



# Contaminated sponges as source of *Klebsiella pneumoniae* prostatitis outbreak after transrectal ultrasound-guided prostate biopsy

Victor Renault<sup>1</sup>, Samuel Chelly<sup>2</sup>, Marie Prime<sup>1</sup>, Guillaume Aubin<sup>3</sup>, Nathalie Bodet<sup>1</sup>, Agnès Guillot<sup>2</sup>, Franck Bruyère<sup>4</sup>, Stéphane Corvec<sup>5,6</sup>, Gabriel Birgand<sup>1,7,8,\*</sup>

<sup>1</sup> Regional Center for Infection Prevention and Control Pays de la Loire, CHU de Nantes, Nantes, France

<sup>2</sup> Service d'Urologie, Clinique Saint Joseph, Trélazé, France

<sup>3</sup> Laboratoire LabOuest, Ancenis, France

<sup>4</sup> Service d'Urologie, CHRU, Tours, France

<sup>5</sup> Service de Bactériologie et des Contrôles Microbiologiques, CHU de Nantes, Nantes, France

<sup>6</sup> INSERM, Immunology and New Concepts in ImmunoTherapy, INCIT, UMR 1302, Nantes Université, Nantes, France

<sup>7</sup> National Institute for Health Research Health Protection Research Unit in Healthcare Associated Infections and Antimicrobial Resistance at Imperial College London, London, United Kingdom

<sup>8</sup> Cibles et médicaments des infections et de l'immunité, IICiMed, UR 1155, Nantes Université, Nantes, France

## ARTICLE INFO

### Article history:

Received 29 July 2025

Revised 5 September 2025

Accepted 9 September 2025

### Keywords:

Prostate biopsy

Infection

Prostatitis

Enterobacteria

Health care-associated infections

## ABSTRACT

**Objectives:** The infection rates following transrectal ultrasound-guided (TRUS) prostate biopsy range from 1–5%, mostly caused by *Escherichia coli*. We investigated an abnormal increase in *Klebsiella pneumoniae* prostatitis rate following TRUS prostate biopsy in a urological surgery center.

**Methods:** The outbreak occurred in a 217-bed private hospital performing TRUS prostate biopsies. After an antibiotic prophylaxis (single 3 g dose of fosfomycin-trometamol 2 hours before the procedure), each biopsy was placed on a pre-impregnated sponge and then transferred to a plastic cassette for pathological analysis. The outbreak investigation relied on a retrospective analysis of cases defined as the occurrence of a urinary or systemic infection caused by *K. pneumoniae* within 7 days following a TRUS prostate biopsy, including a review of procedures and microbiological analysis.

**Results:** Between January 1 and March 31, 2024, 13/49 (27%) patients who underwent TRUS prostate biopsy developed clinical symptoms of prostatitis requiring hospitalization. The incidence rate was 20% (5/25, three with *E. coli*) from January 3 to February 20, 2024 and increased to 33% (8/24, seven with *K. pneumoniae*) from February 21 to March 31, 2024. During the investigation, *K. pneumoniae* strains isolated from clinical samples and moistened sponges were genotypically similar, confirming the latter as the source of infection. The pack of sponges in use was discarded, with sterilization of sponges and trays before their use. No other case of *K. pneumoniae* prostatitis was identified following these measures from April to December 2024.

**Conclusions:** This investigation underlines the critical need for evaluation of practices around the preparation of sponges and cassettes in contact with the puncture needle when performing TRUS prostate biopsy.

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## Introduction

Prostate cancer represents the leading cause of cancer in men, with an estimated 60,000 new cases per year in France [1,2]. An estimation of 130,000 prostate biopsies is performed each year [1]. The current standard diagnosis remains a transrectal or per-

ineal ultrasound-guided (TRUS) prostate needle biopsy performed in consultation under local anesthesia [3]. Despite an estimated low risk of complications, 0.5–7% of patients are hospitalized following TRUS prostate biopsy, with a 30-day mortality rate between 0% and 0.3% [4,5]. Among these complications, 70% are related to infections, with reported incidences from 0–6% of urinary tract infection and 0.1–2.2% of bloodstream infection [5–8]. During a prospective multicenter study, including 2718 patients benefiting from TRUS prostate biopsy in France in 2013, 2.8% (95% confi-

\* Corresponding author.

E-mail address: [gabriel.birgand@chu-nantes.fr](mailto:gabriel.birgand@chu-nantes.fr) (G. Birgand).

dence interval [CI] 2.2–3.4) experienced sepsis related to the procedure [5]. The pathophysiology is based on the direct inoculation of bacteria from the rectal mucosa by the biopsy needle into the prostate, blood vessels, or urinary tract, with *Escherichia coli* representing 75–90% of pathogens isolated from infections [9]. Before 2024, an antibiotic prophylaxis was recommended with fluoroquinolones, a single dose administered orally before TRUS prostate biopsy [3,10]. The high proportion of *E. coli* infection following TRUS prostate biopsy, combined with the low resistance rate of this species to fosfomycin and the consideration of the impact on gut microflora, has driven a switch in antibiotic prophylaxis guidelines from ofloxacin to fosfomycin at the end of 2023 [11].

Outbreaks of TRUS prostate biopsy-related infections have previously been reported with microorganisms resistant to antibiotic prophylaxis [8,12]. Endogenous microflora was described as a potential source of infection, with the growing resistance of *Enterobacterales*, especially fluoroquinolone-resistant *E. coli*, becoming prevalent in the community and the decreased efficacy of antibiotic prophylaxis [12–14]. Moreover, outbreaks were reported resulting from non-sterile handling of materials or inadequate procedures, mostly involving environmental bacteria resistant to antibiotic prophylaxis facilitated by asepsis failures [12,13,15]. Herein, we investigated the causes of an abnormal increase in *Klebsiella pneumoniae* prostatitis rate following TRUS prostate biopsy in March 2024 at a urological surgery center by analyzing patients' characteristics, practices, and potential environmental contaminations.

## Methods

### Population and setting

In March 2024, the urology team of a 217-bed private hospital reported several patients hospitalized for sepsis after a TRUS prostate biopsy to the infection prevention and control (IPC) unit. Overall, 170 TRUS prostate biopsies are performed annually in this hospital, both in an outpatient consulting room and in an operating room. According to the 2024 French national guidelines, the antibiotic prophylaxis regimen was changed in February 2024, switching from ofloxacin (400 mg 1 hour before the procedure) to fosfomycin (3 g 2 hours before the procedure) [11].

### TRUS prostate biopsy protocol

A digestive enema was performed by patients at home, and an oral single dose of 3 g of fosfomycin was ingested by patients 2 hours before the procedure. After checking these previous steps with the patient and the lack of contraindications, patients were placed in a lithotomy position. A protection covered the ultrasound probe with the use of gel. A single-use needle guide was set up on the ultrasound probe (Figure 1). Non-sterile sponges (or pads) were soaked in a saline solution of sodium chloride (0.9% NaCl) and placed in non-sterile plastic boxes for the transport of biopsies to the pathology laboratory. Local anesthesia was performed by injecting 10 ml of 1% lidocaine with a single-use needle into the periprostatic nerve plexus under ultrasound guidance. Regarding bowel preparation, no rectal cleansing or povidone-iodine enema was used prior to biopsy, adhering to French Urology Association recommendations despite European recommendations [3,16]. A single-use biopsy needle was used for each patient, with 10–12 biopsy cores obtained per procedure using the same needle, in accordance with the European and French urology guidelines. No re-use or re-sterilization of the needle was performed. The needle guide was also single-patient use. Once all the biopsies were performed, the plastic boxes were immersed in a bottle containing formol. Between patients, probes were disinfected using Wip'Anios

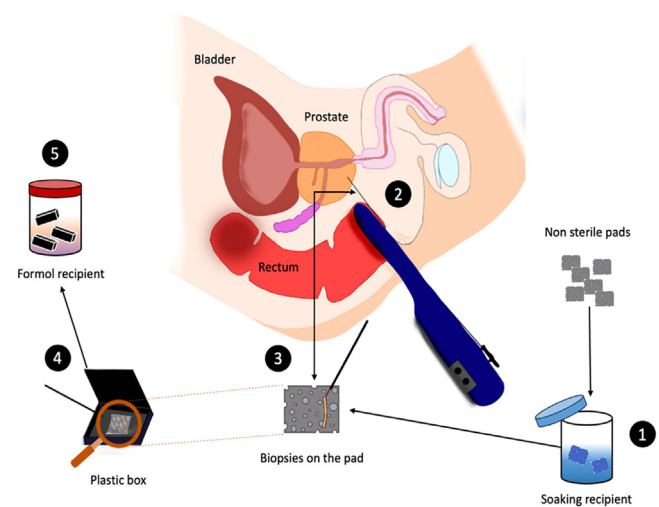


**Figure 1.** Schematic illustration of a transrectal ultrasound-guided prostate biopsy procedure.

Footnotes: 1, Soaking of non-sterile pads in a saline solution of sodium chloride (0.9% NaCl); 2, Performance of transrectal prostate biopsies with the use of a guided single-use needle with the guidance of an ultrasound probe; 3, Deposit of prostate biopsies on non-sterile pads; 4, Storage of pads in non-sterile plastic boxes; 5, Immersion of plastic boxes in a formol containing bottle for lab transport.

Excel® wipes (Anios, Lille, France), a CE-marked disinfectant validated for medical devices and recommended by the manufacturer. At the end of each day, probes underwent high-level disinfection according to manufacturer instructions, including a 5-minute immersion in detergent (Aniosyme X3® 0.5% v/v solution) followed by Anioxide 1000® (3% peracetic acid solution) for 10 minutes, rinsing with bacteriologically controlled water, and drying with sterile pads before storage in a dedicated clean area. At the beginning of each new biopsy session, probes were visually checked. If needed, the validated disinfection protocol was applied before the start of procedures, consisting of wiping with Wip'Anios Excel® as described above.

### Outbreak investigation

A case of post-biopsy prostatitis was defined as a patient with a fever and/or a positive bacterial culture from blood or urine within the 7 days following the procedure. The investigation was performed locally by the IPC unit in collaboration with the regional coordinating center for IPC. Relying on a previous report relating to an outbreak of water-associated microorganisms [15], particular attention was paid to the practices around soaked sponges used to collect biopsies. The IPC team interviewed the staff and visited the outpatient consulting room. The soaked sponges were sampled to perform a microbiological analysis. All infectious complications identified during 2023 were collected through the urology unit register.

### Microbiological methods and molecular typing

Sponges were collected in a sterile container and vortexed for 1 minute with sterile water. Chocolate agar plates (ThermoFisher Scientific, Waltham, USA) were incubated in an aerobic atmosphere, and blood agar plates were incubated in aerobic and anaerobic at 37°C for at least 24 hours (and longer for anaerobic cultures). Bacterial identification was performed by mass spectrometry (Bruker Daltonics, Bremen, Germany) and antimicrobial susceptibility testing by microdilution gallery (Becton Dickinson, Franklin Lakes, USA).

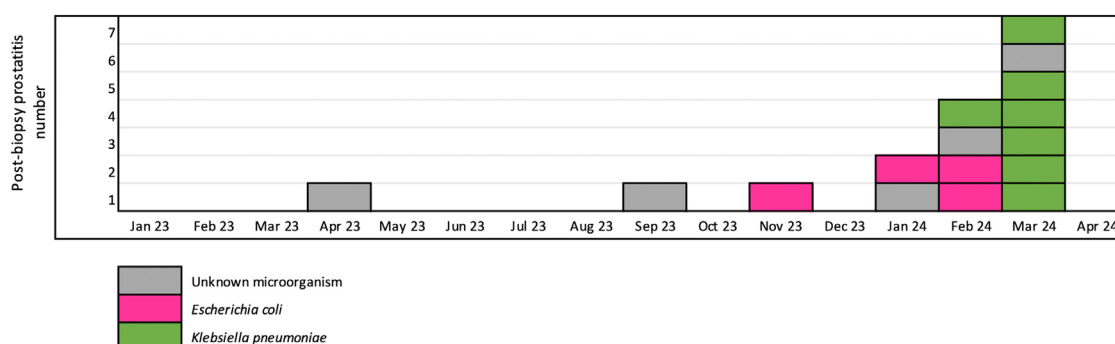


**Figure 2.** Epidemic curve of post-transrectal ultrasound-guided prostate biopsy prostatitis occurred in the clinic from January 2023 to May 2024.

A molecular typing comparison of the clinical strains isolated from clinical samples and sponges was performed by Pulsed-Field Gel Electrophoresis (PFGE). Briefly, a washed bacterial suspension was mixed with 2% Seaplaque agarose (FMC, Rockland, ME, USA) at 55°C and allowed to solidify into plug molds at room temperature. Chromosomal DNA was prepared in several incubating and washing steps using EC buffer (Tris-HCl, NaCl, EDTA, deoxycholate, Sarkosyl) and proteinase K. After digestion of the genomic DNA by *SpeI*, the restriction fragments were separated by pulsed-field electrophoresis using a temperature-controlled CHEF DRIII system (Bio-Rad, Hertfordshire, UK). After staining with 0.5 µg/ml ethidium bromide, the fragments were visualized using a UV transilluminator and then documented using a video gel documentation system. For pulsed-field electrophoresis pattern analysis, the software GelCompar (Applied Maths) was applied. The dendrograms were calculated, and isolates were considered, respectively, identical or closely related when there were either a 0 or a  $\leq 2$  banding differences according to Tenover criteria [17].

### Ethics approval

According to the French and European legislation, the use of data in this retrospective study does not need approval from the ethics committee. Samples for this study, results, and data were recorded during normal medical care of patients.

## Results

### Outbreak description

From January to March 2024, 13/49 (26.5%) patients who underwent a TRUS prostate biopsy were diagnosed with prostatitis in the follow-up period (Figure 2). The retrospective analysis identified three infectious episodes out of 166 (1.8 %) TRUS prostate biopsies in 2023. From January 3 to February 20, 2024, the incidence rate of post-biopsy prostatitis was 20% (5/25, three with *E. coli*, two unknown). From February 21 to March 27, 2024, the incidence rate increased to 33% (8/24, seven with *K. pneumoniae*, one unknown).

### Clinical description

The 13 patients diagnosed with post-biopsy prostatitis were hospitalized within the 7 days following the procedure without death occurring during the follow-up period. The mean delay from procedure to hospitalization was 2.5 days (95% CI 1.5–3.5), with a mean length of stay of 2.85 days (95% CI 2.55–3.15). All of them had a fever and a C-reactive protein serum level above 5 mg/l (min: 6 - max: 275). Among the 12 blood cultures performed, seven (58.3%) were positive with a microorganism. Blood culture

was the only positive microbiological sample for three patients (*data not shown*) with sterile urine samples. Regarding the 12 urine samples performed, all had significant leukocyturia above 10/mm<sup>3</sup> (min: 20 - max: 1450). All cases received an intravenous antibiotic treatment based on ceftriaxone (2 g/24 hours) with (7/13) or without (6/13) an aminoglycoside for at least 24 hours. The antibiotic switch was considered when apyrexia occurred, based on the patient's clinical state. The antibiotic treatment was narrowed down according to the antimicrobial susceptibility testing when apyrexia occurred, based on the patient's clinical state, with a mean delay of 12.7 days (95% CI 11.4–14.01) (Table 1).

### IPC investigation

On the day of the alert, local investigators identified the water of the container in which the sponges were soaked as a potential hazard and removed it. The audit of practices by the IPC team identified breaches in the sterile handling of sponges. Sponges were soaked overnight or between two procedures. The water of the container in which sponges were soaked was sometimes reused from patient to patient and from day to day. The nurses manipulated sponges with gloves for soaking before placing them in biopsy boxes. Gloves were removed to install the patient, and different gloves were donned to help the surgeon with the procedure. The ultrasound probe was covered with a single-use condom.

### Microbiological studies and molecular typing results

Microbiological cultures of the two soaked sponges were positive with *K. pneumoniae*. All dry sponges tested negative. Antimicrobial susceptibility testing of the strains isolated from infected patients is described in Table 2. The three *E. coli* strains isolated during the outbreak period revealed different susceptibility patterns. Patient n°2 had an ESBL (extended-spectrum beta-lactamase) producing *E. coli* strain. All *K. pneumoniae* strains showed the same antimicrobial susceptibility patterns with identical minimal inhibitory concentrations (MIC) for all the antibiotics tested, revealing a high-level producing-penicillinase profile. Molecular typing using PFGE was performed on *K. pneumoniae* clinical strains isolated from three patients (Figure 3; n°7, 8, and 13) with post-biopsy prostatitis and two environmental strains recovered from the sponges, confirming a high relatedness between the isolates with a 100% similarity of the macro-restriction profiles (Figure 3).

### IPC measures and outbreak termination

The stock of sponges was removed when suspected as the source of contamination, and a new batch of sponges was ordered. Then, sponges and boxes were systematically sterilized, and the new set of sponges was used after two consecutive negative microbiological controls. All of this material was placed on a sterile field

**Table 1**  
Clinical and biological characteristics of the 13 post prostate biopsy prostatitis cases between January 1 and March 27, 2024, France.

| Identification n                                | Cases   |                |                |                |          |              |              |              |              |              |              |          |              |
|-------------------------------------------------|---------|----------------|----------------|----------------|----------|--------------|--------------|--------------|--------------|--------------|--------------|----------|--------------|
|                                                 | 1       | 2              | 3              | 4              | 5        | 6            | 7            | 8            | 9            | 10           | 11           | 12       | 13           |
| Age                                             | 70      | 50             | 72             | 67             | 65       | 72           | 68           | 74           | 70           | 72           | 76           | 61       | 58           |
| Intervention date                               | 1/17/24 | 1/24/24        | 1/31/24        | 2/6/24         | 2/7/24   | 2/21/24      | 3/6/24       | 3/13/24      | 3/13/24      | 3/20/24      | 3/20/24      | 3/26/24  | 3/27/24      |
| Antimicrobial prophylaxis                       | OFL     | OFL            | OFL            | OFL            | FOS      | FOS          | FOS          | FOS          | FOS          | FOS          | FOS          | FOS      | FOS          |
| Neutrophils (g/l)                               | 2.75    | 5.94           | 8.45           | 5.82           | 7.77     | 6.45         | 10.78        | 10.97        | 10.87        | 8.83         | 7.26         | 14.09    | 7.53         |
| C-reactive protein (mg/l)                       | 66      | 275            | 105            | 206            | 108      | 93           | 153          | 47           | 164          | 152          | 174          | 6        | 40           |
| Leukocyturia (/mm <sup>3</sup> )                | 396     | 259            | 713            | 250            | 109      | 1450         | 98           | 266          | 735          | NR           | 330          | 20       | 49           |
| Microbial results                               | Neg     | <i>E. coli</i> | <i>E. coli</i> | <i>E. coli</i> | Neg      | <i>K. pn</i> | <i>K. pn</i> | <i>K. pn</i> | <i>K. pn</i> | <i>K. pn</i> | <i>K. pn</i> | Neg      | <i>K. pn</i> |
| Temperature                                     | 38.6    | 38.7           | 40.2           | 38.7           | 38.1     | 37.8         | 38.6         | 41.0         | 39.1         | 38.0         | 38.9         | 38.6     | 38.5         |
| First line regimen                              | CRO     | CRO + AK       | CRO + AK       | CRO + AK       | CRO + AK | CRO          | CRO + AK     | CRO + AK     | CRO          | CRO          | CRO          | CRO      | CRO + G      |
| Antibiotic switch                               | NR      | Ertapenem      | Amoxicillin    | Pivmecillinam  | NR       | Cefixime     | SXT          | SXT          | SXT          | SXT          | SXT          | Cefixime | SXT          |
| Total length of treatment (days)                | 8       | 16             | 13             | 13             | 10       | 10           | 14           | 15           | 13           | 15           | 14           | 10       | 14           |
| Adenocarcinoma diagnosis (Gleason score if yes) | Yes [7] | Yes [6]        | Yes [6]        | Yes [6]        | No       | No           | No           | Yes [7]      | No           | Yes [6]      | Yes [7]      | Yes [9]  | No           |

AK, amikacin; CRO, ceftriaxone; *E. coli*, *Escherichia coli*; FOS, fosfomycin (3 g 2 hours before the procedure); G, gentamicin; *K. pn*, *Klebsiella pneumoniae*; NR, not realized; Neg, negative; OFL, ofloxacin (400 mg 1 hour before the procedure); SXT, trimethoprim/sulfamethoxazole.

and used for one single patient. Sterilized sponges were moistened with single dose sterile physiological saline. No microbiologically confirmed infection occurred from March 2024 to December 31, 2024.

Discussion

We investigated an outbreak of seven prostatitis with genetically similar *K. pneumoniae* after TRUS prostate biopsy occurring between January and March 2024 in a private clinic. This event occurred in the context of a change in antibiotic prophylaxis recommendations from ofloxacin to fosfomycin with more than 50% of outpatients *K. pneumoniae* clinical strains resistant to the latest. Our analysis highlighted breaches in the preparation of sponges (or pads) used to transport biopsies to the pathology laboratory. Based on the strains isolated from clinical cases and sponges, we may assume that sponges were soaked in saline water contaminated with *K. pneumoniae* through inadequate glove use. The repeated contact of the biopsy needle with sponges to deposit biopsy cores may lead to needle contamination and inoculation of patient's prostate with *K. pneumoniae*.

Outbreaks involving contaminated sponges have been previously reported [15]. However, the post-biopsy prostatitis with *K. pneumoniae* associated with cross-contamination of sponges by asepsis failures in a context of switch of antibiotic prophylaxis policy from ofloxacin to fosfomycin has never been described. *K. pneumoniae* is rarely found in infections following TRUS prostate biopsy, whereas *E. coli* represents more than 75% [9]. We highlighted that the use of non-sterile equipment that is, at any moment, in contact with the biopsy material, should be sterilized or single-use. This includes the protection tube, puncture guide, needle, and all materials in contact with the needle, such as the transport medium for any lab tests in contact with the needle. In a French prostate biopsy audit, biptic fragments were placed by direct contact with the needle on a sterile surface for 49.4% and a non-sterile surface for 35.4% [18]. Our experience shows that practitioners using a non-sterile device expose patients to TRUS prostate biopsy-related infections. In these circumstances, compliance with best practices on hand hygiene and glove use is critical to prevent direct and indirect cross-contamination [19]. Although the theoretical use of a new sterile needle for each individual core might have further reduced the risk of transmission from contaminated sponges, such a measure is not currently recommended, would generate major cost and waste implications, and carries no medico-legal justification in routine practice [3,16].

We observed two different periods concerning the bacteria that infected case patients. The *E. coli* period (January 3 to February 20) had multiple strains with different antimicrobial susceptibility profiles, suggesting sporadic or multiple single-case events occurring. Interestingly, all the *E. coli* strains documented (3/3) were resistant to ciprofloxacin, and all the patients (3/3) received ofloxacin (400 mg 1 hour before intervention) as antibiotic prophylaxis. All these strains were susceptible to fosfomycin, considering a MIC of 8 mg/l according to the 2024 CASFM (Comité de l'Antibiogramme - Société Française de Microbiologie) [20]. Fosfomycin has a great susceptibility rate in France against *E. coli*, responsible for 80% of prostate biopsy-related infections. In 2024, fosfomycin susceptibility rate for *E. coli* was 98.1%, whereas *K. pneumoniae* susceptibility rate was only 29.9% [21]. All the *K. pneumoniae* prostatitis cases appeared after February 2024 when the prophylaxis switch was already effective. As the PFGE analysis showed, a perfect similarity between strains' profiles from patients 7, 8, and 13 was demonstrated, suggesting a transmission of the same fosfomycin-susceptible isolate during this outbreak period is plausible. We only tested the fosfomycin MIC for three strains out of six and all were susceptible (MIC = 3 mg/l). Although the clinical impact

**Table 2**  
Antibiotics susceptibility testing results (MIC in mg/l and clinical categorization in bracket) of *Klebsiella pneumoniae* and *Escherichia coli* clinical strains from post-prostate biopsy prostatitis cases between January 1 and March 27, 2024, France.

| Cases | Blood or urine samples | AMPI   | AMC     | TZP     | CRO      | FEP    | IMP       | G      | CIP       | SXT     | NF      | FOS     |
|-------|------------------------|--------|---------|---------|----------|--------|-----------|--------|-----------|---------|---------|---------|
| 1     | Negative               |        |         |         |          |        |           |        |           |         |         |         |
| 2     | <i>E. coli</i>         | >8 (R) | 32 (S)  | NA (S)  | >4 (R)   | 16 (R) | ≤0.25 (S) | >4 (R) | >1 (R)    | >80 (R) | ≤16 (S) | ≤16 (S) |
| 3     | <i>E. coli</i>         | ≤2 (S) | 4 (S)   | NA (S)  | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | 0.5 (R)   | ≤20 (S) | ≤16 (S) | ≤16 (S) |
| 4     | <i>E. coli</i>         | >8 (R) | 8 (S)   | NA (S)  | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | >1 (R)    | >80 (R) | ≤16 (S) | ≤16 (S) |
| 5     | Negative               |        |         |         |          |        |           |        |           |         |         |         |
| 6     | <i>K. pneumoniae</i>   | >8 (R) | >32 (R) | NA (R)  | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | ≤0.25 (S) | ≤20 (S) | 32 (S)  |         |
| 7     | <i>K. pneumoniae</i>   | >8 (R) | 32 (R)  | NA (R)  | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | ≤0.25 (S) | ≤20 (S) | 32 (S)  | 3 (NA)  |
| 8     | <i>K. pneumoniae</i>   | >8 (R) | >32 (R) | NA (R)  | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | ≤0.25 (S) | ≤20 (S) | 32 (S)  | 3 (NA)  |
| 9     | <i>K. pneumoniae</i>   | >8 (R) | >32 (R) | NA (R)  | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | ≤0.25 (S) | ≤20 (S) | 32 (S)  |         |
| 10    | <i>K. pneumoniae</i>   | >8 (R) | >32 (R) | >64 (R) | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | ≤0.25 (S) | ≤20 (S) | 32 (S)  |         |
| 11    | <i>K. pneumoniae</i>   | >8 (R) | >32 (R) | NA (R)  | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | ≤0.25 (S) | ≤20 (S) | 32 (S)  |         |
| 12    | Negative               |        |         |         |          |        |           |        |           |         |         |         |
| 13    | <i>K. pneumoniae</i>   | >8 (R) | >32 (R) | NA (R)  | ≤0.5 (S) | ≤1 (S) | ≤0.25 (S) | ≤1 (S) | ≤0.25 (S) | ≤20 (S) | 32 (S)  | 3 (NA)  |

AMC, Amoxicillin/clavulanate; AMPI, ampicillin; CRO, ceftriaxone; *E. coli*, *Escherichia coli*; FEP, cefepime; FOS, fosfomycin; G, gentamicin; IMP, imipenem; *K. pneumoniae*, *Klebsiella pneumoniae*; MIC, minimal inhibitory concentrations; NA, not available; NF, nitrofurantoin; R, resistant; S, susceptible; SXT, trimethoprim/sulfamethoxazole; TZP, piperacillin and tazobactam.

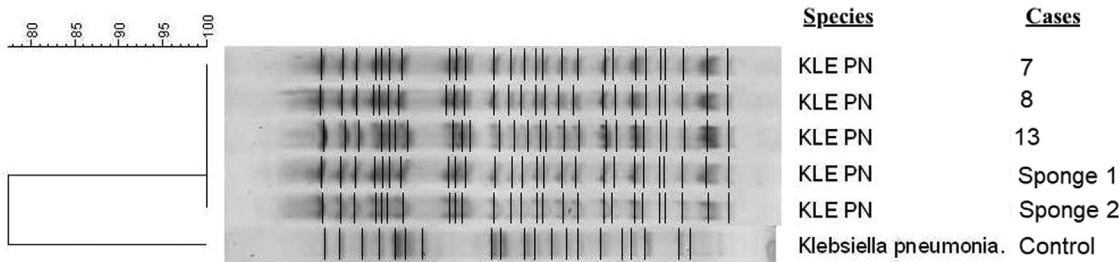


**Figure 3.** Dendrogram of pulsed-field gel electrophoresis of clinical and sponges strains of *Klebsiella pneumoniae*.  
Abbreviations: KLE PN, *Klebsiella pneumoniae*.

is not known, fosfomycin has a higher MIC against *K. pneumoniae* than *E. coli* due to its chromosomal *fosA* gene coding for a glutathione S-transferase [22,23]. However, fosfomycin is well distributed in prostate tissue even without inflammation, suggesting a local efficacy against susceptible microorganisms [24,25].

In this private hospital, the outbreak was reported in the usual ascending manner from clinical wards to the local IPC team, in line with French habits. IPC resources were structurally limited, with only one IPC nurse for 217 beds and no dedicated IPC physician, restricting the capacity for real-time surveillance and proactive monitoring. This constraint likely contributed to the delay in detection. Following the outbreak, corrective measures were implemented, including reinforcement of written protocols, revision of sponge-handling procedures, and expansion of the IPC team from one nurse to three members, enabling more preventive audits and oversight. This highlights the need for stronger IPC support and real-time surveillance systems in hospitals to ensure a prompt detection of abnormal events.

This investigation carries some limitations. First, only strains isolated from positive blood culture were available (3/7 *K. pneumoniae* strains); the water and recipient used to soak sponges were discarded at the time of the investigation. In consequence, we were unable to analyze all clinical isolates and to prove accurately the cross-contaminations with extensive molecular typing during the study period. In addition, the urgent need to end the outbreak made the data observational and the study mostly retrospective and subject to bias. Third, we were unable to perform a risk factor analysis due to not enough statistical power. Fourth, whole-genome sequencing was not performed due to a lack of availability of the method at the time of the investigation. Finally, some cases were potentially missed due to the retrospective assessment of the urology register.

In conclusion, this outbreak of post-TRUS prostate biopsy prostatitis suggests contaminated sponges as the source of infection

with a *K. pneumoniae* clone. This event occurred in the context of a change in antibiotic prophylaxis recommendations from ofloxacin to fosfomycin with >50% of outpatients *K. pneumoniae* clinical strains resistant to the latest. This investigation underlines the critical need for evaluation of hand hygiene and glove use but also practices around the preparation of sponges and cassettes in contact with the puncture needle to minimize the infectious risk when performing TRUS prostate biopsy.

**Declaration of competing interest**

The authors have no competing interests to declare.

**Funding**

This study was supported by the French State through the Agence Nationale de la Recherche (ANR 22 PAMR 0003, France 2030). The sponsors had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

**Ethical review statement**

According to the French and European legislation, the use of data in this retrospective study does not need approval from the ethics committee. Samples for this study, results, and data were recorded during normal medical care of patients.

**Acknowledgments**

None.

## Author contributions

Investigation: VR, SC, NB, AG, FB, GB; Microbiological analysis: SC, GA; data collection and analysis: VR, MP, GB; writing of the 1<sup>st</sup> draft: VR, GB; reviewing of the first draft of the paper: FB, SC; all authors: reviewing of the final article, and all authors approved the final version of the manuscript.

## Declaration of generative AI in scientific writing

The authors declare that they have not used any artificial intelligence in the writing process.

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