Review

The use and effectiveness of cohorting RSV paediatric patients in infection control – a review of the evidence

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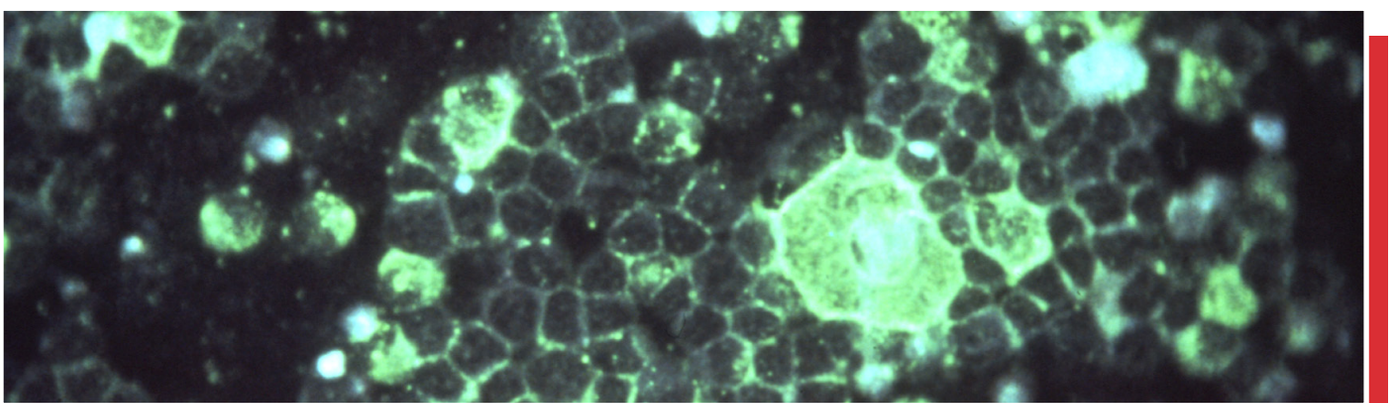


Abstract

Respiratory syncytial virus (RSV) is a contributing factor to an epidemic of respiratory tract infections every year, resulting in significant illness and hospitalisation for many children up to two years of age. As RSV is classified as a 'droplet infection', patients are typically placed in a single room, so as to reduce nosocomial transmission. However, there are potential adverse effects to patient safety and wellbeing by using single rooms. For example, healthcare workers are around two times less likely to enter a single/isolation room than see patients not in cubicles. This means patients are not reviewed or checked as frequently as those not isolated. Due to limited availability of single rooms and the potential adverse effects of single rooms, cohorting children with the same infection may be an alternate safe option. The search strategy identified relevant papers that included primary search terms such as 'RSV' or 'infection control' since 2009. Cohorting was shown to reduce nosocomial transmission by 39-67% indicating that it is an effective infection control measure. Considering the costs of nosocomial infections, it can be argued that an infection control plan which includes cohorting patients is both effective at preventing transmission and cost effective. However, there is insufficient evidence to suggest cohorting should replace single room use in clinical practice.

Abbreviations

RNA - Ribonucleic acid
RSV – Respiratory syncytial virus

Introduction

Respiratory syncytial virus (RSV) is an RNA virus that is the most common respiratory pathogen in infants worldwide.[1] In addition to being highly contagious, it commonly leads to severe infections such as bronchiolitis and pneumonia, both of which are causes of infant mortality. RSV has seven to nine times more deaths than influenza and significantly more morbidity and mortality in children than SARS-CoV-2.[2,3,4] Symptoms for RSV start two to five days after contact with the virus; common symptoms include: runny nose, fever, cough, difficulty eating, drinking and swallowing, wheezing, apnoea, flaring of the nostrils and respiratory distress.[5] Symptoms may not arrive all at once but in stages, with infants only displaying irritability, decreased activity, apnoea or breathing difficulties.[6]

RSV is highly transmissible making it a major nosocomial problem (infections arising as a result of a stay in hospital) for paediatric wards.[5,7] It is transmitted via airborne droplets, which land on fomites such as beds, toys and furniture. These can survive for up to six hours as well as living on contaminated skin for around 25 minutes.[8] Therefore, this is an important topic for infection control in hospitals. The purpose of this review is to examine the evidence for potential measures to prevent transmission of RSV in hospitals; in particular, the evidence for the effectiveness of 'cohorting' and any potential risks or hazards associated with it.

A cohort area is a bay or ward in which a group of patients with the same infection are placed.[7] A cohort of patients can be chosen based on the clinical diagnosis, microbiological confirmation, epidemiology and mode of transmission of the infection. It is an alternate solution to an isolation room or a single room to prevent transmission. This review will compare cohorting patients with the use of single rooms which are defined as "room with a self-contained toilet and its own hand basin".[9]

Methods

Critical literature review

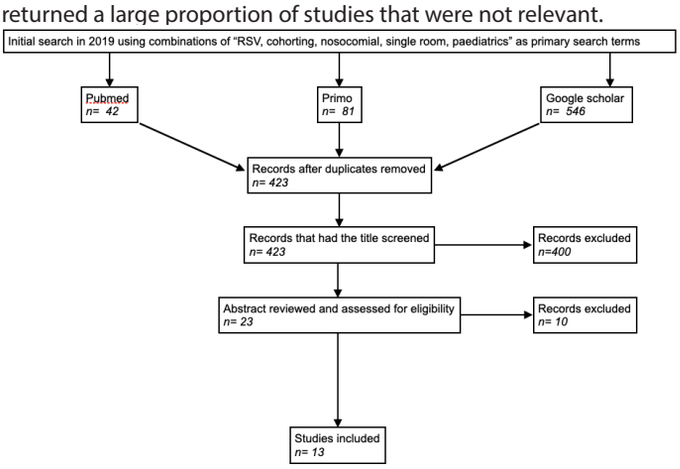
For this literature review Primo, Pubmed and Google Scholar were searched from January 2009 to December 2021 to identify relevant

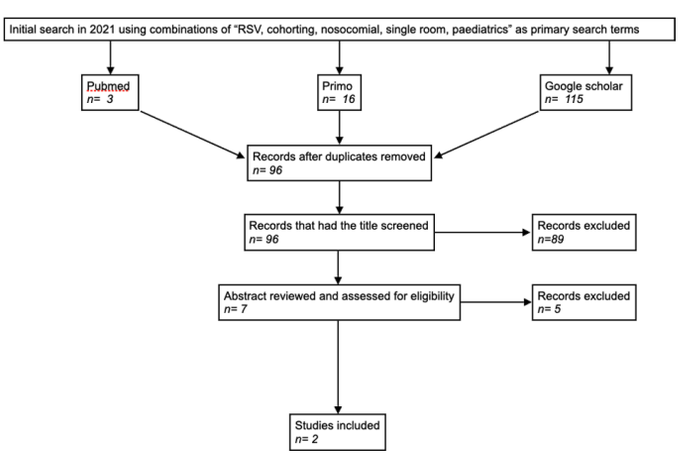
articles.

The search strategy employed the primary search terms of interest: 'RSV', 'cohorting', 'infection control', and 'nosocomial' to identify studies specific for the population of RSV paediatric patients. Studies looking at cohorting with non-RSV infections were also included if they were either: other droplet-based infections, or had reviewed the impact of an infection control measure on patient wellbeing. The search was restricted to papers published in the preceding 10-year period. Several papers published prior to this were selected from citations in review articles previously identified. These were included due to their contribution to the evidence base in relation to underlying guidelines.

Results

The original search identified several papers that were not relevant to this review as they did not focus on nosocomial transmission or infection control. On screening, the papers that did not contain at least two of the primary search terms in the title or abstract were excluded. In the search conducted in 2019, 23 papers were reviewed and assessed for eligibility and 10 were excluded. The 2021 search found an additional seven that needed to be reviewed and from that five were excluded. From citations in those studies an additional seven papers were identified that were published before 2009 and have been included in the number screened. The search results are seen in **Figure 1** and **Figure 2** below. Systematic database searches were supplemented by a manual search of Google Scholar. This returned a large proportion of studies that were not relevant.





Use of cohorting as an infection control measure

When considering whether cohorting is an appropriate infection control measure, many factors are taken into consideration. With regard to the type of infection, a risk assessment taking into account the typical route of transmission as well as symptoms is the first factor. Symptoms that increase the risk of cross transmission are vomiting, diarrhoea and respiratory symptoms. Current protocol states if an isolation room is available then it should be used if the microorganism is airborne.[10] According to Public Health England, a single room should be used if the microorganism is spread by contact or droplet route where available.[10,11] Therefore, as RSV is transmitted by contact with droplets, single rooms are optimal. However, in the UK, there is a seasonal epidemic of respiratory tract infections in hospitals with RSV bronchiolitis being responsible for around one in six of all UK paediatric admissions.[12] In these circumstances, accommodating each patient in their own single room may not be possible.[13] Furthermore, single rooms may not be the best way to control the spread of infection whilst providing optimal patient care.

The overall goal in preventing a breakout of RSV infection within a hospital is to stop or reduce nosocomial transmission.[13] Hospital acquired RSV infections are associated with negative clinical outcomes, including increased mortality and longer length of stay.[8,14] A systematic review in 2016 estimated the median risk of transmission for RSV in hospitals to be 28.5%.[15] For comparison, an estimate done of the risk of nosocomial transmission when a patient is admitted into an Ebola holding unit in Sierra Leone was 3.3% or less.[16] This high transmission rate demonstrates the need for effective infection control (including aseptic techniques, environmental factors and staff training) across any hospital setting. To reduce nosocomial transmission, infection control measures need to be thorough, involving compliance of the staff as well as the patient's family, regardless of single room or cohort arrangements.

An example of effective cohorting was shown in a study looking at the infection control of an outbreak of diverse multi-drug resistant organisms which used some of the strictest control measures.[17] In this study, six patients were isolated in the intensive care unit of the hospital with people traffic redirected away from the entrance to the ward and nursing staff being assigned to only those patients within the cohort. This method improved hand hygiene and reduced hospital acquired infections by reducing the interactions that staff have with isolation patients whilst infected patients were treated. Since the start of 'super-isolation' cohorting there were no infections transmitted nosocomially over the patients' hospital stay of up to 117 days. This demonstrates that when cohorting is used, and compliance to infection control measures are high, it is an effective way of diminishing nosocomial transmission.[17]

In order to reduce nosocomial transmission from RSV paediatric patients during epidemics, one option is to isolate vulnerable (non-RSV infected) patients that have the highest risks of complications from infection. Vulnerable patients include immunocompromised or premature infants.[18] The vulnerable patients in single rooms are placed away from other infants with RSV, followed by which RSV patients can be accommodated in separate rooms or cohorted with other infants with the same infection. Apart from the location of the patient, there are several other factors involved in achieving effective infection control. Cohorting staff, equipment and toys, as well as explaining to parents about droplet infections and the precautions that need to be upheld, are essential.[19,22] When these are adhered to in children with RSV infections, nosocomial transmission can be reduced by 39-67%, thereby highlighting these steps to be effective intervention.[20,21]

The effect of cohorting on patient safety

Hospital guidelines in the UK regarding infection control for RSV patients are very clear.[10] There is research into the effects on patient safety when a patient is put into a single room, however, there is minimal evidence to compare this within cohorting patients with the same infection. A systematic review of the psychological wellbeing of patients in isolation rooms found a negative impact on the patients' mental health.[23] The patients' satisfaction was affected and their behaviour and psychology showed higher amounts of anger, anxiety and depression. Kirkland and Weinstein found that healthcare workers were around two times less likely to enter the rooms of patients in contact isolation which may result in adverse outcomes.[24] This suggests that there may be adverse effects of

isolating patients. The negative consequences of patients in isolation has been recorded in a systematic review with meta analysis looking at the impact of isolation on hospitalised patients who are infectious. The review indicated that there were higher levels of depression and anxiety with pooled standardised mean differences of 1.28 and 1.45, respectively. Although both had high levels of heterogeneity, there were also worse outcomes for a range of care-related factors.[25]

These studies analysed the adult population and therefore the psychological harm may not be directly applicable to infants. However, the behaviour of healthcare professionals in the context of isolation rooms are likely to be just as relevant for infants, particularly if parents are not staying with them. The perceptions of different healthcare professionals on the effects of isolation on patients are not universal. Khan et al found that nursing staff did not think there was any difference in care between isolation patients and others, but physicians believed patients were more prone to adverse events if they were in isolation.[26] Healthcare staff have 90% compliance with infection control measures for patients in single rooms.[22] However, the fact that patients may not be monitored as closely as they would be when cohorted shows that patient safety may be compromised to uphold proper infection control. Mansbach found that one in three infants with viral bronchiolitis will have multiple infections at the point of admission, which raises issues around transmission of other viruses while in the cohort.[27]

Cost-effectiveness

There is a clear annual burden of RSV and other respiratory tract infections on NHS resources so if patient safety is not adversely affected by cohorting, using it to replace single room use could decrease the strain on beds that arrives every winter.[13] However, cohorting also requires rapid RSV testing at additional cost. Infection control measures, such as personal protective equipment, have associated costs that need to be taken into account. The estimated average cost of each nosocomial infection prevented is estimated to be around $170,228; although this is from an American study and costs may be different in the UK setting. Considering the costs of nosocomial infections, the authors concluded that a targeted infection control plan including cohorting patients is both effective and economically worthwhile.[28]

Discussion

Evidence suggests that cohorting is effective in reducing nosocomial transmission and may not possess some of the potential disadvantages of isolating patients. Negative effects such as decreased monitoring and adverse mental health outcomes in single rooms are well documented. However, there remains some unanswered questions with regard to patient safety. There is a concern of cross-infection with other viruses between cohorting infants with one type of infection as they may still infect each other with other viruses. Therefore, patient safety in the cohort room is compromised as nosocomial transmission between cohorted patients can still occur. The potential for a decrease in patient monitoring, and therefore safety, in single rooms is also a potential harm. This in addition to the negative effects of isolation on wellbeing would have been compounded by the decreased visits during the pandemic. As there is decreased hand hygiene compliance and monitoring in single rooms, there is an impact in the effectiveness of infection control measures. Nosocomial transmission rates would be negatively affected by this decrease but this is not currently documented. The safety and wellbeing of the isolated patient must be balanced against the safety of other patients in the hospital. Cohorting patients with only RSV infections while isolating vulnerable patients or patients with multiple infections may remove such a compromise.

Conclusion

When creating a targeted infection control plan there is clear value in using cohorting during seasonal outbreaks of RSV to reduce nosocomial transmission. It is economically valuable and effective as a control measure. However, there is a need for further research into the effects on patient safety in the cohort or research comparing both methods against each other for the purposes of an informed evaluation of current guidelines. Research including factors such as compliance and frequency of patient monitoring, in addition to patient mental wellbeing, would be valuable across both settings. Cohorting should still be considered when developing an infection control plan in preparing for seasonal epidemics of RSV due to its benefits in practicality as well as in patient mental wellbeing. As hospitals recover from a pandemic, an infection control plan for upcoming seasonal epidemics should focus on whether these measures are achievable with reduced resources. To conclude, cohorting patients may be a more effective strategy to reduce nosocomial transmission compared to isolation, and more suitable when staff and equipment resources are limited.

Author contribution

All substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work were by the listed author. I partook in the drafting of the work and revising it critically for important intellectual content and for final approval of the version to be included in INSPIRE at all stages.

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Hello! I'm Josh, a fourth year medical student studying at Peninsula Medical School, Plymouth University. My current medical career interests are in infectious disease, paediatrics and academia so being able to write this review and get involved in the research process has been really exciting for me. In my spare time I love surfing in South Devon and Cornwall, playing basketball and visiting Dartmoor National Park when the weather allows.