Outbreak Column 22: How to manage an outbreak

Evonne T Curran

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Abstract

This outbreak column uses the Health Protection Scotland (HPS) Outbreak Process and Algorithm to examine and reflect on a published outbreak report. The report involved an extensively drug-resistant *Acinetobacter baumannii* in an oncology unit. High-reliability theory is then used to reflect on how the outbreak was managed and consider how best to improve local outbreak prevention, preparedness, detection and management. The conclusion of this exercise is that if the possibility of an era of untreatable infections caused by antibiotic-resistant organisms is to be significantly postponed, Infection Prevention and Control Teams must improve their ability to get others to prevent cross-transmission in the absence of recognised risks.

Keywords

Outbreak, acinetobacter, high-reliability theory

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Introduction

Outbreaks in care settings present life-threatening risks to people. Whether in hospitals, care homes or any other care facility, the detection of an outbreak means something has gone wrong. Something in our outbreak-prevention activity was insufficient to avert an outbreak. Although not all outbreaks are preventable, and infection prevention and control specialists do not control infection (this is the task of frontline workers and how well they implement standard precautions [SPs]), there is inevitably some sense of personal responsibility for the outbreak. The situation must be repaired without further injury to anyone. So, after 21 Outbreak Columns, this one will focus not so much on an organism or type of outbreak, but on how to manage one. To do this, a published outbreak report will be evaluated using Health Protection Scotland's (HPS) Hospital Outbreak Process and Algorithm (HPS, 2013). This HPS tool condenses the entire outbreak procedure to two sides of A4. The Hospital Outbreak Algorithm includes three assessment questions: Is it an outbreak? Are control measures working? Is it safe to resume normal services? The outbreak checklist presents the necessary actions and is designed to negate omission error. This checklist is shown abridged as Table 1. Omitted from the HPS procedure in this exercise is an assessment of the outbreak size/impact and the necessary internal communications; space does not permit this.

Those reading and analysing outbreak reports do so with the uncertainty removed; we know how the epidemic curve moved. Therefore, readers are cautioned to avoid hindsight bias when examining the investigators' decisions. The focus of the analysis will be on stopping new cases by interrupting transmission routes. The implications for preventing and managing future outbreaks will be considered using high-reliability theory (HRT). Finally, it will be argued that to prevent or significantly delay an era of untreatable infections due to ineffective antibiotics, we must sustainably improve our ability to get others to prevent cross-transmission. This article focuses on the outbreak report by Gray et al. (2016), which involved an extensively drug resistant *Acinetobacter baumannii* (XDR-Ab) in an oncology unit.

Alert Signal Assessment 1: Is it an outbreak?

Outbreaks are detected when an alert signal from microbiological, surveillance or clinical data is presented to the

School of Health and Life Sciences, Glasgow Caledonian University,
Independent Infection Prevention Nurse Consultant, Glasgow, UK

Corresponding author:

Evonne T Curran, School of Health and Life Sciences, Glasgow
Caledonian University, Independent Infection Prevention Nurse
Consultant, Glasgow G2 6QE, UK.
Email: evonne.curran@ntlworld.com

Table 1. The HPS outbreak checklist (abridged).

Alert Signal Assessment 1: Is it an outbreak? (from laboratory, clinical or surveillance data)
Initial control measures for Patient, Healthcare worker and Visitor (PHV) safety
Agree the assessment of the outbreak severity and communicate
Outbreak investigations <ul style="list-style-type: none"> • Define a case • Identify and count all cases • Describe the cases • Look for a system change • Present the data • Develop a hypothesis • Consider the need for additional case finding • Take microbiological samples • IPCT – step-by-step observation of procedures • Confirm that standard precautions and transmission precautions are in place • Continue to assess and communicate updates
Confirm all recommend control measures are being applied
Assessment 2: Are the control measures working?
Assessment 3: Is it safe to resume services
Post-outbreak actions <ul style="list-style-type: none"> • Debrief, action plan, identify and share lessons • Produce a report and publish

Infection Prevention and Control Team (IPCT) for an outbreak assessment. In the day-to-day world of the IPCT, alert signals can be a subtle change in routine data or an obvious one. The alert signal from Gray et al. (2016) was as follows: ‘On November 21st 2013, an asymptomatic carrier of extensively drug-resistant *Acinetobacter baumannii* (XDR-Ab) was detected in the oncology unit of a 637-bed primary and tertiary care centre.’ As a result, all patients in the 32-bedded unit were screened for XDR-Ab; seven additional carriers were identified.

So, is it an outbreak? To confirm an outbreak, current levels are compared with the background rate. The report, however, moves directly from the identification of a single case to screening of all those potentially exposed (the rationale for this is discussed later). Outbreak Column 8 on pseudo outbreaks and no-infection outbreaks included an algorithm for the assessment of alert signals, suggesting there were four possible options for alert signals:

- an unrelated cluster of real infections (e.g. chance or change in surveillance);
- a related cluster of false infections (e.g. a systematic laboratory diagnosing error or specimen contamination);
- a no-infection outbreak (where people acquire a pathogen in a care setting but are uninfected);

- an outbreak (where people have acquired an organism and some have been infected) (Curran, 2013a).

In Gray et al., when reporting the assessment of the alert signal appears to be a ‘no-infection outbreak’ as acquisition is happening in the care setting – but there is no initial mention of ill-health due to XDR-Ab. Treating no-infection outbreaks as outbreaks is justified as it is perhaps just chance that care-setting cross-transmission has yet to result in infections (Curran, 2013a). Stopping transmission may also prevent the outbreak organism’s resistance genes being transferred to a more pathogenic organism. Using the principles of situation awareness, the alert signal would be assessed as shown in Table 2.

Accurate and complete situation awareness increases the likelihood that effective outbreak decisions will follow (Endsley, 2005). The correct decision here is obvious – even in the absence of cases with infection, the IPCT should immediately start the outbreak process. Gray et al. (2016) reveal that over the next two weeks, three patients developed a blood stream infection (BSI) with XDR-Ab in the oncology unit and ICU; the situation was now an outbreak.

Initial control measures for patients, healthcare worker (HCW) and visitor safety

Following assessment of the alert signal, the HPS outbreak process algorithm (Table 1) continues with initial control measures for patient, healthcare worker and visitor (PHV) safety. Before meetings of any committee, virtual or otherwise, before any investigations begin, it is necessary to undertake an immediate PHV safety assessment and deploy initial control measures to prevent further transmission. The control measures deployed relate to the recognised modes of transmission for *Acinetobacter* species, and the organisms’ specific characteristics. However, as Gray et al. (2016) indicate, ‘uncertainties remain regarding control measures’ for *Acinetobacter* outbreaks. APIC (2010) states the ‘most common mechanism of [*Acinetobacter* spp] transmission’ is via contact (direct and indirect). *Acinetobacter baumannii* survives desiccation in the hospital environment (mean 27 days) (Peleg et al., 2008) and airborne dissemination occurs during procedures that disturb the air, e.g. wound dressings and bed-making (Allen and Green, 1987). Airborne dissemination leads to environmental contamination and subsequent contact transmission when the organisms have settled out onto surfaces. HPS has pre-prepared outbreak trigger tools which list the control measures designed to counter contact transmission and thereby negate omission error (HPS, 2014). These can save time when instigating control measures. The initial control measures/actions in Table 3 below would advance PHV safety.

Table 2. Situation awareness of the outbreak alert signal.

Perception – what is happening?	8/32 (25%) of patients on the oncology ward have become colonised with XDR-Ab.
Comprehension – so what?	There is ongoing transmission of an XDR organism in the oncology unit. This organism is known to cause difficult-to-control outbreaks. Oncology patients have risk factors for infections with this organism. As no one is yet sick this is at present a no-infection outbreak.
Prediction – what will happen next if nothing changes?	Unless actions are taken, cross-transmission will continue and patients may become infected. If infections arise they will be difficult to treat and could be life-threatening for patients.

Table 3. Initial control measures for PHV safety.

<p><i>Let everyone in the clinical area know.</i> Letting everyone know is listed as a control measure as that is what it is. By letting HCWs know that sub-optimal IPC has been detected is likely to have a positive effect on both personal IPC practices and in the promoting of optimal IPC practices by others. There is ongoing transmission on the ward with an XDR organism which is being spread via contact between people and the environment.</p> <p>Hand hygiene as per the five moments is vital.</p> <p>The environment requires decontamination which includes disinfection in addition to cleaning. The disinfectant method, i.e. application, contact time and removal, must be sufficient to kill the organism and be clear to those using it.</p> <p>As <i>Acinetobacter baumannii</i> can cause BSIs in oncology patients via their vascular access devices (VAD), all VAD procedures must be performed using an aseptic technique.</p>
<p><i>Preparing the staff to communicate</i> with the patients and their families about what is happening. The cooperation with control measures by patients and their families is vital and this action done well will aid compliance.</p>
<p><i>Separating and isolating/cohorting patients</i> who are colonised from those who are not, is important to prevent further transmission. However, if the ward is full this will not be possible as a one-step procedure. Also, for every patient movement there will need to be effective environmental decontamination.</p>
<p><i>Considering stopping admissions</i> at least until patients with XDR-Ab are separated / cohorted and areas have been decontaminated.</p>
<p><i>Providing dedicated equipment</i> for colonised and unaffected patients.</p>
<p><i>Adding disinfectant</i> to routine cleaning.</p>
<p><i>Starting the pre-agreed communications</i> for local outbreaks.</p>
<p>Further control measures would need to be added as the outbreak progresses and more information on modes of transmission or sources of contamination is revealed. Throughout the outbreak, the IPCT must monitor to ensure that all advocated control measures are being effectively applied. Having put in place these initial control measures the outbreak investigations can begin.</p>

Outbreak investigations

Case definition

A case definition includes person characteristics, a place, a time-period and the disease/organism or clinical features. It may be adapted as the outbreak progresses. It must be sufficient to differentiate those who are cases from those who are not. The initial definition from Gray et al. (2016) was as follows: ‘Case: any patient newly found to be colonised or infected by XDR-Ab between June 1st 2011 and January 31st 2015’. Noteworthy about this definition is the absence of ‘a place’ which the investigators perhaps thought was obvious. Also, the long duration given the alert signal was in November 2013. The definition was refined over time as pulse-field gel electrophoresis (PFGE) determined the specifics of the outbreak strain, i.e. strains from all confirmed

cases carried the carbapenemase OXA-51 and TEM β -lactamase genes.

Count all the cases and find additional cases

Once there is an agreed definition, cases can be counted. In the hospital, this will involve a look back through computer held records to confirm background levels and to identify any missed cases from recently discharged or transferred patients. Investigations will also reveal if this problem was arising in neighbouring hospitals, other health board areas or throughout the country. Investigations reported by Gray et al. (2016) were that in the preceding 19 months, XDR-Ab had been isolated from 17 patients, of whom two had had a BSI and died. This demonstrated that the outbreak had started before November 2013.

Table 4. Characteristics of the patients in the Gray et al. (2016) outbreak.

Characteristic	n	%
Male	16	55
Female	13	45
Pre-existing chronic condition	29	100
At least 1 break in the skin or indwelling device	28	97
Shared a ward with a potential source course (excluding index case)	26	93
Antibiotics in the last 2 weeks pre isolation of XDR-Ab	25	86
Urinary tract infection	1	3
XDR-Ab blood stream infection	5	17
• Deaths	5	100
• Central venous catheters	5	100
• First positive specimen blood	3	75

These 17 newly identified patients had been cared for in six separate wards but nine were in one medical ward. Two patients with the outbreak organism had been in the Oncology ward 14 months before the outbreak was detected.

Counting those who are known to be colonised is often supplemented with active screening of people who may have been exposed. The extent to which this is done is determined by how important it is to identify everyone who is colonised and whether they are likely to suffer infection later. Apart from individuals who may acquire infection, screening decisions need to consider how likely a failure to screen all those at risk might result in the outbreak re-emerging within the hospital because of the ongoing transmission. The screening conducted in the paper by Gray et al. (2016) involved:

- initial – patients who shared a room with a case;
- from May 2013 – weekly screening of all patients sharing a ward with a known case;
- from December 2013 – readmission screening if previously shared a room with a case;
- 12–23rd December – a single hospital-wide round of screening.

By the time the outbreak ended, there were 29 cases in total, of which five had a XDR-Ab BSI. The authors state that these deaths were all clinically attributable to XDR-Ab. One of 24 remaining patients was diagnosed with a urinary tract infection.

Describe the cases

Describing the cases is necessary to identify characteristics or exposures that might give clues about possible sources and modes of transmission. It also helps to identify those who are vulnerable to acquiring the organisms, i.e. those who have risk factors for acquisition and infection. A thorough case-note review revealed the characteristics of the cases which reflect the known risk factors for this pathogen (Table 4).

Look for a change in the system

The HPS outbreak process includes this step which is not mentioned in Gray et al. but is useful. Many outbreaks start with a change in the system – the system itself comprising people, environment, equipment, methods, information and culture. For example, outbreaks are sometimes reported after failing staff numbers (people) (Hensel et al., 2017) or when novel procedures or equipment are used (Verfaillie et al., 2015). Just asking the question: *Tell me, what has changed here recently*, often reveals useful results. Outbreaks that do not involve a sudden system change can be the result of inertia or entropy. Inertia can manifest as an unwillingness or inability to adapt to a changing situation, e.g. the incidence rate increased without a matched response (Rumelt, 2011). Entropy is an inevitable and steady deterioration in a weakly managed system, e.g. one whose focus is redirected to non-infection prevention priorities (Rumelt, 2011). Understanding the events that provoked the outbreak can help when deciding the changes needed to prevent recurrence.

Present the data

Presentation of the data illustrates to those who are not directly involved in the data collection the extent of the problem and its progress. Data indicate where and when transmission events are likely to have taken place – and whether they have stopped. There are a variety of methods that can be used to present data, e.g. epidemic curves, time lines, ward maps, line-lists and transmission maps. The presentation of data by Gray et al. is exemplary. Not only is there an epidemic curve, an unbroken chain of plausible transmission from one case to the next is presented. This transmission map was produced following extensive note review which looked for locations of transmission and combined this with PFGE data. For only one probable case is there an unconfirmed transmission link. Undoubtedly, some colonised cases will have been missed. What is noted from the *'plausible'* transmission map is that most cases have one transmission event per known case, one has two, but one patient in the oncology ward had six links. This was identified following screening. It suggests that either initial screening may have missed cases or that perhaps one super-spreading event took place in the oncology unit in November.

Develop a hypothesis

Outbreak investigators have procedures of interest. In the outbreak described by Gray et al., there were no specific procedures or locations (other than their ward placement) identified as potentially contributing to the outbreak. Therefore, exposure is likely to have taken place where the patients were located, 26 (93%) of whom shared a room with a colonised case before they themselves were identified as a carrier. The recognised modes of transmission for this organism, i.e. direct and indirect contact (augmented by airborne dissemination) are implicated here. The hypothesis in the Gray et al. (2016) outbreak is that contact transmission with XDR-Ab occurred either directly between patients, or indirectly through staff, shared equipment or the environment.

Consider microbiological sampling of the environment / equipment / people

Having developed a hypothesis, microbiological sampling can provide evidence to support it. However, before undertaking any microbiological environmental or equipment sampling, there needs to be a clear question(s) to which the sampling is attempting to provide an answer. For example,

Are the hands of staff colonised with *Acinetobacter baumannii* after performing hand hygiene?

Is the environment near patients colonised with XDR-Ab still contaminated post decontamination?

Is the environment near uncolonised patients contaminated with XDR-Ab?

Questions for ongoing sampling of people could include:

Are the colonised patients still colonised?

What sites of the colonised patients are positive?

Gray et al. (2016) did not describe any environmental sampling. However, if cases had continued to arise, where exposure could not be linked to another case, then this may have become necessary. The screening of patients, described earlier, showed the most frequently colonised sites were: rectum (57%); groin (60%); and wounds (60%). Samples of all invasive (non-vascular devices) were positive. Staff were not screened.

IPCT – step-by-step observation of procedures

There were no specific procedures of interest noted for a review other than the obvious hand hygiene. In such instances, what is useful is sometimes just to sit and

watch the ward operate for a couple of hours and note the traffic, i.e. how many times people enter and leave rooms, and touch various places. This can also show how many times hand hygiene and personal protective glove use is done correctly, i.e. sufficient to prevent transmission. The high-traffic areas illustrate that even though the patients may have been separated by cohorting and isolation, the opportunities for transmission remain ever-present (and outside isolation rooms). Observing the decontamination procedures at these times is also useful as inadequate cleaning is another means to disseminate any organism – especially for such an environmental survivor as XDR-Ab.

Confirm through audit data that standard precautions are being followed

SPs prevent outbreaks – but only if they are consistently practised. Therefore, during outbreaks auditing emphasises the importance of these measures and confirms whether the advocated control measures to prevent contact transmission are in place (at least while the audit is ongoing). Grey et al. (2016) report undertaking formal audits repeatedly and feeding the data back regarding both hand hygiene and environmental decontamination.

The control measures deployed by Gray et al. (2016)

The actual control measures Gray et al. (2016) used are listed below. Two measures, ‘lowering the risk to progression’ and ‘rigorous decontamination’, are non-specific and provide insufficient information for those who would perhaps want to follow suit if they have a similar outbreak.

- creation of an XDR-Ab cohort ward with ‘a strong culture of infection control’;
- lowering the risk of progression to infection;
- rigorous decontamination of the affected wards;
- additional infection control training;
- dedicated equipment for cases;
- daily baths with chlorhexidine gluconate-impregnated wipes for cases.

The daily baths with chlorhexidine gluconate were deployed to reduce the amount of XDR-Ab disseminate from colonised patients into the environment. Its usefulness was plausible and associated with a changed epidemic curve. However, since its use occurred concurrently with all the other measures, it is not possible to determine the specific efficacy of each measure. This is a common difficulty, i.e. evaluating the effectiveness of individual outbreak control measures in the context of multiple measures being simultaneously deployed.

Assessment 2: Are the outbreak control measures working?

With the investigations confirming the most likely mode of transmission is contact, and the control measures aimed at preventing ongoing transmission, the next step is to assess if these control measures are working. If the control measures are effective then new cases should cease. This is easily assessed when the organism has a specific and short incubation period – but this is not the case with *Acinetobacter* spp. However, for Gray et al. (2016) there were only two cases identified after their control measures were deployed; the cross-transmission in these two cases most likely occurred before control measure deployment. What the investigators could not conclude was which of their control measures had stopped identified transmission.

Assessment 3: Is it safe to review resume normal services?

For Gray et al. (2016), cross-transmission had ceased but colonised patients remained in the hospital and further transmission risk could not be immediately negated. Patients colonised on a previous admission may also be readmitted and present an additional risk. What adds to the uncertainty of outbreak management is this organism has neither a fixed incubation period, nor a definitive colonisation period. It is therefore difficult to know whether new cases will occur and consequently they must act with due caution at this juncture. The control measures are still needed while positive patients remain in hospital and perhaps for some time thereafter. Other outbreak reports confirm the difficulties, e.g. *Acinetobacter baumannii* has been found on bedrails 19 days after a positive patient's discharge (Catalano et al., 1999). Consequently, careful, monitored decontamination of environments when patients are discharged is required. Pressure for beds should not be a driver for the premature discontinuation of control measures or for failing to confirm that the environment is safe. The IPCT must be reassured with evidence that the environment is safe. A 'deep clean' is often advocated after an outbreak, but this is something of a misnomer, as cleaning – however deep – is insufficient to remove many outbreak pathogens. What is needed is an Effective Decontamination Procedure (EDP), i.e. a procedure which has been shown to have the capability of removing the outbreak organism from the environment. Regardless of the method used, the EDP selected, needs close supervision.

Gray et al. (2016) report no additional cases in the 20 months after the last case was identified (January 2014). The HPS process advocates a debrief, action plan and sharing of lessons once the outbreak is over. To complete this Outbreak Column exercise, HRT will be explored and suggestions provided to improve future outbreak: prevention, preparedness, detection and management with regard to this outbreak.

Reflections on high-reliability theory and outbreak management

HRT emerged from studies of both disasters and the organisations which avoided them. Weick and Sutcliffe (2007) advocate that HRT has five processes that denote mindfulness and thereby the capability to prevent, find and manage events – thus achieving reliability. High-reliability characteristics include both the anticipation (three processes) of events and their containment (two processes). This is akin to the prevention, preparedness and detection of outbreaks as well as the response or management of them.

Anticipation: pre-occupation with failure

Having a preoccupation with failure means being alert to possible failure, actively looking for weak links and negating them (Weick et al., 1999). The phrase 'an accident waiting to happen' denotes an absence of a preoccupation with failure. That failure is likely to happen is noted – but no attempt to negate the risk takes place. IPCTs have two types of data which can be used to indicate outbreak vulnerability: alert organism data and process audit data (e.g. hand hygiene, glove use). For IPCTs, a preoccupation with failure to reduce outbreaks could involve working more with HCWs in the clinical areas which have most identified cross-transmission, alert organisms and/or poor process data. A more active infection prevention programme in the Grey et al. medical 2 ward, where transmission had been ongoing for several months, may have prevented the outbreak in oncology.

Anticipation: reluctance to simplify

Most enquiry reports include a narrative where before the disaster someone presented to someone-in-charge data that identified a significant risk (Schein et al., 2013). What happened is that the someone-in-charge dismissed the data by providing an explanation that erroneously negated the risk or re-assigned the problem. My personal example of this was when I arrived on a certain ward with evidence of cross-transmission therein:

ICN:	Sister, there is another patient with a Group A Strep, I think there may be a problem.
Ward sister:	Yes. That will be in the theatre.

The ward sister here was not going to contemplate that the cross-transmission could be arising on her ward. With hindsight, it could be argued that the Gray et al. (2016) missed or insufficiently responded to alert signals before November 2013. A reluctance to simplify means that data are continuously analysed – and not just by a computer – for emerging trends, and that all alert signals are investigated to prevent delays in detecting outbreaks.

Anticipation: sensitivity to operations

In Outbreak Column 10, which focused on outbreak causation, Curran (2013b) showed that the requirements needed for an outbreak are present in every ward every day. Further, the dynamic nature of healthcare (patients, care settings, care workers, care procedures) means that the opportunities for cross-transmission and cross-infection are also continuously changing. As an example, many clinical areas where intravenous drugs are prepared contain a wash-hand basin. However, the availability of alcohol-based hand rubs negates the need for a wash-hand basin in prep rooms, the presence of a sink merely increases the risk of microbial contamination from splashes. Splash contamination can lead to contaminated drugs and BSIs (Curran, 2011). Sensitivity to operations requires IPCTs to continuously consider the changing outbreak risks, seeking to highlight and negate them.

Containment: commitment to resilience

There are three aspects to having a commitment to resilience: preserving function; ability to return to normal; and learning and growing from the event (and similar events reported by others, e.g. reading, analysing and acting on published outbreak reports) (Weick and Sutcliffe, 2007). During an outbreak, the hospital must '*absorb the strain and remain functional*' – without of course exposing others to risk. This means the process for outbreak management must itself be effective and provide the swiftest route to gaining control. Thus, having and using a procedure for managing an outbreak is itself a commitment to resilience. The Gray et al. (2016) report shows that cross-transmission ceased once control measures were instigated and that returning to normal services did not reignite the outbreak. The article itself demonstrates a commitment to resilience; not only did the authors personally reflect and learn, they provided the opportunity for others to do so.

Containment: deference to expertise

Deference to expertise necessitates identifying and using experts. An early question for the outbreak management coordinator is whether there is sufficient expertise around the table to begin with. If there is not, then an urgent action is to identify and invite relevant expert(s). Of note, this could include deference to lower ranking HCWs (Weick and Sutcliffe, 2007). For example, the people who most accurately know about the patients' diarrhoea symptoms are likely to be healthcare assistants, and those who know their patients best (ward managers) should be deferred to for considerations on how communications should be relayed. Identifying and inviting experts and deferring to them – whatever rank they are – is a sign of strength in outbreak management.

Final comments

This outbreak column has used the HPS outbreak process to review a published outbreak report and then reflected on the outbreak management using HRT. This outbreak column confirms the need to treat no-infection outbreaks as outbreaks. Hindsight bias will cause IPC practitioners to ask why it took so long to identify the Gray et al. (2016) outbreak. That screening of all ward patients was ongoing in May 2013 confirms that this problem was not being ignored – but with hindsight – perhaps environmental screening at that time may have identified persistent and unidentified reservoirs and with additional control measures further transmission halted. That two people had had a BSI and had died of attributable XDR-Ab before the outbreak was declared is mitigated by the acknowledged difficulties in assessing the clinical significance of *Acinetobacter* spp infections (Peleg et al., 2008). Four of the five patients with a BSI had advanced malignancy; three were receiving palliative care. Unless IPCTs determine the outcome on every patient with a drug-resistant organism and produce epidemic curves for every drug-resistant organism, there will be delays in identifying such situations.

XDR organisms are a current problem for many IPCTs. XDR outbreaks are driven by antibiotic usage which can be optimised with antibiotic stewardship. However, effectively practised SPs will prevent cross-infection and negate the need for antibiotics in the first place. Therefore, to reduce antibiotic resistance (and XDR outbreak risks) one must prevent infections by SPs (which should include the optimising invasive device use). As shown in the Gray et al. (2016) paper, once control measures were applied, cross-transmission can be halted. The conundrum is how to prevent outbreaks by optimising SPs in the absence of an outbreak or recognised risk. For all the monumental efforts thus far, hand hygiene is still insufficiently well-practised and routine glove misuse merely aids cross-transmission (Loveday et al., 2014). If the threat of an absence of effective antibiotics to treat infections is to be postponed, then the ability of IPCTs to get others to prevent cross-transmission needs sustained improvement.

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