Reducing the number of missed isolation days in a paediatric high-dependency unit using semi-permanent pods

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Abstract

Background: Single rooms are in short supply in many hospitals.

Aim: To evaluate the impact of introducing semi-permanent pods to convert multi-occupancy bays into single occupancy pods.

Methods: We performed a 24-month pre–post observational study in a 15-bed paediatric high dependency unit. Three semi-permanent pods were installed in February 2013, in the middle of the 24-month period. The percentage of missed isolation days and the proportion of days for which >4 patients required isolation (which would exceed existing isolation facilities) were compared for the year prior to the pods with the first year of pod use using a Fisher's exact tests.

Results: Missed isolation days fell from 58.2% (662/1138; 95% confidence interval [CI], 55.3–61.0) pre-pod to 14.8% (205/1382; 95% CI, 13.0–16.8) during the first year of pod use ($P < 0.001$). The percentage of days for which >4 patients required isolation was 74.5% overall (95% CI, 70.5–78.8), and increased from 63% (95% CI, 56.2–69.4) pre-Pod to 86% (95% CI, 80.9–90.3) during pod use ($P < 0.001$).

Discussion: The introduction of three semi-permanent pods was feasible in our paediatric HDU setting and reduced the number of missed isolation days, and hence transmission risk, for important hospital pathogens.

Keywords

Contact precautions, isolation, MRSA, respiratory viruses, single room

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Introduction

Single rooms are currently in short supply in the many hospitals (Pennington and Isles, 2013; Wigglesworth and Wilcox, 2006). The UK Department of Health recommends that new hospitals have at least 50% single rooms (Department of Health, 2011), although most NHS hospitals currently have considerably less than this (Moore et al., 2010; National Audit Office, 2009). Single rooms are associated with lower rates of healthcare-associated infection (Borg, 2003; Haill et al., 2012; Levin et al., 2011; Teltsch et al., 2011). For example, a number of studies have reported lower rates of infection following a conversion from a multi-occupancy ward to 100% single rooms (Levin et al., 2011; Teltsch et al., 2011).

Furthermore, a lack of single rooms for patients with infectious and non-infectious needs can result in interruptions to patient throughput including Accident & Emergency blocking (Moore et al., 2010). Some patients

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Figure 1. Image of the pods in the HDU.

prefer single rooms and report higher levels of satisfaction than those cared for in bays (Barlas et al., 2001; Moore et al., 2010). Also, there is a lower risk of 'mix-up' errors due to uninterrupted patient contact (Maben, 2009). However, caring for patients in multi-occupancy bays is associated with a reduced risk of adverse events due to improved observation (Maben, 2009; Stelfox et al., 2003). For example, one study found that isolated patients were twice as likely to experience adverse events during their hospitalisation (Stelfox et al., 2003). Some patients in single rooms report less social contact and feelings of isolation (Tarzi et al., 2001; Young and Yarandipour, 2007). Also, bays require a lower staffing ratio, meaning that 100% single room units have higher staffing costs (Mooney, 2008; Young and Yarandipour, 2007).

The 15-bed high dependency unit (HDU) in our 246-bed specialist paediatric hospital has four single rooms and a frequent need to isolate patients with bacterial (including methicillin-resistant *Staphylococcus aureus* [MRSA], extended spectrum β -lactamase producers [ESBL] and, increasingly, carbapenemase-producing Enterobacteriaceae [CPE]) and respiratory (including respiratory syncytial virus [RSV] and influenza) pathogens. Lack of available single rooms means that 'isolation' is often attempted in bays. Therefore, we decided to evaluate semi-permanent structures that are used to convert multi-occupancy bays into single-occupancy pods (Figure 1). The pods provide a bespoke, semi-permanent structure with a door and an integral air handling system to provide a negative airflow (Figure 1). The pods can be built with minimal disruption over an existing vacated bed space without the need to close wards. We implemented three pods and evaluated their impact in terms of reducing missed isolation days.

Methods

Three pods (Bioquell Pod, Bioquell, Andover, Hants) were installed in February 2013. The usage of each bed on the unit was recorded daily for routine infection control reasons. This data collection was performed by nurses in the infection control team on all working days. Patient isolation priorities were as follows: airborne (for example, measles) > droplet (for example, respiratory viruses) > contact (for example, MRSA, rotavirus). 'Missed isolation days' occurred when a patient-day that would usually be spent in a single room was spent in a multi-occupancy bay. Missed isolation days were compared for the year prior to the pods (February 2012 to Jan 2013) with the first year of pod use (February 2013 to January 2014). The percentage of 'missed isolation days' was calculated overall and for each pathogen, and compared using a Fisher's exact test. In order to evaluate changes in the burden of patients requiring isolation over time, the mean number of patients isolated and missed per day were calculated for each month, and for the year before the pods and the first year of pod use. The mean number of missed isolations per day for the first year of pod use and the year before the pods was compared using a T-test. We also compared the proportion of days for which >4 patients required isolation, which would have exceeded our single room capacity, in the year before pods with the first year of pod usage using a Fisher's exact test.

This work was classified as service evaluation and exempt from Research Ethics Committee review. The study analysed data that had already been collected for routine infection control purposes with the permission of the hospital.

Results

Data were recorded for 203 days pre-pod and 211 days in the first year of pod usage. The data were collected on working

Table 1. Missed isolation days in the first year of pod use compared with the previous year.

Pathogen	Pre-pod use			During pod use			P value
	Missed isolation days (n)	Total required isolation days (n)	Isolation days missed (%)	Missed isolation days (n)	Total required isolation days (n)	Isolation days missed (n)	
MRSA	303	591	51.3	33	410	8.0	<0.001
ESBL / CRE	149	565	26.4	118	750	15.7	<0.001
Respiratory viruses	108	179	60.3	38	233	16.3	<0.001
Rotavirus	68	138	49.3	45	74	60.8	0.109
Overall	662	1138	58.2	205	1382	14.8	<0.001

Figure 2. Change in the mean monthly number of isolated / missed isolations per day. Arrow indicates when the pods were introduced.

days in the year, and other duties occasionally meant that collection of the data was not possible. Overall, missed isolation days fell from 58.2% (662/1138; 95% confidence interval [CI], 55.3–61.0) pre-pod to 14.8% (205/1382; 95% CI, 13.0–16.8) during the first year of pod use ($P < 0.001$) (Table 1). The impact was most marked for MRSA (51.3%; 95% CI, 47.2–55.3, to 8.0%; 95% CI, 5.8–11.1; $P < 0.001$) and respiratory viruses (60.3%, 95% CI, 53.0–67.2, to 16.3%; 95% CI, 12.1–21.6; $P < 0.001$). The proportion of isolation days for rotavirus that were missed did not change significantly in the first year of pod use; this is because rotavirus received a low prioritisation for isolation compared with other pathogens using our local algorithm.

There was an increase in the burden of patients requiring isolation. A mean of 5.5 (standard deviation 2.1) patients per day required isolation in the year before the pod versus

6.5 (standard deviation 2.0) patients per day in the first year of pod usage ($P < 0.001$). This was especially marked for the respiratory viruses, where the number of isolation days increased 33% from 179 to 233, most likely due to improved diagnostics (a PCR for respiratory pathogens was introduced from September 2013), and for ESBL/CRE, where the number of isolation days increased 33% from 565 to 750, most likely due to an increasing epidemiological trend.

There was considerable seasonal variation in the demand for single rooms, peaking during the winter months (Figure 2). However, the percentage of days for which >4 patients required isolation (which exceeded the number of single rooms on the unit before the pods) was 74.5% overall (95% CI, 70.5–78.8) and increased from 63% (95% CI, 56.2–69.4) pre-pod to 86% (95% CI, 80.9–90.3) during the first year of pod use ($P < 0.001$).

Discussion

Introducing three semi-permanent pods to our 15-bed HDU significantly reduced the number of missed isolation days and thus reduced transmission risk. The effect was especially marked for MRSA and respiratory viruses. The burden of patients requiring isolation increased significantly over the study period; we attribute this to an increase in the epidemiological trend of resistant Enterobacteriaceae (ESBL and CRE) and to the introduction of rapid PCR testing for respiratory viruses. Demand exceeded the isolation capacity of the HDU prior to pods (four single rooms) for 90% of the first year of pod use. Thus, notwithstanding some seasonal variation in the burden of isolation room requirement, pods were necessary for 90% of the year. This illustrates, that the four single rooms that we had available on the unit prior to the installation of the pods were inadequate for its needs.

A number of other studies have evaluated single room use and isolation capacity (Kim et al., 1987; Wigglesworth and Wilcox, 2006). A study from a paediatric hospital in Canada in 1987 found that 13.3% of ICU patient days required isolation (Kim et al., 1987). A more recent study from the UK reported an overall proportion of missed isolations of 22%, 16% in the adult ICU, 14% on neonatal units and 7% in paediatrics (Wigglesworth and Wilcox, 2006). Direct comparison with these studies is not useful due to differences in the structure of units and local epidemiology; however, they illustrate a frequent need to isolate patients that often exceeds single room capacity, as was the case in our study.

Drivers for improving our isolation capacity included severe patient flow problems due to an outbreak of human metapneumovirus (hMPV) which led to a Care Quality Commission (CQC, a national external quality review body) review and a reported Serious Untoward Incident (SUI) to our commissioners. Furthermore, we had a frequent requirement to isolate patients who also required visibility, for whom risk assessment indicated that single rooms were not suitable.

The pods provided additional flexibility in managing the care of patients on the HDU. Acceptability to staff, patients and parents was good; parents frequently commented that they preferred the pods to isolation in a side room, although some parents commend on reduced space within the pods. The pods offered improved visibility over isolation in single rooms and a noise reduction compared with isolation in the bays. The pods also improve isolation capacity in the event of outbreaks of hospital pathogens or in the event of pandemic respiratory viruses such as SARS, MERS or influenza. The pods did not require permanent changes to the ward and were installed over two days; the unit remained operational throughout the installation. The pod can also be sealed for hydrogen peroxide vapour (HPV) decontamination, which has been shown to reduce the chances of an

incoming patient acquiring a pathogen from the prior room occupant by 64% (Passaretti et al., 2013).

Other options for improving the isolation capacity of the unit include building more single rooms or other temporary single room options (Moore et al., 2010). Several barrier screen options are available, including 'KwickScreen' (KwickScreen, London), but these do not provide a solid physical barrier, do not have a door and do not have any mechanism to contain air. We did use KwickScreens prior to the implementation of the pods, but considered their main advantage to be improved privacy rather than improved containment of hospital pathogens. The 'Temporary Side Room' (TSR) was assessed at UCLH in London and is more closely analogous to the pod. However, the TSR has standard dimensions, with some flexibility in the TSR width, and is not currently available commercially. In contrast, the pod that we assessed is designed and built to fit into each individual bed space. We discounted the possibility of building more side rooms due to high costs, the need to reduce the number of beds on the unit and the need to close the unit to allow new single rooms to be built.

Our study has a number of limitations. We only considered infective uses of single rooms. Many requirements for single rooms do not relate to hospital pathogens, for example, patients who require increased privacy and dignity. Therefore, our findings on the requirement for single rooms are likely to be an underestimate, when considering non-infective single room requirements. We did not evaluate rates of infection before and after the introduction of the pods due to a number of other infection control interventions at or around the same time (including a change in disinfectant). We are unable to report on the relative cost of the pods compared with a permanent conversion to single rooms because the hospital did not consider a permanent modification of the unit, which was coming towards the end of its operational life. Also, the pods were only available to rent, so we were not able to compare different financial models for installing pods.

In summary, the introduction of three semi-permanent pods was feasible in our paediatric HDU setting and reduced the number of missed isolation days, and hence transmission risk, for important hospital pathogens.

Declaration of conflicting interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: There was no special funding required for this study. The Bioquell Pods evaluated in this study were rented by Alder Hey at normal commercial rates. JAO was employed part-time at Bioquell at the time of this study; Bioquell had no specific role in the study aside from this employment (which ended in April 2015); JAO was involved in the study design, data analysis, and manuscript preparation, all of which were agreed by all authors

prior to submission; JAO is now employed by Imperial College Healthcare NHS Trust and serves as a consultant to GAMA Healthcare. JAO would like to acknowledge support from the National Institute for Health Research Health Protection Research Unit (NIHR HPRU) in Healthcare-Associated Infection and Antimicrobial Resistance at Imperial College London in partnership with Public Health England (PHE), and the Imperial College Healthcare Trust NIHR Biomedical Research Centre (BRC). The other authors work at Alder Hey, which uses Bioquell Pods, but have no personal relationships with Bioquell relevant to this article. All authors have no non-financial interests that may be relevant to the submitted work.

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