Where or where not to test for *Pseudomonas aeruginosa*

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Overview

• *Pseudomonas aeruginosa*
  – Setting the scene
• Research at UHB
  – Areas where transmission seen
  – Critical Care Service improvement
• Conclusions
Pseudomonas aeruginosa

- *P. aeruginosa* is widespread in the environment:
  - Soil, water & moist environments
- Usually colonises hospital and domestic sink traps, taps and drains
- Humans may be colonised at moist sites
- Highly opportunistic pathogen
- Hospital outbreaks are frequently reported from water sources
- Water transmission has become a matter of urgent concern

Pseudomonas outbreak one year on: police begin investigation into babies' deaths

By Niall McCracken, 21 January 2013

The Western & Belfast Trust say hygiene standards have improved

By Niall McCracken

The review team also found there was no common approach across neonatal units for declaring an outbreak.
Introduction to UHB NHS Trust

- 1400 in-patient beds
- 42 theatres
- 100 bed critical care unit
- Largest solid organ transplant centre in Europe
- Royal Centre for Defence Medicine
- Regional Major Trauma Centre
- Specialist services include:
  - Burns
  - Trauma & Orthopaedic
  - Liver surgery
  - Renal services
  - Cardiac surgery
  - Haematology and oncology
  - Neurosurgery
Short report

Where to do water testing for *Pseudomonas aeruginosa* in a healthcare setting

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**SUMMARY**

*Pseudomonas aeruginosa* is an important nosocomial pathogen widely colonizing hospital water supplies. The Department of Health (England) Health Technical Memorandum (HTM) 04-01 addresses the risk posed by recommending water-testing in augmented care areas including outpatient haemodialysis. We discuss how two teaching hospitals independently reviewed the risk to outpatient haemodialysis patients, drawing the same conclusion. The highest number of infection episodes with *P. aeruginosa* was observed in critical care followed by burns and haematology, with the lowest in haemodialysis. Based on these results, we suggest that water sampling should be undertaken in areas such as critical care, burns, and haematology, but not in outpatient haemodialysis.

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### Table I
Percentage of augmented care water outlets positive for *Pseudomonas aeruginosa* per year between 2013 and 2016

<table>
<thead>
<tr>
<th>Area</th>
<th>No. of outlets</th>
<th>Positive outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2013</td>
</tr>
<tr>
<td>Critical care</td>
<td>231</td>
<td>20%</td>
</tr>
<tr>
<td>Burns unit</td>
<td>69</td>
<td>29%</td>
</tr>
<tr>
<td>Haematology unit</td>
<td>87</td>
<td>6%</td>
</tr>
<tr>
<td>Haemodialysis unit</td>
<td>149</td>
<td>17%</td>
</tr>
</tbody>
</table>

### Table II
Total number of patients with *Pseudomonas aeruginosa* infection or colonization across Queen Elizabeth Hospital Birmingham per year in critical care, burns, haematology, and haemodialysis units

<table>
<thead>
<tr>
<th>Area</th>
<th><em>P. aeruginosa</em> infections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
</tr>
<tr>
<td>Critical care</td>
<td>93</td>
</tr>
<tr>
<td>Burns unit</td>
<td>19</td>
</tr>
<tr>
<td>Haematology unit</td>
<td>15</td>
</tr>
<tr>
<td>Haemodialysis unit</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>130</td>
</tr>
</tbody>
</table>
Short report

Continued transmission of *Pseudomonas aeruginosa* from a wash hand basin tap in a critical care unit

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**SUMMARY**

*Pseudomonas aeruginosa* is an important nosocomial pathogen, colonizing hospital water supplies including taps and sinks. We report a cluster of *P. aeruginosa* acquisitions during a period of five months from tap water to patients occupying the same burns single room in a critical care unit. *Pseudomonas aeruginosa* cultured from clinical isolates from four different patients was indistinguishable from water strains by pulsed-field gel electrophoresis. Water outlets in critical care may be a source of *P. aeruginosa* despite following the national guidance, and updated guidance and improved control measures are needed to reduce the risks of transmission to patients.

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• Found some patient water transmission events from routine surveillance

Garvey MI et al., J Hosp Infect 2016
UHB water results

• Water sampling in augmented care as per HTM 04-01
• Critical care (231 outlets) results:

### Table 1
Total number of ICU water outlets positive for *P. aeruginosa* per year between 2013 and 2016.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Area A</td>
<td>(20) 29%</td>
<td>(21) 30%</td>
<td>(28) 40%</td>
<td>(29) 41%</td>
</tr>
<tr>
<td>Area B</td>
<td>(11) 22%</td>
<td>(14) 29%</td>
<td>(14) 28%</td>
<td>(10) 20%</td>
</tr>
<tr>
<td>Area C</td>
<td>(8) 15%</td>
<td>(13) 28%</td>
<td>(15) 30%</td>
<td>(12) 24%</td>
</tr>
<tr>
<td>Area D</td>
<td>(7) 10%</td>
<td>(14) 23%</td>
<td>(17) 28%</td>
<td>(22) 36%</td>
</tr>
<tr>
<td>Total</td>
<td>(46) 20%</td>
<td>(59) 26%</td>
<td>(54) 24%</td>
<td>(73) 31%</td>
</tr>
</tbody>
</table>

Key: *Numbers in the brackets refer to number of positive outlets.

### Table 2
Total number of patient *P. aeruginosa* isolates across ICU per year.

<table>
<thead>
<tr>
<th>ICU</th>
<th><em>P. aeruginosa</em> isolates 2014</th>
<th><em>P. aeruginosa</em> isolates 2015</th>
<th><em>P. aeruginosa</em> isolates 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area A</td>
<td>27</td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>Area B</td>
<td>28</td>
<td>31</td>
<td>16</td>
</tr>
<tr>
<td>Area C</td>
<td>22</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>Area D</td>
<td>25</td>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>104</td>
<td>57</td>
</tr>
</tbody>
</table>

Garvey *et al.*, Int J Hyg Environ Health 2017
Engineering waterborne *Pseudomonas aeruginosa* out of a critical care unit

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\(^b\) Hospital Infection Research Laboratory, University Hospitals Birmingham NHS Foundation Trust, Queen Elizabeth Hospital Birmingham, Edgbaston, Birmingham B15 2WB, United Kingdom

**Abstract**

Objective: To describe engineering and holistic interventions on water outlets contaminated with *Pseudomonas aeruginosa* and the observed impact on clinical *P. aeruginosa* patient isolates in a large Intensive Care Unit (ICU).

Design: Descriptive study.

Setting: Queen Elizabeth Hospital Birmingham (QEH), part of University Hospitals Birmingham (UHB) NHS Foundation Trust is a tertiary referral teaching hospital in Birmingham, UK and provides clinical services to nearly 1 million patients every year.

Methods: Breakpoint models were used to detect any significant changes in the cumulative yearly rates of clinical *P. aeruginosa* patient isolates from August 2013–December 2016 across QEH.

Results: Water sampling undertaken on the ICU indicated 30% of the outlets were positive for *P. aeruginosa* at any one time. Molecular typing of patient and water isolates via Pulsed Field Gel Electrophoresis suggested there was a 30% transmission rate of *P. aeruginosa* from the water to patients on the ICU. From February 2014, QEH implemented engineering interventions, consisting of new tap outlets and PALL point-of-use filters; as well as holistic measures, from February 2016 including a revised tap cleaning method and appropriate disposal of patient waste water. Breakpoint models indicated the engineering and holistic interventions resulted in a significant \(p < 0.001\) 50% reduction in the number of *P. aeruginosa* clinical patient isolates over a year.

Conclusion: Here we demonstrate that the role of waterborne transmission of *P. aeruginosa* in an ICU cannot be overlooked. We suggest both holistic and environmental factors are important in reducing transmission.

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Service improvement

Fig. 1. Using breakpoint changes patient *P. aeruginosa* isolate rates per 100,000 bed days were analysed between August 2013-December 2016 across the entire ICU. The breakpoint model identified three probable changes in rate (breakpoint dotted lines), with the fitted means of the segments either side indicated by horizontal blue bars. The first breakpoint was a result of introducing PALL end filters on selected outlets on ICU area B, the second breakpoint was coincident with PALL end filters being fitted on selected outlets across the entire ICU, and the third breakpoint as a response to the holistic infection control interventions and installation of new tap outlets on ICU area A. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Key: Red arrows, and boxes indicate Infection Control Interventions, dotted line represents breakpoints. Intervention A corresponds to the introduction of PALL filters on selected outlets on ICU area B, intervention B corresponds to the fitting of PALL filters on selected outlets across the entire ICU, intervention C corresponds to holistic infection control interventions, intervention D corresponds to the installation of new tap outlets on ICU area A.

Garvey et al., Int J Hyg Environ Health 2017

Delivering the best in care
Quick J et al., BMJ 2014

Figure 2  A schematic view of the 300-day study of Pseudomonas aeruginosa in a burns centre and critical care unit. Time in days is shown along the x axis with bed numbers in the critical care unit and burns unit along the y axis. Each circular icon indicates a positive isolate of P. aeruginosa. The icon’s logotype indicates which environment it originated from (wound, urine/sputum, environment or water). The filled colour of the icon indicates the clade it belongs to. Patient icons represent the enrolment of a screening patient into the study and their location. Patient movements around the hospital are noted by dotted lines. The five patients infected with P. aeruginosa are denoted by rounded boxes. Boxes are coloured according to the patient number. In the event two or more isolates of the same source and clade were collected on the same day, these have been collapsed into a single circular icon.
Table 1. Data on *Pseudomonas aeruginosa* at any site between January 2013 and August 2017 on the hematology ward.

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>January–August 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water samples positive for <em>P. aeruginosa</em> (%)*</td>
<td>14 (16/114)</td>
<td>5.7 (12/209)</td>
<td>5.1 (9/176)</td>
<td>1.7 (3/177)</td>
<td>1 (1/95)</td>
</tr>
<tr>
<td>Positive outlets for <em>P. aeruginosa</em> (%)†</td>
<td>18 (12/88)</td>
<td>6.8 (6/88)</td>
<td>3.4 (3/88)</td>
<td>2.3 (2/88)</td>
<td>1.1 (1/88)</td>
</tr>
<tr>
<td><em>P. aeruginosa</em> infection or colonization (number of patients)</td>
<td>15</td>
<td>16</td>
<td>13</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Number of <em>P. aeruginosa</em> bloodstream infection episodes‡</td>
<td>12</td>
<td>15</td>
<td>15</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Bed days—clinical hematology</td>
<td>11,269</td>
<td>11,137</td>
<td>11,230</td>
<td>11,289</td>
<td>9,734</td>
</tr>
</tbody>
</table>

*Parenthetical values are number of water samples positive for *P. aeruginosa* against number of water samples taken.
†Parenthetical values are number of outlets of 88 total on the clinical hematology ward.
‡A bacteremic (bloodstream infection) episode was defined as the 14-day interval from the date of the first positive blood culture for *P. aeruginosa*; positive blood cultures outside this timeframe constituted a different episode.

**Results.** *P. aeruginosa* cultured from blood cultures from 3 patients was indistinguishable from water strains, by molecular typing. Based on infection control inspections, the transmission event was surmised to be due to cleaning of equipment, specifically an infusion therapy procedure tray used to transport intravenous drugs to patients, with water from an outlet colonized by *P. aeruginosa*.

**Conclusion.** We show the importance of holistic factors, such as disposal of patient waste water, cleaning of tap outlets, and cleaning of medical equipment, in the transmission of *P. aeruginosa*, and demonstrate that the role of waterborne transmission of this organism in a hematology setting cannot be overlooked. We suggest that appropriate management of water, including both holistic and engineering interventions, is needed to stop transmission of *P. aeruginosa* from water to patients.

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Table I

Pseudomonas aeruginosa and Enterobacteriaceae bloodstream infections (BSIs) in haematology patients, 2010–2016

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Enterobacteriaceae and P. aeruginosa episodes</th>
<th>P. aeruginosa episodes</th>
<th>No. (%)</th>
<th>95% CI</th>
<th>No. (%) of patients with P. aeruginosa BSI who died</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. (%)</td>
<td>95% CI</td>
<td></td>
<td>One-month all-cause mortality</td>
</tr>
<tr>
<td>2010</td>
<td>70</td>
<td>6 (8.6)</td>
<td>4.0–17.5</td>
<td></td>
<td>1 (16.7)</td>
</tr>
<tr>
<td>2011</td>
<td>45</td>
<td>11 (24.4)</td>
<td>14.2–38.7</td>
<td></td>
<td>1 (9.1)</td>
</tr>
<tr>
<td>2012</td>
<td>60</td>
<td>16 (26.7)</td>
<td>17.1–39.0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2013</td>
<td>60</td>
<td>12 (20.0)</td>
<td>11.8–31.8</td>
<td></td>
<td>1 (8.3)</td>
</tr>
<tr>
<td>2014</td>
<td>73</td>
<td>15 (20.5)</td>
<td>12.9–31.2</td>
<td></td>
<td>2 (13.3)</td>
</tr>
<tr>
<td>2015</td>
<td>64</td>
<td>15 (23.4)</td>
<td>14.7–35.1</td>
<td></td>
<td>1 (6.7)</td>
</tr>
<tr>
<td>2016</td>
<td>56</td>
<td>13 (23.2)</td>
<td>14.1–35.8</td>
<td></td>
<td>2 (15.4)</td>
</tr>
</tbody>
</table>

CI, confidence interval.

Table II

Antimicrobial susceptibilities of Pseudomonas aeruginosa bloodstream infection episodes per year from 2010 to 2016

<table>
<thead>
<tr>
<th>Year</th>
<th>No. tested</th>
<th>Amikacin</th>
<th>Gentamicin</th>
<th>Ciprofloxacin</th>
<th>Ceftazidime</th>
<th>Piperacillin–tazobactam</th>
<th>Meropenem</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>2011</td>
<td>11</td>
<td>0</td>
<td>18</td>
<td>9</td>
<td>18</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>2012</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2013</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>17</td>
<td>25</td>
<td>17</td>
</tr>
<tr>
<td>2014</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td>2015</td>
<td>15</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>2016</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>23</td>
<td>18</td>
<td>38</td>
</tr>
</tbody>
</table>
Letter to the Editor

Evaluating the risks of wash hand basin tap disinfection

Sir,

Pseudomonas aeruginosa is an important nosocomial pathogen colonizing hospital water supplies including taps and sinks. A recent short report by Garvey et al. described an outbreak of P. aeruginosa in a critical care unit, and detailed how the UK National guidance HTM 04-01 was implemented. Despite this, continued transmission of P. aeruginosa from water to patient occurred, with the source suspected to be a specific wash hand basin.

There have been reports detailing how tap outlets may be contaminated with P. aeruginosa from disposal of patient water down a wash hand basin to contamination of the tap outlet by inadequate cleaning methods.1-3 Garvey et al. reported that a revised cleaning method for tap outlets in the critical care unit had been established at the University Hospitals Birmingham (UHB) NHS Foundation Trust. Here we describe the cleaning method developed by the facilities and infection control team. The method described in the healthcare manual (NHS, National Patient Safety Agency) for tap outlets was assessed for efficacy; briefly, UV Glow Cream (Deb Group Ltd, Derby, UK) was placed on the outlet (Figure 1A) and the revised healthcare manual protocol was followed. The tap, sink and surrounding area were then visualized under UV light (Figure 1B). UV cream was found to be spread across all parts of the tap outlet (Figure 1B).

Using UV cream as a crude marker of cleaning efficacy, a range of cleaning methods (subtle modifications of the NHS revised cleaning manual) were tested using either a two-, three-, four- or five-cloth method with a detergent cleaner (1000 ppm; Chlor Clean; Guest Medical Ltd, Aylesford, UK). Chlor-Clean was prepared in strict accordance with the manufacturer’s instructions. A two-cloth cleaning method was found to spread UV cream around the tap outlet. A four- or five-cloth method was deemed too complex and expensive. The most effective method used a three-cloth cleaning technique as described below.

1. Preparation: Emptying the sink and removing any organic material from the plughole, drain and overflow. The tap was then turned on and water was left to run while cleaning the outer surfaces of the tap.
2. Cloth 1: Cleaning around the tap and sink outlet, using a J-cloth. It should be noted that cloths are never put back into the cleaning solution after they are first dampened, preventing cross-contamination. Cloth 1 was dampened in detergent solution and wrung dry. The cloth was folded in half and half again with the cloth face being turned when moving from surface to surface. Working on the outside of the sink only, cleaning took place in the following order:

   - Mirrors, wall tiles, back splash, ledges, pipe work, dispensers, and undersides and edges of the sink. The cloth was disposed of when this step was finished or alternatively when all eight sides of the cloth had been used. After this steps the taps were turned off, equating to 2 min of flushing.
   - Cloth 2: cleaning the tap outlet: A second cloth was dampened in detergent solution and wrung dry. The cloth was folded in half and half again with the cloth face being turned when moving from surface to surface. Only the tap was cleaned, in the following order: working from the outside to the inside first clean the tap bar, tap lever and tap spout. The tap tip was not touched during the cleaning. The cloth was disposed of when the cleaning stage was finished or alternatively when all eight sides had been used.
   - Cloth 3: cleaning the sink: As above, a new cloth was dampened in detergent solution and wrung dry. The cloth was folded in half and half again with the cloth face being turned when moving from surface to surface. Only the sink was cleaned and in the following order: working from the outside to the inside: outside of the sink, inside surface of the sink, overflow plug, plug chain, and drain. The cloth was disposed of when finished or alternatively when all eight sides had been used.

On completion of the procedure, the tap outlet was visualized using UV light to identify any residual UV cream, as shown in Figure 2, no residual UV marks were identified.

In summary we discuss a revised cleaning method of tap outlets with the aim of reducing the risk of contamination from P. aeruginosa in healthcare institutions. Intrinsically and holistic factors such as cleaning need to be considered as routes of transmission. The use of UV cream allowed for visualization of possible bacterial dispersal during the cleaning procedure. Using more cloths means that cleaning is more convoluted, complicates the method, increases the cleaning time, and is costlier to perform: the risk of cleaning methods which could lead to contamination of taps from inadequate cleaning methods needs to be considered in the future.

Conflicts of interest statement
None declared.

Funding sources
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References


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0195-6975/© 2016 Published by Elsevier Ltd on behalf of the Healthcare Infection Society.
The risks of contamination from tap end filters

Sir,

The recent Editorial by Walker and Moore proposes that the risks associated with Pseudomonas aeruginosa and contaminated water have not been fully controlled or understood. In addition, the Department of Health has updated the Health Technical Memorandum (HTM) 04-01, emphasizing the role of water in nosocomial infections. Our recent Short report describes an outbreak of P. aeruginosa in an intensive care unit. Continued transmission of P. aeruginosa was seen from water to patient with the source suspected to be a specific hand wash basin; remedial work was undertaken on the tap outlet, including chlorination and disinfection. When the outlet remained intermittently positive for P. aeruginosa despite the remedial work, a Pall-Aquasafe® (AQUA15S; Pall Medical, Fribourg, Switzerland) disposable tap water end filter was installed. Subsequently P. aeruginosa was not detected in the water collected after the filter and there were no further cases of P. aeruginosa transmission. Tap water end filters, which can be used for a maximum period of 31 days following initial connection to a tap outlet, have a variety of applications including providing water for use in topical applications such as personal hygiene and wound care; for consumption and preparation of cold drinks and food, and for rinsing medical instruments. The double-layer sterilizing grade Super™ membrane (Pall Medical) is rated at 0.2 μm and protects against waterborne particulates and pathogens such as Legionella spp. and Pseudomonas spp.

Due to the identified risks of P. aeruginosa transmission in our patient population, we undertook clinical surveillance of P. aeruginosa infection. Since using end filters on tap outlets positive for P. aeruginosa in the critical care units we have observed visible contamination of the end filter. Figure 1 shows a tap water end filter with visible contamination on the surface. Further investigation at the surface of the filter identified a multidrug-resistant P. aeruginosa. Pulsed-field gel electrophoresis typing of the strain from the contamination on the tap water end filter showed that it was indistinguishable from a clinical isolate from the patient adjacent to the sink. There have been reports detailing how tap outlets may be contaminated with P. aeruginosa resulting from the disposal of waste water from a patient into a hand wash basin and also contamination of the tap outlet by inadequate cleaning methods. Here we demonstrate that, with the installation of a tap water end filter, contamination of the end filter with P. aeruginosa may occur in the same way as contamination of the tap outlet. When the end filters were removed after 11 days, there was visible contamination of the outlet and subsequent testing of the water identified P. aeruginosa.

Guidance for the use of end filters means that they must be replaced every month at a cost of around £150 per filter. At our hospital there are 231 tap water outlets, including clinical and non-clinical sinks and showers, in the critical care unit. If tap water end filters were installed on every outlet, the associated costs for the hospital would be £11,550 per month (£138,600 per year). The replacement of tap water end filters also requires ongoing review, which in turn costs time and manpower resources. Given the costs and resources required, tap water end filters are installed on selected outlets in University Hospitals Birmingham where the risk of transmission of P. aeruginosa to patients is highest, such as hand wash basins in a patient's bedside. Thus, tap water end filters are installed on 130 of the 231 outlets and this costs the Trust £6,500 per month (£78,000 per year). The use of the end filters has resulted in a reduction of the numbers of P. aeruginosa infections in the critical care unit. However, the costs of installing and maintaining the end filters are high. We have shown that tap water end filters can be contaminated with patient waste water and that contamination of the tap tip can occur in the event of the contamination with patient waste water. To reduce the risk of transmission of waterborne pathogens such as P. aeruginosa in healthcare settings, we suggest that further research is required. A one-off
PALL filters cont..

- 231 outlets – PALL filter £50 per PALL filter, manufacturers instructions replace every month = £11,550/month, £138,600/year
- Minimum clinical areas 130 = £6,500/month, £78,000/year
- ?contamination
- ?do these get changed every month
- ?biofilm build up – contamination of water system
- Recurring costs
- Vs tap costs (one off): £92,168 for taps plus £92,400 for fitting, total cost = £184,568
- For 130 taps £51,870, fitting £52,000 = £103,870

Garvey et al., J Hosp Infect 2016
The sink as a potential source of transmission of carbapenemase-producing Enterobacteriaceae in the intensive care unit

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Abstract

Background: Carbapenemase-producing Enterobacteriaceae (CPE) are emerging pathogens that represent a major public health threat. In the University Hospital of Brussels, the incidence of new patients with CPE rose from 1 case in 2010 to 35 cases in 2015. Between January and August 2015, five patients became infected/colonized with CPE during their stay in the same room in the intensive care unit (ICU). Since the time period between those patients was relatively short and the strains belonged to different species with different antibiograms and mechanisms of resistance, the hypothesis was that the environment could be a possible source of transmission.

Methods and results: Environmental samples suggested that a contaminated sink was the source of the outbreak. Besides other strains, Citrobacter freundii type OXA-48 was frequently isolated from patients and sinks. To investigate the phylogenetic relationship between those strains, pulsed-field gel electrophoresis was performed. The strains isolated from patients and the sink in the implicated room were highly related and pointed to sink-to-patient transmission. In total, 7 of 8 sinks in the isolation rooms of the ICU were found to be CPE contaminated. To control the outbreak, the sinks and their plumbings were replaced by new ones with another structure, they were flushed every morning with a glucoprotamin solution and routines regarding sink practices were improved leading to discontinuation of the outbreak.

Conclusions: This outbreak highlights that hospital sink drains can accumulate strains with resistance genes and become a potential source of CPE.

Keywords: Carbapenemase-producing Enterobacteriaceae, Hospital sinks, Outbreak, Intensive care unit, Citrobacter freundii OXA-48, Transmission

Garvey MI et al., J Hosp Infect 2017; De Geyter et al., Antimicrobial Resist Infect Control 2017
Final thoughts

• Holistic factors as well as engineering

• Contamination of taps with *Pseudomonas*
  – Cleaning, waste water disposal, remedial work

• New hospital factors
  – Taps not flushed regularly before moving into hospital, taps contaminated at source

• Must dispose of contaminated water such as wash water, effluent appropriately in sluice not hand wash basins

• At UHB transmission from water to patients occurs in Critical Care, Burns, Clinical Haematology however rarely seen in haemodialysis
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Thank you

Questions?