and exercise, even during times of stress.

Appendix 6. Armstrong Viewer Assessment (AVA)

The AVA is a validated scale that can be used to determine patient experience with the educational materials viewed.

How did you feel about this video? It was: very good, good, fair, poor, or very poor

Appendix 7. Medication Adherence Questionnaire (MAQ)

The MAQ consists of four items pertaining to patient adherence to their prescribed treatments with a scoring scheme of “Yes” = 1 or “No” = 0. The total possible score can range from 0-4. A score of 0 indicates treatment adherence and a score of 1-4 indicates treatment non-adherence.

Please answer yes or no to the following questions:

- Do you ever forget to take your medicine?
- Are you careless at times about taking your medicine?
- Sometimes if you feel worse when you take the medicine, do you stop taking it?
- When you feel better do you sometimes stop taking your medicine?

Appendix 8. Patient Knowledge Questionnaire

<u>Psoriasis Treatment Overview</u>

Please answer the following questions about psoriasis treatments:

1. Which of the following are treatments for psoriasis?
    a) Topicals
    b) Light therapy
    c) Biologics
    d) Pills
    e) All of the above

2. True or false: Topicals and light therapy are typically for patients with mild-to-moderate psoriasis.
3. True or false Biologics are injectable medications for moderate-to-severe psoriasis
4. Yes or no: Does the severity and location of your psoriasis help determine which medication might be right for you?
5. True or false: Psoriasis is a chronic condition that needs regular treatment to prevent flares.

<u>Psoriasis and Diet</u>

Please answer the following questions about psoriasis and diet:

1. True or false: A gluten-free diet can significantly improve your psoriasis.
2. True or false: Diet changes are recommended as a standard treatment for psoriasis.
3. True or false: Weight reduction with a low-calorie diet is recommended for psoriasis patients.
4. True or false: Taking supplements, such as selenium, B12, Vitamin D is recommended for the purpose of treating psoriasis.
5. Yes or No**:** Can diet changes make a significant impact on psoriasis?

<u>Skin Research</u>

Please answer the following questions about skin research:

1. True or false: Clinical research is an opportunity to receive cutting-edge treatment that may significantly benefit you.
2. True or false: Typically, treatments within clinical research trials are at no cost to you.
3. Where can you find information on clinical trials occurring in the US?
    a) National Psoriasis Foundation website
    b) ClinicalTrials.gov
    c) National Eczema Foundation website
    d) All of the above
4. True or false: Clinical trials only include injectable medications.
5. True or false: Clinical research helps contribute to a greater understanding of illnesses and treatments.

Appendix 9. Psoriasis Area and Severity Index (PASI) Score

Area Score:

% involvement	**0**	**1-9%**	**10 - 29%**	**30 - 49%**	**50 - 69%**	**70 - 89%**	**90 - 100%**
Region score	0	1	2	3	4	5	6

Body Region	**Erythema**	**Induration**	**Scaling**	**Area Score**	**Multiplier**	**Score**
Head and Neck	(+	+	)	x	X0.1	
Trunk	(+	+	)	x	X0.3	
Upper Extremities	(+	+	)	x	X0.2	
Lower Extremities	(+	+	)	x	X0.4	

The Final PASI score is the sum of the 4-region score	________ (0-72)

Appendix 10. Physician Global Assessment

Score	Definition	Description
0	Clear	No signs of psoriasis, but post-inflammatory discoloration may be present
1	Almost Clear	Only minimal plaque elevation, scaling, and erythema
2	Mild	Slight plaque elevation, scaling, and erythema
3	Moderate	Moderate plaque elevation, scaling, and erythema
4	Severe	Very marked plaque elevation, scaling, and erythema

Appendix 11. Body Surface Area

Affected Area	% Area Affected
Head and Neck	(0-10)
Upper Extremities	(0-20)
Trunk	(0-30)
Lower Extremities	(0-40)

Appendix 12. Informed Consent Provided to Participants in Aim 3 Study

INFORMED CONSENT FOR RESEARCH

Study Title: Tailored Patient-Provider Communication (TPPC): A Pragmatic, Single-Blinded Trial Evaluating the Impact of TPPC in Dermatology Patients compared to Standard Patient-Provider Communication.

Principal Investigator: April W. Armstrong, MD, MPH

Department: Dermatology

INTRODUCTION

We invite you to take part in a research study. Please take as much time as you need to read the consent form. You may want to discuss it with your family, friends, or your personal doctor. If you find any of the language difficult to understand, please ask questions. If you decide to participate, you will be asked to sign this form. A copy of the signed form will be provided to you for your records.

KEY INFORMATION

The following is a short summary of this study to help you decide whether or not you should participate. More detailed information is listed later on in this form.

1. Being in this research study is voluntary – it is your choice.

2. You are being asked to take part in this study because you have been diagnosed with acne, atopic dermatitis, or psoriasis and are at least 18 years of age. The purpose of this study is to investigate alternative methods of communication

between doctors and participants with acne, atopic dermatitis, and psoriasis. Your participation in this study will last 3 months. Procedures will include delivering information regarding potential clinical trials that you may be eligible for and/or educational content relevant to your skin condition. You will also have the option to complete electronic questionnaires. This study will not affect your current or future dermatological care.

3. There are risks from participating in this study. The most common risks are that people who are not connected with this study will learn your identity of your personal information. More detailed information about the risks of this study can be found under the “What are the risks and possible discomforts?” section.

4. You may not receive any direct benefit from taking part in this study. However, your participation in this study may help us learn how to increase the number of patients who communicate with dermatology healthcare providers.

5. If you decide not to participate in this research, your other choices may include would be not to take part in this study.

DETAILED INFORMATION

PURPOSE

This study is about investigating alternative methods of communication between doctors and participants. We hope to learn about the relevance and effectiveness of different communication methods for clinical trial recruitment and participant education. 200 participants will take part in the study. Both men and women who are at least 18 years of age may qualify. If you qualify to be included in this study and agree to participate, you will take part in the study procedures below. It is important that you complete all activities required for the study.

PROCEDURES

If you choose to participate in this study, you will be randomly assigned (like drawing straws) to one of two groups. Approximately 67 participants will be assigned to receive one form of communication from their dermatology healthcare providers and approximately 67 participants will be assigned to receive an alternative form of communication from their dermatology healthcare providers. Depending on the group to which you as assigned, your study healthcare provider will send you:

1) Communication including questionnaires regarding clinical trials and/or education relevant to your skin condition.
2) Questionnaires regarding the educational material sent.

You have a 50:50 chance of being assigned to either communication group.

Neither you nor the study doctor or study staff will be able to pick which type of communication you will receive. This study is single-blinded meaning that the study team will know the different types of communication being studied, but you will not know.

You can expect to receive 3 communication messages regarding the availability of relevant clinical trials and new educational information relating to your skin condition.

Before participating in this research, the study will be explained to you by the study doctor or a member of the study doctor’s staff. The purpose of the study will be reviewed, and the potential risks and discomforts of your participation will be explained. After you have read, understood, and signed/dated this consent form, you will be asked for information about your health, and your ability to use electronic tablets will be checked to determine if you qualify to participate in the study.

You will complete the following procedures:

Screening Visit (Week 0)

- Your medical history will be reviewed to determine your eligibility to participate.

Enrolment/Baseline (Visit 1, Week 0, Month 0)

- Your eligibility for the study will be verified.
- You will be asked about your demographic information, health history (including dermatology condition(s) and severity), socioeconomic status, personal information, such as your name, date of birth, race, ethnicity, gender and any medicines that you are currently taking.
- Your disease severity will be assessed utilizing verified standard measurement scales relevant to your dermatology condition(s).
- Your ability to use online communication messaging will be assessed.
- Your ability to complete electronic questionnaires will be assessed.
- You will receive training on how to take high-quality photographs at month 3 from your device and submit these pictures to our online dermatologist online.
- You will be randomized to receive a type of communication.
- You will receive access to a weblink which will take you to relevant educational materials and associated questionnaires on an online platform called *Wecudos*.

Assessment 2, Week 8 (Month 1.5)

- You will receive access to a weblink which will take you to relevant educational materials and associated questionnaires via *Wecudos*.
- We will assess your response to questionnaires that may have been delivered to you during this time.

Assessment 3, Week 12 (Month 3)

- We will assess your response to questionnaires that may have been delivered to you during this time.
- You will upload digital photographs of your skin lesions to the study website. and submit these pictures to our online dermatologist online via *Wecudos or RedCap*. If the image quality of the photos you take is poor, the online dermatologist will ask you to re-submit adequate images for clinical assessment. A trained and qualified dermatologist will use the photos you determine the severity of your skin condition.
- We will send you a courtesy phone call or message to inform you that the study has ended, and you will no longer be receiving further communication.

RISKS AND DISCOMFORTS

Possible risks and discomforts you could experience during this study include people who are not connected with this study will learn your identity of your personal information. There is also a risk that there may be a security breach associated with communication via electronic platforms. However, our research team is committed to protecting privacy and maintaining confidentiality of each participants' personal information.

Some questions within questionnaires may make you feel uneasy or embarrassed. You can choose to skip or stop answering any questions that make you uncomfortable. There are no known unforeseen risks possible.

Surveys/Questionnaires/Interviews: Some of the questions may make you feel uneasy or embarrassed. You can choose to skip or stop answering any questions you don't want to.

Breach of Confidentiality: There is a small risk that people who are not connected with this study will learn your identity or your personal information.

Unforeseen Risks: There may be other risks that are not known at this time.

BENEFITS

There are no direct benefits to you from taking part in this study. However, your participation in this study may help us learn how to increase the number of patients who:

1) Can communicate with dermatology healthcare providers
2) Participate in clinical trials
3) Receive useful educational content
4) Are satisfied and more involved in their dermatology healthcare

PRIVACY/CONFIDENTIALITY

We will keep your records for this study confidential as far as permitted by law. However, if we are required to do so by law, we will disclose confidential information about you. Efforts will be made to limit the use and disclosure of your personal information, including research study and medical records, to people who are required to review this information. We may publish the information from this study in journals or present it at meetings. If we do, we will not use your name.

The University of Southern California's Institutional Review Board (IRB) may review your records. Organizations that may also inspect and copy your information include the Food and Drug Administration (FDA) and the National Psoriasis Foundation (NPF).

Other people who provide medical care or who handle billing and payment at USC may review your research records and medical records, if necessary to conduct the research.

A description of this clinical trial will be available on http://www.ClinicalTrials.gov, as required by US law. This web site will not include information that can identify you. At most, the web site will include a summary of the results. You can search this web site at any time.

Federal law provides additional protections of your medical records and related health information. These are described in the HIPAA Authorization document. You will be asked to sign a separate HIPAA Authorization for Research form authorizing the access, use, creation, and disclosure of your health information.

Any video or photograph content used from patients will be obtained following the patients' written consent. Subject numbers will be used in place of patient names. We will not be anonymizing or de-identifying the digital photographs that are uploaded onto the *Wecudos* study website. However, photographs will be stored on the website in an encrypted form that meets the standards defined by HIPAA, on secure computer servers in controlled facilities. The electronic platform hosts a multitude of security technologies and procedures to protect personal information, including prevention of viewing photographs from unauthorized users and inability to replicate photos or use photos outside of the secure platform.

Individual responses to survey questionnaires will be stored in password-protected, electronic HIPAA-compliant databases called Research Electronic Data Capture (REDCap) and *Wecudos.* Only the investigators, study staff, IRB, and other authorized/designated individuals will be allowed access. All stored study information will be destroyed five years after the data are analyzed. Personally, identifying information will be removed from any data that are analyzed and published.

Your information or samples that are collected as part of this research will be used or distributed for future research studies without your additional informed consent. Any information that identifies you (such as your name) will be removed from your private information or samples before being shared with others.

A description of this clinical trial will be available on http://www.ClinicalTrials.gov, as required by U.S. Law. This Web site will not include information that can identify you. At most, the Web site will include a summary of the results. You can search this Web site at any time.

ALTERNATIVES

An alternative would be not to take part in this study and continue with your current care. Taking part in this study will not affect current or future dermatology healthcare.

PAYMENTS

You will not be compensated for your participation in this research.

COST

There is no cost to you for taking part in this study.

VOLUNTARY PARTICIPATION

It is your choice whether or not to participate. If you choose to participate, you may change your mind and leave the study at any time. Refusal to participate or stopping your participation will involve no penalty or loss of benefits to which you are otherwise entitled. If withdrawal must be gradual for safety reasons, the study doctor will tell you.

If you stop being in the research, already collected data may not be removed from the study database. You will be asked whether the investigator can continue to collect data from your records. If you agree, this data will be handled the same as the research data. No new information or samples will be collected about you or from you by the study team without your permission.

The study site may still, after your withdrawal, need to report any safety event that you may have experienced due to your participation to all entities involved in the study. Your personal information, including any identifiable information, that has already been collected up to the time of your withdrawal will be kept and used to guarantee the integrity of the study, to determine the safety effects, and to satisfy any legal or regulatory requirements.

CONTACT INFORMATION

If you have questions, concerns, complaints, or think the research has hurt you, talk to the study doctor April Armstrong at 323-865-3641 with any questions, concerns, or complaints about the research or your participation in this study.

This research has been reviewed by the USC Institutional Review Board (IRB). The IRB is a research review board that reviews and monitors research studies to protect the rights and welfare of research participants. Contact the IRB if you have questions about your rights as a research participant or you have complaints about the research. You may contact the IRB at (323) 442-0114 or by email at irb@usc.edu.

STATEMENT OF CONSENT

I have read (or someone has read to me) the information provided above. I have been given a chance to ask questions. All my questions have been answered. By signing this form, I am agreeing to take part in this study.

Name of Research Participant	Signature	Date Signed (and Time*)

Person Obtaining Consent

I have personally explained the research to the participant using non-technical language. I have answered all the participant's questions. I believe that the participant understands the information described in this informed consent and freely consents to participate.

Name of Person Obtaining Informed Consent	Signature	Date Signed (and Time*)

Appendix 13. Photography Training for Participants in Aim 3 Study

Photography Training for Participants

How to Take Photos of Your Skin

Photo Tips

- ✓ **Check images for focus, coverage, and exposure.**
- ✓ **Hold camera steady with both hands.**
- ✓ **Center anatomy in frame. Include only clinical information.**
- ✓ **Use Macro mode for close-up photos.**
- ✓ **Keep camera level with anatomy; do not angle up or down.**
- ✓ **Keep the camera zoom consistent.**
- ✓ **Use the flash, but not closer than 12 inches for macro images.**
- ✓ **Shoot against a featureless backdrop, such as a wall or door.**
- ✓ **Compression/Image Quality setting: JPEG Basic or Normal.**

Please upload photos of any active areas of your skin using the instructions provided.

HEAD AND NECK

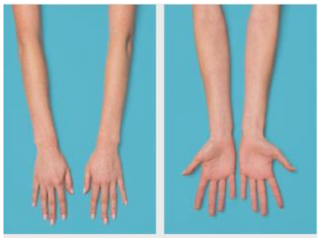
Preparation: Remove jewelry and makeup. Restrain hair. **Positioning:** Seated. Tuck chin slightly. Minimize rotation and tilting. Neutral expression.

ARMS

Upper Arms **Lower Arms**

Preparation: Remove applicable clothing and jewelry. Restrain hair.
Positioning: Standing, arms at side, palms facing front.

Hands



Preparation: Remove applicable clothing and jewelry.
Positioning: Seated, rest arms on table.

Preparation: Remove jewelry. Roll up sleeves.
Positioning: Seated, rest hands on table.

Armpits

Elbows

Preparation: Remove jewelry and deodorant, if visible. Restrain hair. **Positioning:** Standing, arms raised.

Preparation: Remove applicable clothing. **Positioning:** Standing.

TORSO AND BACK

Preparation: Remove clothing from upper body. Remove jewelry. Restrain hair.
Positioning: Standing, back straight. Minimize rotation and leaning.

GENITALS AND BUTTOCKS

Preparation: Remove clothing.
Positioning: Lithotomy pose for female.

LEGS

Front and Back of Legs

Preparation: Remove shoes, socks and applicable clothing.
Positioning: Standing, feet slightly apart.

Outer and Inner Legs

Preparation: Remove shoes, socks and applicable clothing.
Positioning: Bend knee of leg furthest from camera and move foot forward.

Feet

Preparation: Remove shoes, socks and applicable clothing. Brush debris from bottom of feet. **Positioning:** Keep feet close together. Have patient kneel for soles of feet.

Knees

Preparation: Remove applicable clothing. **Positioning:** Standing.