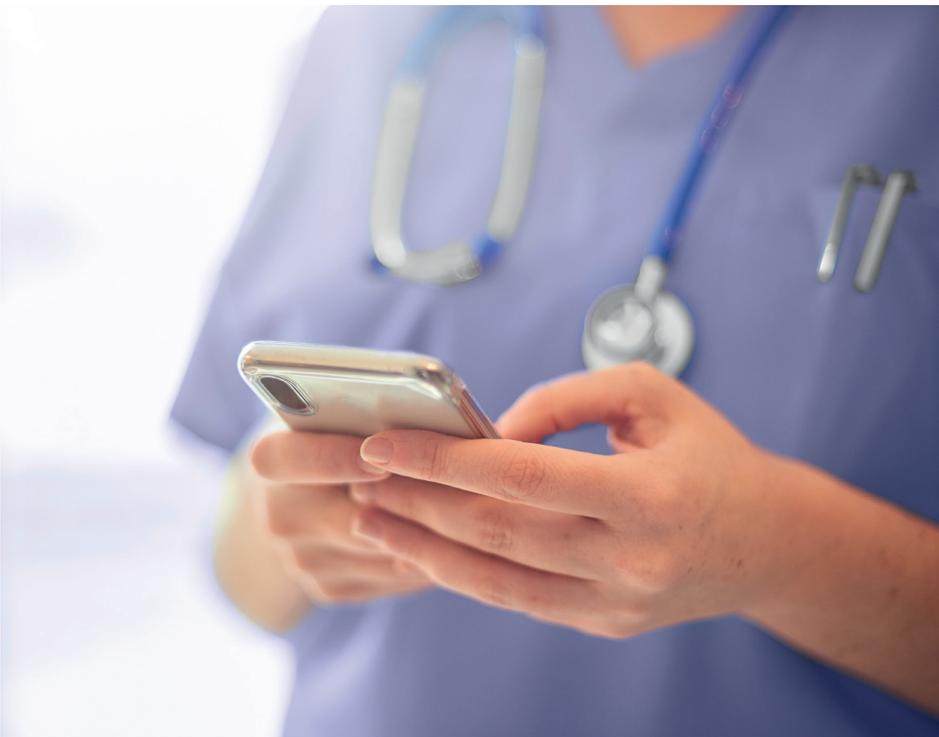


Practical study

Tracing transmission paths in hospitals with a “tracer”.



Designing hygiene measures in a targeted manner is an effective tool against hospital-acquired infections. Using a “tracer” – silica nanoparticles with encapsulated DNA – and under real conditions, it was possible for the first time to trace the transmission routes that a specific pathogen can take and what information can be derived for disinfection measures.¹

Question: What role do a shared patient bathroom, ward cell phones, stethoscopes, and hands play in pathogen transmission?

Recently, the significance of the immediate patient environment for transmission incidents has been increasingly recognized – also and in particular for antibiotic-resistant bacteria. The present study used an outbreak of *vancomycin-resistant enterococci* (VRE) as an opportunity to examine, by means of a “silica nanoparticle DNA tracer”, how a pathogen spreads from a contaminated body site of a patient who is accommodated in a two-bed room and shares the patient toilet with the neighbouring room. This “patient experiment” took place under real conditions.

To determine whether mobile phones shared by healthcare staff (ward mobile phones) also play a role in the transmission of pathogens from one patient to the other, several areas were contaminated with the “tracer” in a quasi-realistic setting. Afterwards, the authors investigated a standard examination situation involving the ward mobile phone and individually used stethoscopes (“mobile device experiment”).

Patient experiment methods

The inoculation of a small area of skin with the “tracer” in the subgluteal region of Patient A served as the initial pathogen reservoir. Patient A was then asked to get dressed and go to the bathroom, sit on the toilet

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seat for ten seconds, flush, then wash the hands and open the bathroom door to go back to bed. Following this, samples were taken from the patient’s subgluteal region, the toilet seat, the flush plate, the water tap and the door handle. The entire procedure was then repeated with Patient B.

To examine the further spread of the “tracer pathogen”, the authors allowed an eight-hour period to pass during which the patients were asked to behave normally and were not given any further instructions. After these eight hours, swabs of the following areas were taken:

- hands of Patient A and B
- in both rooms: bed control unit, patient’s mobile phone/telephone, entertainment device controls and intravenous pump
- computer keyboard and mobile phones of the nursing and medical staff responsible for Patient A and B during the eight hour shift (one person each)

Mobile device experiment methods

For this experiment, the “tracer” was first applied to the neck, chest and wrist of Patient A. Then, the following scenario was examined: Doctor A listens to Patient A’s heart and takes radial pulse. Doctor A makes a 30-second call with the ward mobile phone and then leaves it on the ward. Shortly afterwards, Doctor B uses the same ward mobile phone for a telephone call and, after the 30-second conversation, examines Patient B’s heart tones and radial pulse.

Swabs of the following regions were taken before and after the experiment:

- wrists, neck and chest of Patient A and B
- hands, cheeks and stethoscopes of doctor A and B
- front and back of the ward mobile phone

Patient experiment results

A total of 133 swabs from three runs resulted in the following positive rates:

Subgluteal region Patient A and Patient B	100 %
Toilet seat	100 %
Tap	100 %
Entertainment device controls	100 %
Hand of Patient A	100 %
Patient mobiles/phones	83,3 %
Bed controls	83,3 %
Intravenous pumps	80 %
Toilet flush plate	75 %
Door handle	75 %
Computer keyboard of medical staff in charge	66,6 %
Mobile phones of nursing/medical staff in charge	33,3 %
Computer keyboard of nursing staff in charge	33,3 %
Hand of Patient B	0 %

Practical study

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Mobile device experiment results

22 swabs were taken after the simulated standard examination; a total of two runs were carried out. They resulted in a positive rate of about 73 % of the regions sampled:

- hands, cheeks and stethoscopes of Doctor A and B
- front and back of the ward mobile phone

Tracer transmission to Patient B was detected in one of the two runs.

Conclusion of the experiments

This study is the first to show, under real conditions, the path of transmission – namely via a shared toilet – from a small area of skin in the subgluteal region of one patient to another patient. Moreover, it illustrates the subsequent further spread to many objects in the immediate patient environment in both rooms, as well as to surfaces distant from the patient, such as the computer keyboards of the staff in charge or their mobile phones. The main vectors here are the hands of both patients and healthcare professionals.

In the re-enactment of the physical examination, the doctors' hands and the ward mobile phone were identified as possible carriers of microorganisms – as was the stethoscope.



Crucial infection control measures include:

- hand disinfection by healthcare staff and also by patients as indicated
- disinfection of stethoscopes between patient examinations
- regular disinfection of high-touch objects – both near patients and in other hospital areas
- adapted cleaning and disinfection protocols for outbreaks and shared bathrooms – e. g. notifying cleaning staff after a patient has used the bathroom and disinfecting high-touch surfaces

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¹ Ullrich, C., Luescher, A.M., Koch, J. et al.: Silica nanoparticles with encapsulated DNA (SPED) to trace the spread of pathogens in healthcare. Antimicrob Resist Infect Control 11, 4 (2022)