Viral haemorrhagic fever: a local operational approach.

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With the current Ebola outbreak in west Africa and continued intermittent outbreaks of other viral haemorrhagic fevers, there are concerns about identifying and managing cases imported to the UK. This article summarizes new guidance for acute care units, and describes management of the patient with suspected viral haemorrhagic fever.

Key messages

- Robust risk assessment for viral haemorrhagic fever is essential in managing fever in the returned traveller.
- Differential diagnoses such as malaria or sepsis must be considered, investigated and managed appropriately.
- Early case discussion with infection specialists, and onwards with the national Imported Fever Service where appropriate, can facilitate appropriate investigation and management.
- Adopting strict infection control practices, appropriate to the patient's level of risk for viral haemorrhagic fever, is paramount to maintaining a safe environment for healthcare staff and the public.
- Notification of suspected viral haemorrhagic fever cases to Public Health teams is essential, and should not wait for laboratory confirmation.

Introduction

Ebola virus was last diagnosed in the UK in 1976, yet new cases may soon present as the largest outbreak of this disease to date continues, with the global death toll likely to be considerable. The latest outbreak is suspected to have begun in a young child in southern Guinea from an animal source, but cases have now arisen across west Africa, predominantly in Liberia, Guinea and Sierra Leone (Baize et al, 2014). The World Health Organization has declared the outbreak a global health emergency and a public health risk to other states; indeed recent Ebola cases in Nigeria, initially linked to a traveller from Liberia, highlight the potential for international transmission. Moreover the repatriation of Ebola-infected expatriates to their home nations for treatment (Torjesen, 2014) makes transfer of this virus to industrialized countries inevitable. In addition to Ebola, other high-mortality viral haemorrhagic fever pathogens continue to occur in intermittent outbreaks, including Lassa, Crimean–Congo and Marburg viruses.

The relatively non-specific initial presentation of viral haemorrhagic fever, combined with the low incidence, can make diagnosis difficult for health-care professionals. Yet the significant clinical, infection control and public health sequelae of this disease mean continued vigilance for potential cases is essential.

The current Ebola outbreak has renewed focus on clinical and public health responses to viral haemorrhagic fever. In the UK, Public Health England (2014d), the Advisory Committee on Dangerous Pathogens (2014b) and the National Ambulance Resilience Unit (2014) have revised their national guidance. Internationally, the World Health Organization has launched an intensified response plan, including use of international health regulations legislative powers (World Health Organization, 2005) and interim infection prevention and control guidance (World Health Organization, 2014c), while updated guidance has also been issued from the United States Centers for Disease Control and Prevention (2014). This article summarizes the key points from much of this updated guidance and presents an operational approach adopted in a large infectious diseases unit, which may be of use to other units in their necessary engagement with and implementation of the formal national guidance.

Epidemiology: detail is essential.

While Ebola, Marburg and Lassa viruses are confined to certain geographical regions of Africa, Crimean–Congo haemorrhagic fever has a much wider area of endemicity. The current epidemiology of viral haemorrhagic fever viruses is depicted in Figure 1, but in many countries surveillance may not be robust enough to detect small outbreaks or may lag significantly. As evidenced by the current Ebola outbreak, the epidemiology of viral haemorrhagic fever can change rapidly. Therefore, while febrile travellers from viral haemorrhagic fever-endemic areas should certainly trigger a thorough risk assessment, patients with unusual febrile illness who have recently returned from other areas of the world should also prompt clinicians to consult up-to-date information on current viral haemorrhagic fever risk areas (**Table 1**).

Presentation: can be non-specific.

Patients with fever and a recent travel history may present via the emergency department, be referred from primary care, or be transferred in from other health-care institutions often with fever of unknown origin. Equally possible are patients already admitted, often with an undefined febrile illness, in whom a diagnosis of viral haemorrhagic fever may not yet have been considered. Early viral haemorrhagic fever presenting complaints are relatively non-specific:

- Myalgia and/or arthralgia
- Fatigue/malaise
- Pharyngitis
- Conjunctivitis
- Headache
- Diarrhoea /vomiting
- Rash (morbilliform in some cases of early Ebola/Marburg disease; ecchymosis or a petechial rash may appear late in all VHF viruses)

In late viral haemorrhagic fever disease, signs include:

- Shock
- Haemorrhage (haematemesis, bloody diarrhoea, or from mucous membranes)
- Encephalopathy
- Oedema of the face and neck

The lack of specific early signs and symptoms mean the clinical presentation may often be misinterpreted as an alternative infective pathogen rather than viral haemorrhagic fever. Indeed fever in the returned traveller will most likely not be viral haemorrhagic fever, but rather one of the other causes of febrile illness (Figure 2) (Johnston et al, 2009; Leder et al, 2013). However, delay in considering viral haemorrhagic fever at initial assessment (Kitching et al, 2009) or omitting appropriate baseline investigations as a result of preoccupation with viral haemorrhagic fever (Woodrow et al, 2007; Advisory Committee on Dangerous Pathogens, 2014b), thereby delaying management of other diagnoses (Case study), are common pitfalls in fever in the returned traveller. It is advisable therefore that any new local guidelines consider a practical approach to management of fever in the returned traveller that will outlast the current Ebola outbreak.

Risk assessment: the bottom line.

An immediate risk assessment for viral haemorrhagic fever must be made in febrile returned travellers. The incubation periods for viral haemorrhagic fevers vary by causative virus, but all lie within 2-21 days after exposure. Presentation with fever outside of this window makes a diagnosis of viral haemorrhagic fever highly unlikely. The possibility of viral haemorrhagic fever is raised when *both* of the following criteria are present;

1. fever (>38.0^{o}C; either at presentation or within the last 24 hours)
2. travel within the last 21 days to a viral haemorrhagic fever-endemic country, or contact with a suspected or confirmed case of viral haemorrhagic fever within the last 21 days.

Further details on specific activities must then be sought to classify the level of risk (**Figure 3**). Those classified as ‘high possibility of viral haemorrhagic fever’ necessitate specific management, infection control and public health actions. These patients should be immediately isolated in a side room and discussed with the local infection specialists (Infectious Diseases, Clinical Virology, or Clinical Microbiology depending upon local pathways), followed by appropriate, rapid, laboratory testing.

Investigations: minimise risk to all involved.

Onward transmission of viral haemorrhagic fever from patients to clinical and laboratory health-care workers is possible (Tarantola et al, 2006). The main risk arises from direct contact with bodily fluids

or blood. Specimens from ‘low possibility of viral haemorrhagic fever’ patients can be taken and processed as standard samples (Advisory Committee on Dangerous Pathogens, 2014b). In contrast, those from ‘high possibility of viral haemorrhagic fever’ patients should be:

1. Pre-emptively notified to the laboratory so that appropriate infection control procedures can be instigated (local protocols should be followed to ensure that such information is cascaded to laboratory personnel in all pathology disciplines)
2. Kept to a minimum, while still maintaining a safe diagnostic pathway for patient management
3. Undertaken only by a doctor or nurse experienced in venepuncture following stringent infection control procedures
4. Transported between patient and laboratory safely, e.g. transporting the sample to the laboratory specimen reception by hand (i.e. not via a pneumatic tube system) in a suitable container (likely at a minimum to include double bagging of the specimens and placement in a sealable, hardened plastic receptacle that is made readily available for such use).

Once received in the laboratory, samples must be processed at containment level 2 (samples can be processed in routine closed auto-analysers). Although not explicitly set out in guidelines, it is the authors’ view that venepuncture to obtain all the samples required for safe patient care and diagnosis should ideally be undertaken on a single occasion after initial risk assessment, to limit discomfort to the patient and risk to the practitioner. This would require institutions to develop local plans for safe transport and holding of samples pending initial tests. Other bodily fluids, including urine and stool, are also potentially infectious. Therefore in ‘high possibility of viral haemorrhagic fever’ patients these, and arterial blood gas samples, should first be discussed with an infection specialist.

Essential initial investigations should include: a malarial test (either blood film microscopy or rapid antigen test), full blood count, urea and electrolytes, liver function tests, C-reactive protein, glucose, clotting and blood cultures (Johnston et al, 2009; Advisory Committee on Dangerous Pathogens, 2014b; Public Health England, 2014d). Furthermore, where patients have been categorized as ‘high possibility of viral haemorrhagic fever’, and the initial malaria test is negative, specific testing for viral haemorrhagic fever is indicated. Testing for viral haemorrhagic fever is organized through the imported fever service (Public Health England, 2014a) by the local infection specialist.

Testing only occurs in regional centres – most frequently in England at the Public Health England rare and imported pathogens laboratory. Practically, this requires 4.5 ml of whole blood in an EDTA tube and a minimum of 0.5 ml (preferably >4 ml) of clotted blood (Public Health England, 2014c) together with the rare and imported pathogens laboratory request form completed by the clinical team (as clinical and epidemiological information is required). Laboratory staff should then transfer the rare and imported pathogens laboratory samples to the necessary United Nations approved transit container and organize an approved courier. On occasion the clinical team may need to organize this. In such circumstances, there should be local policies as to how to enact this, but the packaging must conform to UN2814 standards and the courier must have an Agreement to carry Dangerous Goods by Road licence (Economic Commission for Europe Committee on Inland Transport, 2013). It is important that clear contact details for the responsible clinician are passed to the imported fever service team, enabling results to be rapidly relayed when available. Given the shift system adopted by many hospitals, the authors' view is that this should be a senior infection physician who is aware of the patient and who will be readily contactable by telephone for the next 24–48 hours, rather than a busy frontline physician.

Plain radiography may be necessary for acutely unwell patients. Those categorized as 'low possibility of viral haemorrhagic fever' can have portable radiographs performed, with suitable precautions used as advocated for other communicable diseases (e.g. use of disposable impervious cassette or detector covers) (Fox and Harvey, 2008). In those categorized as 'high possibility of viral haemorrhagic fever' each investigation should be considered carefully and, where undertaken, appropriate post-procedure decontamination of equipment according to recent guidance on control measures for blood-borne viruses in the clinical setting (Advisory Committee on Dangerous Pathogens, 2014a).

Infection control: safety is paramount.

Management of suspected viral haemorrhagic fever patients must be undertaken with strict adherence to infection control guidelines. These vary according to the risk categorization of the patient, and whether there is a risk of bodily fluids being aerosolized or splashed (**Table 2**). Health-care organizations must prepare their staff in complying with these guidelines. In the authors' experience

two issues frequently occur. First, staff are often unfamiliar with the safe procedure for gowning and, importantly, degowning. Training and clear diagrams may be needed (World Health Organization, 2014c). Second, staff must be trained in the proper use of FFP3 respirators and, in particular, how to fit test a mask. Although staff may have had previous training in preparation for influenza and other respiratory-borne infections, re-training may be necessary (Public Health England, 2013).

Planning patient flow is essential. Identification of appropriate single side rooms for assessment and involvement of the emergency planning team should occur early. Where patients are assessed as 'high possibility of viral haemorrhagic fever' and testing for viral haemorrhagic fever is indicated, clear plans for where to physically manage the patient for the first 12–24 hours (until the viral haemorrhagic fever results are available) must be made. If the patient is being managed in an appropriate side room within the emergency unit, unnecessary moves to other areas of the hospital, for example to avoid breaching waiting time targets, must be prevented. Where a child is undergoing viral haemorrhagic fever risk assessment (sick children may travel unnoticed more easily than a sick adult), and arrives with parent(s), cohorting in a side room until more information is available is prudent.

Confirmed cases of viral haemorrhagic fever must be managed at a high level isolation unit. The Royal Free Hospital in north London is currently the only unit nationally. The decision to transfer a patient should be made by the responsible clinician with agreement from the high level isolation unit team. Logistically these transfers can be complex to organize and an appropriate ambulance must be used (National Ambulance Resilience Unit, 2014). During this time care for the patient must continue using strict infection prevention and control precautions (**Table 2**).

Clinical Management: predominantly supportive.

Returned travellers presenting with fever where a diagnosis other than viral haemorrhagic fever is possible or confirmed, or where diagnostic tests for viral haemorrhagic fever are awaited, should be managed according to best practice, including for malaria (Lalloo et al, 2007), influenza-like illness (Public Health England, 2014b) and sepsis (Dellinger et al, 2013). Intravenous lines will likely be required and, providing strict infection control guidelines are observed, are not contraindicated. An assessment for the need for broad-spectrum empiric antibacterials should be made – these are

frequently indicated in unwell febrile patients and should not await test results. In contrast, empiric use of antimalarials is not usually indicated, and malarial test results should be awaited before starting these. Where patients are confirmed as having viral haemorrhagic fever, care is predominantly supportive, focussing on: analgesia, antipyretics (avoiding non-steroidal anti-inflammatory agents), oxygenation, maintaining adequate organ perfusion (with intravenous crystalloid fluids), anticonvulsants, and replacement of blood products and electrolytes (World Health Organization, 2014a).

Specific antiviral therapies have not been proven to work for any of the viral haemorrhagic fever pathogens. There is observational evidence that, specifically for Lassa virus and Crimean–Congo haemorrhagic fever, parenteral ribavirin may be effective if given early (Soares-Weiser et al, 2010; Dahmane et al, 2014). While novel antivirals, antibodies and vaccines for a number of viral haemorrhagic fever including Ebola are all in development, none have reached planned clinical evaluation (Qiu et al, 2013; Enserink, 2014), yet mechanisms do exist to speed up new drug approval (Aebersold, 2012). Limited use of experimental antibodies has recently been approved by the World Health Organization for the Ebola cases in west Africa although demand is likely to outstrip supply.

Public health action: wider implications.

The public health importance of viral haemorrhagic fever stems from the risk of both hospital and community transmission, the high case-fatality rate, the lack of available treatment, and difficulties in prompt recognition and diagnosis (Advisory Committee on Dangerous Pathogens, 2014b). Viral haemorrhagic fever is classed as a notifiable disease under UK health protection legislation. This requires registered medical practitioners and laboratories to notify cases in England to the proper officer of the local authority (usually via local health protection teams), and in Wales to the consultant in communicable disease control of the health protection team of the Public Health Wales NHS Trust. The notification is classed as urgent and therefore should be made by telephone as soon as possible after clinically suspicion, and always within 24 hours, followed by written notification within 3 days. In Scotland notifications should be made to the relevant health board, and in Northern Ireland to the Regional Director of Public Health of the Public Health Agency, both via telephone as soon as possible. Notification should not be delayed by waiting for disease confirmation. These bodies may also be contacted by port authorities regarding passengers arriving in the UK with suspected viral

haemorrhagic fever. Forward notification to other relevant bodies such as directors of public health and the Department of Health will then occur dependent on the country in which the case is notified. In all UK countries a 'confirmed' case requires reporting to the European Centre for Disease Control and the World Health Organization.

Public health actions must be launched when a patient is categorized as 'high possibility of viral haemorrhagic fever'. Three main concerns are: risk assessment, control, and management of contacts. Public health teams will attempt to ensure that patients have been risk assessed and classified appropriately (**Figure 3**). They should also clarify that initial actions have been taken in terms of isolation of the patient (including consideration of transfer to a high level isolation unit), and that timely investigation and management has occurred.

The Incident Control Team

Once viral haemorrhagic fever has been confirmed (and occasionally for 'high possibility of viral haemorrhagic fever' cases) an incident control team must be set up. This is likely to include: a consultant in communicable disease control, a local infection specialist, a local authority member of the public health team where appropriate, and representatives from the local trust, the high level isolation unit team, the regional reference laboratory, regional epidemiology, and the communications team. The main responsibility of the incident control team is to ensure recommendations contained in the Advisory Committee on Dangerous Pathogens (2014b) guidance are carried out and to determine the parties responsible for certain actions, in particular for risk assessing contacts. A 'monitoring officer' will be designated to oversee follow up of high risk contacts. An essential role of the incident control team in these cases, which often generate intense media interest and a high degree of public concern, is to agree key media messages between all parties alongside a lead for media handling. Thus, no media messages or press statements should be released without the agreement of all parties involved. Such statements should also be shared with the Department of Health.

Management of contacts

Current guidance defines a contact as a person who has been exposed to an infected person or his/her blood, body fluids, excretions or tissues following the onset of their fever (Advisory Committee on Dangerous Pathogens, 2014b). The public health team will identify such contacts and categorize them

into one of three categories: category 1 (no risk), category 2 (low risk) and category 3 (high risk). This allows contacts to be managed with either reassurance, passive or active monitoring as outlined in **Table 3**.

Contact tracing should begin as soon as a patient has been assessed as 'confirmed viral haemorrhagic fever' (Advisory Committee on Dangerous Pathogens, 2014b), but public health teams may well gather initial contact information before disease confirmation in order to avoid potential delays and given the possibility of clinical deterioration. This will often be done over the telephone in liaison with the clinical team involved or the hospital infection control team.

Prophylaxis

Guidance is currently unclear regarding prophylaxis of contacts in the context of viral haemorrhagic fever caused by the arenaviruses. Prophylaxis is generally not recommended but could be considered for very high risk contacts (Advisory Committee on Dangerous Pathogens, 2014b). Antivirals such as oral ribavirin may be effective in the early stages of Lassa fever, although there is concern that it may prolong the incubation period (Bausch et al, 2010). Discussion within the incident control team should occur in cases where prophylaxis is being considered.

Post mortem examination and care of the deceased

Viral haemorrhagic fever can be transmitted via contact with the bodies of those who die of the disease. Thus post mortems should be avoided in these patients, as should embalming, as these procedures expose staff to unacceptable risks. If testing is required to verify the cause of death, this needs to be carefully considered and a consensus reached regarding the extent of sampling required, with autopsy avoided unless diagnostic testing for viral haemorrhagic fever is negative. All staff involved should ensure adequate personal protective equipment is used.

Patients declining admission or confinement

Several media reports have arisen during the current Ebola outbreak concerning difficulties ensuring that viral haemorrhagic fever patients are cared for under appropriate isolation in medical facilities. In the UK, on the very rare occasions that voluntary cooperation is not forthcoming, powers exist under public health legislation (Department of Health, 2010) to impose certain restrictions or requirements

where an infection or contamination presents, or could present, significant harm to human health. Practically, this would need to be done through a local authority application to a Justice of the Peace for a Part 2A order.

Air travel

A concern of the media, and the public, is the scenario of a patient with viral haemorrhagic fever having travelled on a commercial aircraft, despite the very small chances of transmission. Contact tracing would be considered only in confirmed cases (or 'probable cases' with specific symptoms or epidemiological links as defined by the guidelines) who were symptomatic on the flight and the flight was within the last 21 days (European Centre for Disease Prevention and Control, 2011). For Lassa fever there would additionally have to be exposure to bodily fluids of the case on board. Contact tracing should only be concerned with passengers who were one seat away from the index case in all directions, and crew members and cleaning staff working in the section where they were seated. Any person reporting direct contact with the case for Ebola and Marburg, or with bodily fluids of the case for Lassa fever, should also be traced (European Centre for Disease Prevention and Control, 2011).

Conclusion

Febrile patients presenting within 21 days of returning from viral haemorrhagic fever-endemic or outbreak countries should be carefully risk assessed in accordance with the formal national guidance and algorithms. For the minority of patients who are deemed to have a 'high possibility of viral haemorrhagic fever', there are significant implications for management, infection prevention and control, and public health action. Health-care providers must pre-empt these cases and operationalize the numerous recent national and international guidelines for management of viral haemorrhagic fever, implementing robust local pathways to ensure safety for the patient, health-care staff and the public.

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Table 1. Resources for detailed real-time viral haemorrhagic fever epidemiology.

Viral haemorrhagic fevers vary markedly in incidence by region and over time. Resources for up-to-date information on current VHF cases and outbreaks are:

- The Global Outbreak Alert & Response Network (World Health Organization, 2014). http://www.who.int/csr/outbreaknetwork/en/

- The Outbreak Surveillance System (National Travel Health Network and Centre, 2014). http://www.nathnac.org/countrysearch.aspx

- The Program for Monitoring Emerging Diseases (ProMED) (International Society for Infectious Diseases, 2014). http://www.promedmail.org/

Case study. The complexities of diagnosis for 'fever in the returned traveller'.

57-year-old man presented to the emergency department of a UK teaching hospital, before the current Ebola outbreak, with a 2-day history of high fever (40°C), myalgia and malaise. He had returned from a 10-day trip to Sierra Leone 20 days previously, where he had been touring rural plantations on business. He had not taken any malaria prophylaxis, but denied any insect bites, contact with animals or unwell humans, apart from a colleague who was treated for malaria.

An initial malaria film and antigen test were both negative. Investigations demonstrated a thrombocytopaenia (45 x 109/litre), a mild leucopaenia (neutrophils 2.0 x 109/litre; lymphocytes 0.3 x 109/litre) and a mild transaminitis (alanine transaminase 48 iu/litre). Testing for influenza, other respiratory viruses and HIV was negative. His fever persisted for the next 48 hours, and he was referred to the infection specialists. Discussion between the local infection specialists and the imported fever service supported the need to test for viral haemorrhagic fever and other imported pathogens in the context of persisting fever, notwithstanding the lack of current outbreak. The viral haemorrhagic fever polymerase chain reactions conducted at the regional testing facility were negative, as were tests for rickettsiae, dengue and chikungunya. The patient's fever settled spontaneously over the next 24 hours and he was discharged, only to re-present 48 hours later with a return of fever. Despite six previous blood films and a malaria antigen test all being negative, polymerase chain reaction, undertaken by the imported fever service, confirmed him to have malaria. Careful re-analysis of the initial blood films identified Plasmodium malariae on one of the films.

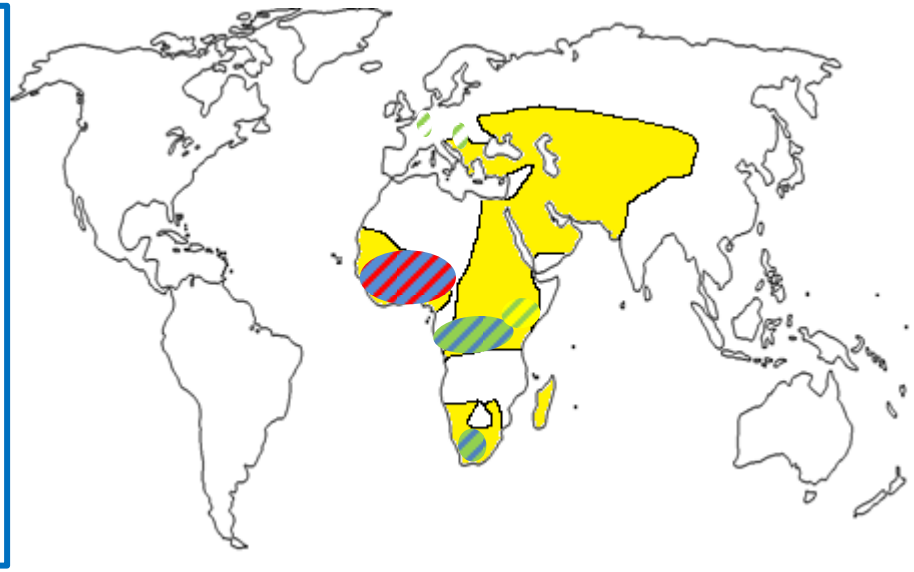
Lessons learnt:

- Viral haemorrhagic fever risk assessments may need to be re-visited if patients with fever in the returned traveller do not have a firm diagnosis made, or do not clinically improve
- Repeat testing for malaria is an essential part of diagnosis in patients with fever in the returned traveller. Malaria antigen testing may miss some cases
- Infection specialists and the imported fever service can provide key clinical input and facilitate rapid testing for viral haemorrhagic fever and other potential pathogens.

Figure 1. Global epidemiology of viral haemorrhagic fever; a complex picture

Crimean-Congo fever (Bunyaviridae family);
Widespread area of endemicity, extending across much of Africa, the Middle East and into Asia. Reservoir and the vector: Ixodid (hard) ticks. Ruminants and domesticated animals can serve as amplifying hosts. Person to person transmission has been reported though bodily fluids, including through medical equipment.

Ebola (Filoviridae family);
Countries reporting current outbreaks include Guinea, Sierra Leone, Liberia and Nigeria. Historical outbreaks reported in several central African countries and South Africa. Natural reservoir: not yet confirmed, but may be bats. Consumption of bush meat is a risk factor. Person to person transmission is through bodily fluids, including through healthcare equipment.



Lassa (Arenaviridae family);
Countries reporting endemic disease include Guinea, Sierra Leone, Liberia and Nigeria, with periodic isolation reported in other West African countries. Reservoir: *Mastomys* (a rodent). Transmission is via contact with its urine and droppings or objects/food contaminated with them. Person to person transmission can occur through bodily fluids.

Marburg (Filoviridae family);
Countries reporting outbreaks include Angola, Democratic republic of Congo, Uganda, Zimbabwe and South Africa. In the 1960s cases were also reported in Germany and Belgrade. Natural reservoir: animal, most likely bats. Can be transmitted through faeces or aerosols.

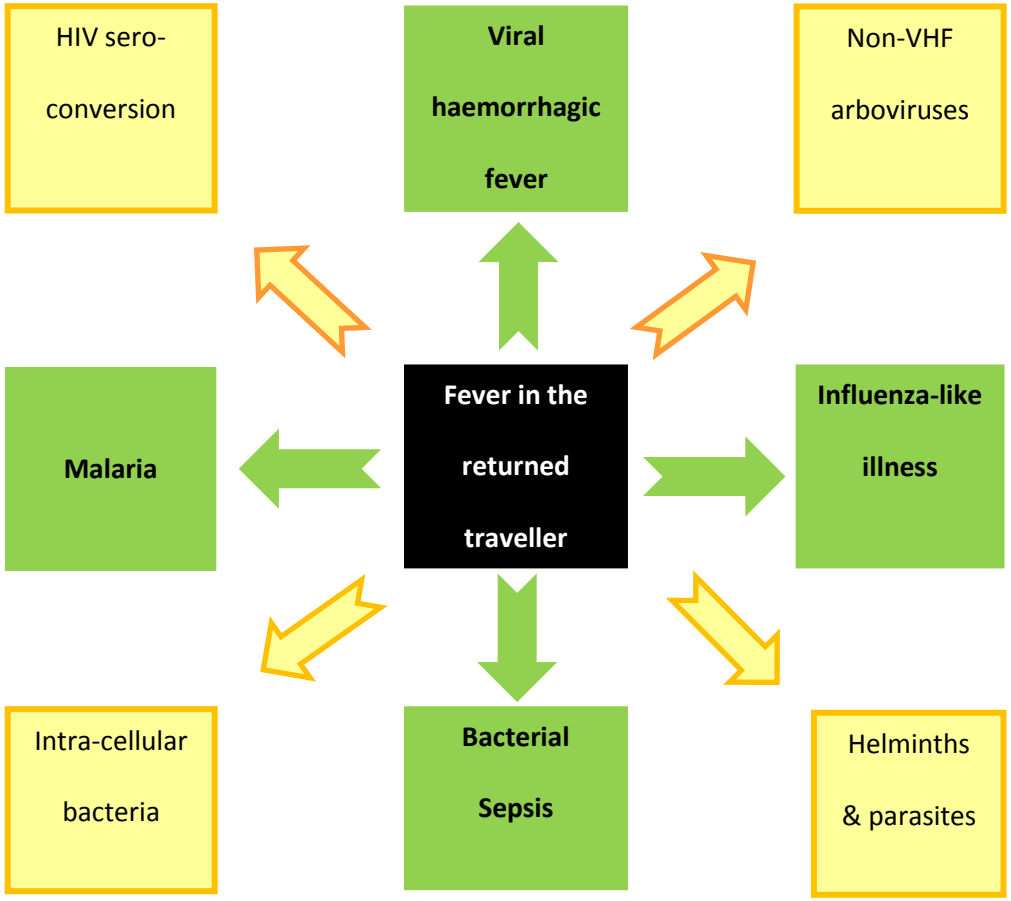
Other identified viral haemorrhagic fevers include:

- Lujo – South Africa
- Chapare and Machupo – Bolivia
- Kyasanur forest disease – India
- Alkhurma – Saudia Arabia
- Guanarito – Venezuela
- Junín – Argentina
- Sabiá - Brazil
- Omsk – Russia

Dengue (a Flaviviridae); is a mosquito-borne virus prevalent across much of the tropics which causes a febrile illness. A small minority (more frequent during a second infection) progress to haemorrhagic shock through a process of antibody-dependant enhancement. Person to person transmission has been reported through blood transfusion and transplantation.

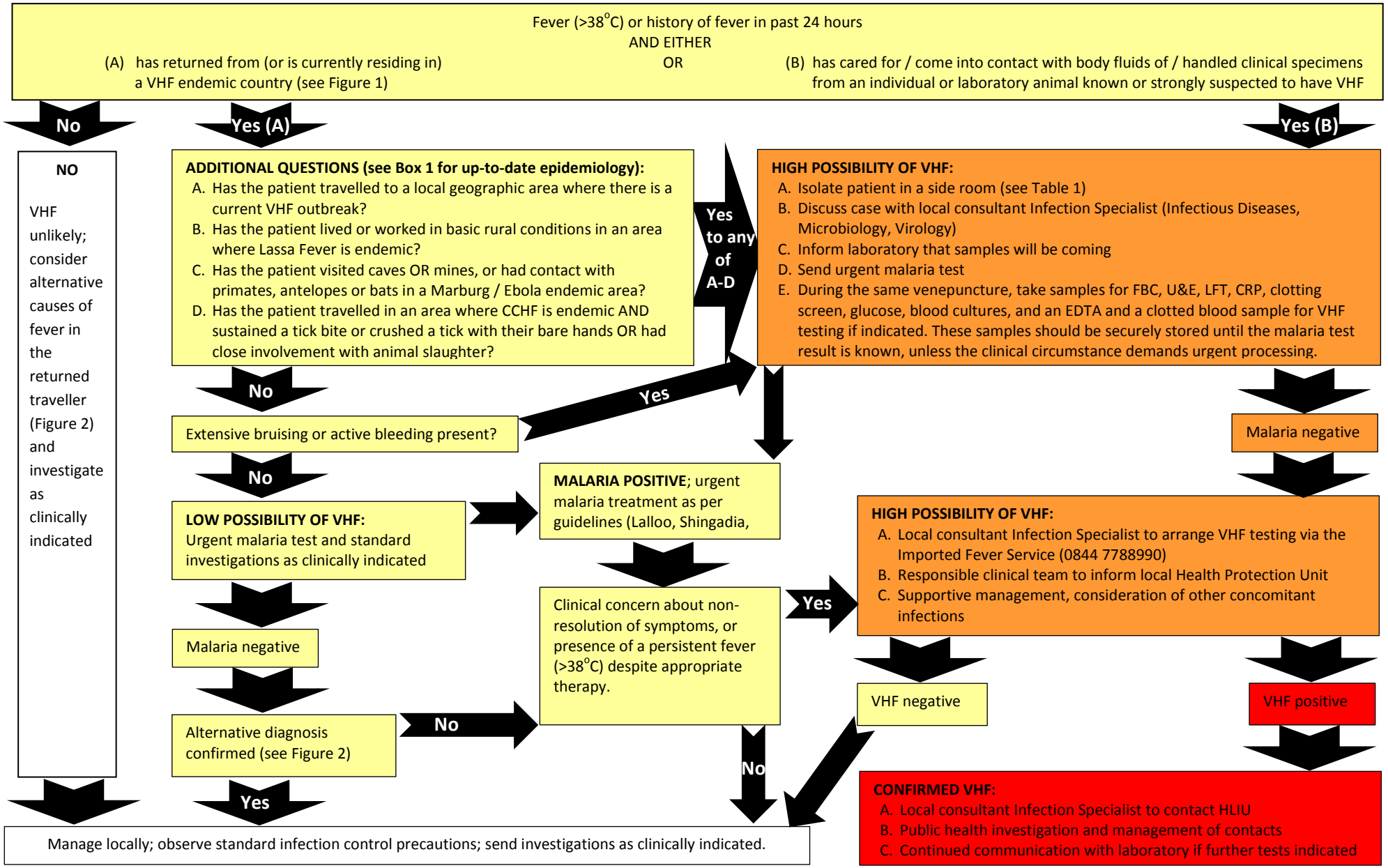
Legend: Up-to-date information on specific at-risk areas is available from several sources (see Box 1).

Figure 2. Framework for prioritising differential diagnoses of fever in the returned traveller on initial assessment.



Legend: Of particular importance in fever in the returned traveller (green boxes) are malaria and sepsis, both of which require urgent targeted therapy, and influenza-like illness for which specific infection prevention and control measures are warranted. Other diagnoses (yellow boxes) should also be considered according to history and other clinical indicators.

Figure 3. Viral haemorrhagic fever risk assessment – an example of a local algorithm modified for practical application.



Legend: Modified from Public Health England (2014d). The original Public Health England algorithm must be used when developing local protocols, this modified protocol is illustrative only as an example of a local adaptation of national guidelines. VHF: viral haemorrhagic fever, CCHF: Crimean-Congo haemorrhagic fever, HLIU: High Level Isolation Unit, FBC: full blood count, U&E: urea and electrolytes, LFT: liver function tests, CRP: C-reactive protein.

Table 1. Infection prevention and control advice for patients with possible or confirmed viral haemorrhagic fever.

	Infection control measures for patients who have a low possibility of VHF	**Infection control measures for patients who have a high possibility of VHF**	**Infection control measures for patients with confirmed VHF**
Isolation	Single side room with toilet en suite (or at least dedicated commode) immediately.	Single side room with toilet en suite (or at least dedicated commode) immediately until the possibility of VHF has been ruled out. Transfer to the HLIU to be considered if bruising, bleeding or uncontrolled vomiting or diarrhoea.	Immediate transfer to a HLIU unless there are exceptional circumstances that prevent the patient's transfer. In this case, liaison with the HLIU team, the local incident control team, and strict adherence to the ACDP guidelines, is essential.
	A lobby area for gowning and de-gowning is desirable for assessment of patients who are considered 'high possibility of VHF', and strongly advisable for those in either 'low-' or 'high possibility of VHF' where aerosol or splash risks are apparent.		
Equipment	All equipment where possible must be single use and needleless devices must be used on intravenous lines to reduce the risk of needle stick injury.		
Hands	Hand hygiene Gloves	Hand hygiene Gloves ***IF** bruising or bleeding or uncontrolled vomiting or diarrhoea: double gloves*	Hand hygiene Double gloves
Eyes	None ***IF** aerosol generating or splash risk: eye protection*	Eye protection	Disposable visor
Face	None ***IF** aerosol generating: FFP3 respirator* ***IF** splash risk: fluid repellent surgical facemask*	Fluid repellent surgical face mask ***IF** aerosol generating or bruising or bleeding or uncontrolled vomiting or diarrhoea: FFP3 respirator face mask*	FFP3 respirator face mask
Body	Plastic apron	Plastic apron ***IF** bruising or bleeding or uncontrolled vomiting or diarrhoea: Fluid repellent disposable gown or suit*	Fluid repellent disposable long sleeve gown or all-in-one disposable suit **AND** Plastic apron (over the disposable gown/suit)

Legend: Modified from 'Management of Hazard Group 4 viral haemorrhagic fevers and similar human infectious diseases of high consequence', (Advisory Committee on Dangerous Pathogens, 2014b). HLIU: High Level Isolation Unit. VHF: Viral haemorrhagic fever. FFP3: Filtering facepiece level 3 (a European Committee for Standardisation certified equivalent may be used as an alternative).

Table 2. Categorisation and management of contacts of VHF confirmed cases.

	Risk Category		
	No risk (Category 1)	**Low risk (Category 2)**	**High risk (Category 3)**
Definition	• No direct contact with the patient or body fluids. • Casual contact: (e.g. sharing a room with the patient, without direct contact with body fluids or other potentially infectious material).	• Direct contact with the patient (e.g. routine medical/nursing care, handling of clinical/laboratory specimens, but did not handle body fluids, and wore personal protective equipment appropriately).	• Unprotected exposure of skin or mucous membranes to potentially infectious blood or body fluids, including on clothing and bedding. Includes: • unprotected handling of clinical/laboratory specimens • mucosal exposure to splashes • needle stick injury • kissing and/or sexual contact.
Management	Reassure about absence of risk.	Reassure about low risk 'Passive monitoring': • Self-monitor for fever/symptoms for 21 days from last possible exposure • Report to the Monitoring Officer if temperature >38.0ºC • Further evaluation as necessary.	Inform about risks 'Active monitoring': • Record own temperature daily for 21 days following last contact with the patient • Report this temperature to the Monitoring Officer by 12 noon each day • Further evaluation as necessary • Inform Monitoring Officer urgently if symptoms develop.
	Provide category-specific written information. No restrictions on movement or work should be instituted unless symptoms develop.		

Legend: Modified from 'Management of Hazard Group 4 viral haemorrhagic fevers and similar human infectious diseases of high consequence', (Advisory Committee on Dangerous Pathogens, 2014b).