

SHORT REPORT

Multiuse patient monitoring equipment as a risk factor for acquisition of *Candida auris*

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Introduction

Candida auris is an emerging and multi-drug resistant pathogen recently associated with outbreaks worldwide, often in intensive care settings (1). Following the alerts issued by the CDC and PHE in June 2016 (2,3), a look back exercise in the neurological intensive care unit (NITU) in the Oxford University Hospitals NHS Foundation Trust identified five clinical cases of *C. auris* infection. After the identification of an additional isolate in a urine sample, a patient and environmental screening programme was introduced in the last week of October 2016. We report here a summary of our initial findings which other affected units may wish to consider as part of their infection prevention and control measures.

Methods

Patient screening

Patients were screened on admission to the NITU, weekly, and on discharge, from October 2016 to May 2017. Screening sites were nose, axilla, groin, tracheostomy and wound swabs (Sigma Transwab®), and urine culture. This was modified in January 2017 to three times weekly screening via axilla and groin swabs, with a full specimen screen on admission and discharge. Patients on the neuroscience ward (the main step-down ward for NITU) were also screened weekly. Swabs were cultured on Sabouraud Dextrose Agar W/ Chloramphenicol (SabC) at 37°C in air. Colonies with morphological characteristics of *C. auris* were identified using via the Bruker MALDI biotyper system - resulting spectra were analysed with MALDI biotyper RealTime Classification software version 3.0.

Environmental screening

Various methodologies for environmental screening were used with an emphasis on sampling high-touch areas and multi-use devices. These included the use of

bacterial swabs in a liquid transport medium (Sigma Transwab®), sponges to sample larger surface areas (Polywipe™), and Sabouraud dextrose agar contact plates (55mm diameter). Enrichment culture was performed in brain heart infusion or malt extract broth. The air was sampled using passive air sampling techniques (SabC settle plates) and two active air samplers (an AirIdeal and Coriolis air sampler operating at 100 and 300 L/min respectively). Confirmation of *C. auris* was achieved using the Bruker MALDI biotyper system as above.

Results

Patient screening

Between the end of October 2016 to the end of May 2017, approximately 15,000 screens from 726 individual patients were received. Two hundred and eighty patients were from NITU, 407 from the neuroscience ward and 39 from other clinical areas, including the adult intensive care unit. Fifty-eight patients became *C. auris* colonised or infected, with two cases of candidaemia (Figure 1). Fifty-seven of the 58 patients colonised or infected with *C. auris* had been admitted to NITU during their hospital stay.

Environmental screening

There were three phases of environmental screening; November 2016, February 2017, and April 2017, with follow-up samples as indicated. A total of 128 samples were obtained. Sampling methods and results are detailed in Table 1. Briefly, *C. auris* detection in the general environment was low (one settle plate positive on one sampling point). However, the organism was detected from multiuse patient monitoring equipment (skin surface temperature probes and a pulse oximeter) and a patient hoist.

Following the finding of *C. auris* on a skin surface temperature probe using a contact plate

(<http://www.philips.co.uk/healthcare/product/HC989803162641/skin-surface-temperature-probe-sensor>), the probes were withdrawn from use on April 11th. However, during the annual leave of a senior nurse, the probes came back into use, and acquisitions continued (Figure 1). All probes were withdrawn from the unit on April 24th, and handed over to the Infection, Prevention and Control team for culture. Ten probes were cultured, of which four probes had been in recent use on the ward, and six were in storage or broken/damaged. *C. auris* was cultured from four probes (on enrichment in brain heart infusion broth). It is not known if these were the four probes in recent use.

Discussion

Recommended infection, prevention and control (IPC) measures to control outbreaks of *C. auris* include patient contact isolation, and enhanced cleaning with chlorine based products (3,4). Additional measures taken on the NITU were 'decluttering' to facilitate cleaning, the reduction of bedside stock of equipment and other items, and removal of fans and forced air convection blankets. Despite the implementation of these intensive IPC measures, the

outbreak in the Oxford NITU has been prolonged and with a high acquisition rate, with detection of colonisation or infection in 20% (57/280) patients during the screening period described.

On the NITU, continuous patient temperature monitoring with a re-usable skin surface temperature probe in the axilla was part of routine care for ventilated patients. Cleaning of probes between patients is by means of quaternary ammonium compound pre-prepared wipes (Clinell Universal Sanitising Wipes). The temperature probes are difficult to clean, with a rubber two-layer sheath protecting the distal end of the wire adjacent to the sensor (Figure 2). We provide evidence that *C. auris* can be recovered from 'cleaned' skin surface temperature probes supporting the hypothesis that re-usable equipment is a risk factor for colonisation/infection with this organism. Removal of skin surface temperature probes from the unit appears to reduce the acquisition rate (Figure 1).

Our initial observations will be further investigated by conducting a cohort study examining risk factors for colonisation and infection using the Infections in Oxford Research database (5). We continue the three-times weekly screening for *C. auris* on all patients in the NITU.

References

- 1: Schelenz S, Hagen F, Rhodes JL, Abdolrasouli A, Chowdhary A, Hall A, Ryan L, Shackleton J, Trimlett R, Meis JF, Armstrong-James D, Fisher MC. First hospital outbreak of the globally emerging *Candida auris* in a European hospital. *Antimicrob Resist Infect Control*. 2016 Oct 19;5:35.
2. <https://www.cdc.gov/fungal/diseases/candidiasis/candida-auris-alert.html>
3. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/534174/Guidance_Candida_auris.pdf
4. European Centre for Disease Prevention and Control. *Candida auris* in healthcare settings – Europe – 19 December 2016. Stockholm: ECDC; 2016.
5. <https://oxfordbrc.nihr.ac.uk/research-themes-overview/antimicrobial-resistance-and-modernising-microbiology/infections-in-oxfordshire-research-database-iord/>

Acknowledgements

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Figure 1. Weekly *Candida auris* new acquisition rate on the NITU.

y axis: number of patients with newly identified *C. auris* positive screening samples
x axis: Date in weekly increments

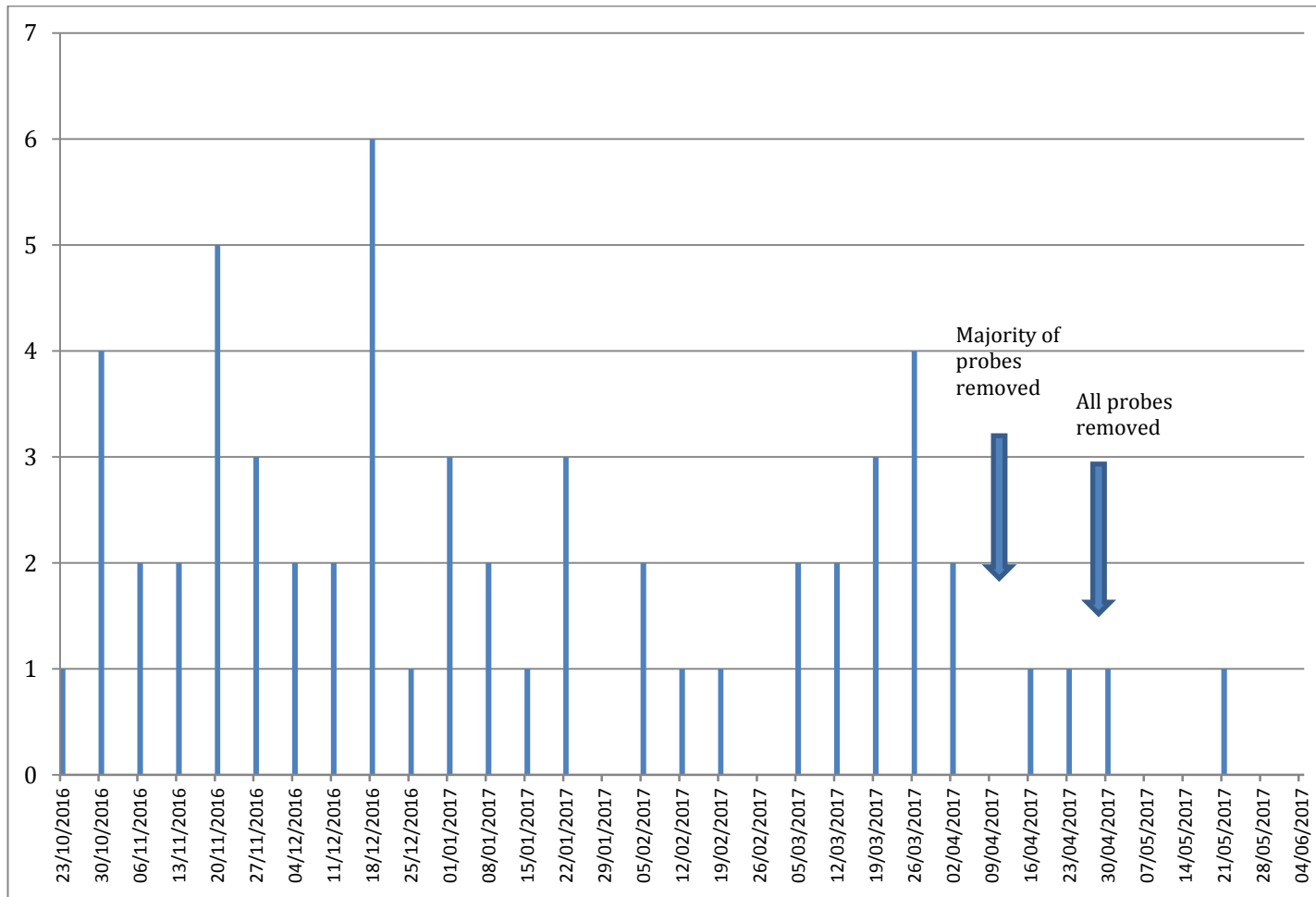


Figure 2. Skin surface temperature probe

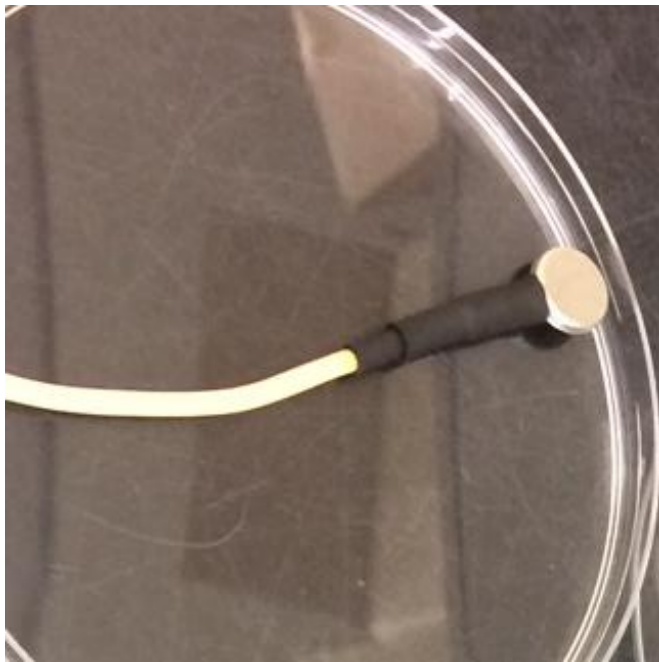


Table 1: Results of environmental sampling

Site	Date	Sampling method	Culture (Sabouraud Dextrose Agar +/- Chloramphenicol)	Enrichment (Brain heart)
Pulse oximeter	23/11/16	Swab in liquid transport medium	1/1 <i>C. auris</i>	
Dynamic mattresses x4	23/11/16	Swab in liquid transport medium	4/4 No growth	
Curtains	23/11/16	Contact plate	No growth	
Blood pressure cuff	23/11/16	Swab in liquid transport medium	No growth	
Air x 16 [§]	24/11/16	SabC Settle plates	1 colony <i>C. auris</i>[^]	
			2 x 1 colony <i>C. guilliermondii</i>	
			1 colony <i>C. albicans</i>	
			12/16 plates No growth	
Pulse oximeters x 12	29/11/16	Swab in liquid transport medium	12/12 No growth	
Central ventilation ceiling tile	29/11/16	Swab in liquid transport medium	No growth	
Waste water x 4 sink P traps	03/02/17	50mls from P trap	4/4 No growth	
Sink surface x 4	03/02/17	Polywipe plus 5ml saline	4/4 No growth	
Ceiling fan/tile	03/02/17	Polywipe plus 5ml saline	1/1 No growth	1/1 No growth
Computer keyboard*	03/02/17	Polywipe plus 5ml saline	4/4 No growth	4/4 No growth
Suction apparatus*	03/02/17	Polywipe plus 5ml saline	4/4 No growth	4/4 No growth
Bedrails*	03/02/17	Polywipe plus 5ml saline	4/4 No growth	4/4 No growth
Trolley**	03/02/17	Polywipe plus 5ml saline	2/2 No growth	2/2 No growth
Ventilator/controls***	03/02/17	Polywipe plus 5ml saline	2/2 No growth	2/2 No growth
40 surfaces****	04/04/17	Contact plate	38/40 no growth (see below)	
Temperature probe x 1	04/04/17	Contact plate	1/1 <i>C. auris</i>	
Patient mobile hoist	04/04/17	Contact plate	1/1 <i>C. auris</i>	
Twelve surfaces [#]	04/04/17	Cotton-tipped swabs and malt extract broth	12/12 no growth	12/12 No growth (malt extract broth)
Air [¥]	04/04/17	Air Ideal (sampling at 100 L/min)	No growth	
Air [¥]	04/04/17	Coriolis sampler (sampling at 300 L/min)	No Growth	
Temperature probe x 1 ^{^^}	15/04/17	Swab in liquid transport medium	No growth	
Temperature probe x 10	16/05/17	Contact plates and enrichment culture	10/10 No growth	4/10 <i>C. auris</i>

[§]Two settle plates were placed in 4 bedspaces/bed spaces for 5 hours during a day shift, and repeated during a nightshift.

[^] plate initially in an empty bedspace; a colonised patient was moved into the bed during the period of observation.

[¥] Air samplers were positioned in a negative bed space; a positive bed space; a positive side room; an empty (previously positive) bed space and at the doctors/nursing station. Can assume that at the time of sampling, the number of *C. auris* in the air was < 1 cfu/m³ of air sampled.

*From 4 bedspaces, 2 occupied by colonised patients.

**From 2 bedspaces occupied by colonised patients.

***From 2 unoccupied bedspaces.

**** From 2 bedspaces, 1 occupied by a colonised patient

[#] From the wider NITU environment

^{^^}Temperature probe in use, *C. auris* negative patient