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Keeping It Real: Infection Prevention and Control Problems and Solutions in Low- and Middle-income Countries

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Abstract: Infection prevention challenges are ubiquitous in healthcare, but some are unique to or more prevalent in low-and middle-income country settings. Despite limited resources, innovative and committed paediatric healthcare providers and infection preventionists have found creative solutions to address the very real and pressing risks their patients face every day. We gathered examples of infection prevention and control challenges faced by clinicians in resource-limited healthcare facilities, and the real-world infection prevention and control solutions they implemented, with the goal of learning broader lessons applicable to low-and middle-income countrie.

Key words: infection prevention, infection control, low-and-middle income.

While the evidence-base to support infection prevention and control (IPC) practices has grown steadily over the past decade, healthcare workers (HCW) in all settings struggle to implement some of the new (as well as older) evidence-based practice to prevent healthcare-associated infections (HAI).[1] For resource-limited settings, this challenge is even greater with the competing pressures of limited financial resources, overcrowding and understaffing and suboptimal infrastructure and clinical care environment.[2–4] Tragically, these are the settings in which the very best and most innovative IPC practices might have the largest impact. The prevalence of HAI among patients hospitalized in low-and-middle income countries (LMICs) is 3- to 20-fold above that in well-resourced settings.[5,6]

Despite limited resources, innovative and commited infection preventionists, healthcare epidemiologists, and clinicians have found creative solutions to address the very real and pressing risks their patients face every day. Below we share seven vignettes that illustrate these real-life solutions to common IPC challenges. Some of these vignettes describe solving problems that plague all of us, no matter the available resources. The struggle to get clinicians to perform hand hygiene knows no geographic boundaries! However, some resource-limited settings present unique challenges. These include preventing vector-borne infections within inpatient care settings. Creative solutions, borne of limited resources and necessity, inform all of us how to do more and better in our own work setting.

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METHODS

An open call was sent out via email in September 2020 for clinicians to share their experiences in finding solutions to real world IPC challenges in low- and middle-income settings. It was sent via the World Society of Paediatric Infectious Diseases (WSPID), and also through the WSPID regional member societies: African (AfSPID), Asian (ASPID), Australasian (ANZPID), European (ESPID), North American (PIDS) and South American (SLIPE). The definition of LMIC used was according to the World Bank group. Clinicians in LMIC were requested to author a brief "real world problem, real world solution" for IPC and/or AMS (see accompanying paper) describing their setting, the problem encountered, and the solution(s) applied by them in their workplace that could "help colleagues in other parts of the world solve the same problem or understand the challenges of work in LMIC." Potential IPC areas for consideration were suggested, but not limited to: reuse of medical equipment, controlling vectors, environmental cleaning and surveillance. The experiences were collated and are presented here.

REAL-WORLD SITUATIONS

Contributions were received from Africa, Asia and Latin America from clinicians who described the IPC challenges and the solutions implemented by them in their local settings.

IMPROVING HAND HYGIENE IN A TEACHING HOSPITAL

Setting

A large university teaching hospital in Ethiopia.

TABLE 1. My 5 Moments for Hand Hygiene (2 "Befores" and 3 "Afters")[7]

HCWs should clean their hands:
1. Before touching a patient
2. Before clean/aseptic procedures
3. After body fluid exposure risk
4. After touching a patient
5. After touching patient surroundings

Problem

The overall baseline rates of hand hygiene compliance among healthcare workers (HCWs) in the inpatient service was only 4.8% before the intervention. This poor hand hygiene practice was due to scarcity of safe water, hand sanitizer or dispensers. Also, many sinks were either nonfunctional or leaking. There was a knowledge gap among HCWs about the 5 moments of hand hygiene[7] (see Table 1) and the correct techniques. In a focus group discussion, many participants said that lack of proper training, poor accessibility of hand hygiene products and workload were their major challenges to practicing optimal hand hygiene.

Solution

We implemented a hand hygiene bundle strategy[8] consisting of in-house production of alcohol-based hand sanitizer and dispensers for every patient bed, staff education and motivation, a celebration of world hand hygiene day and placing hand hygiene posters at strategic sites in close cooperation with a European partner hospital. In addition, volunteer infection control nurses were selected from each ward and a multidisciplinary infection prevention committee was established. Following the intervention, compliance with hand hygiene practice increased over 10-fold within 1 year.

Lessons

Alcohol-based hand rub is accepted as the primary hand disinfection method in the hospital. Infection prevention has become a hospital-wide emphasized topic. hand hygiene campaigns in resource-limited settings benefit from multimodal strategies and knowledge exchange. The utilization of local resources also should be further emphasized.

MANAGING SEPSIS IN NEONATES

Setting

Neonatal unit at a tertiary-care public referral hospital, in Gaborone, Botswana.

Problem

Neonatal sepsis is one of the most common complications experienced by hospitalized neonates, with frequent outbreaks caused by Gram-negative pathogens such as *Klebsiella pneumoniae*.[9,10] Due to limited availability of hospitals capable of providing advanced care, premature or critically ill neonates are often sent to a regional or national referral centers for care because doctors at smaller hospitals lack experience in caring for preterm babies. This practice can tax the human and material resources of the referral center. Overcrowding of marginally staffed neonatal units can be associated with increased risk of sepsis and shortage of critical resources such as blood culture bottles that are essential to manage babies with suspected sepsis.

Solutions

Clinical assessment is essential to predict which babies may have sepsis so that antibiotics can be initiated in a timely fashion. Regardless of the presence or absence blood culture bottles, a high index of clinical suspicion is essential. For example, lethargy, poor feeding or "not quite right" according to mom can be important signals of sepsis, in addition to obvious changes in vital signs such as fever and tarchycardia. An issue with this clinical approach is that the symptoms and signs of sepsis are often nonspecific. If blood cultures are not available, one must rely only on clinical acumen, without microbiology data to confirm sepsis or select appropriate antibiotics according to culture and sensitivity. Inflammatory markers, such as C-reactive protein may be helpful in making decisions to start or stop antibiotics, but are seldom available in this resource-limited neonatal unit.

To reduce overcrowding in the referral neonatal unit, we frequently spoke with doctors in peripheral clinics to accept the neonates they had referred to us after clinical improvement but still too small to be discharged home. We tried to send these babies to their family's local hospital for weight gain, emphasizing that this would be safer for the babies, and provide more one-on-one time with mom, while reducing our hospital's problem with overcrowding. After initial success, we noted a re-emergence of reluctance from peripheral settings to accept low birth weight stable babies for weight gain.

Lessons

Trust your instinct as a doctor. If you are suspicious, just go all the way (eg, start antibiotics rather than waiting for more signs). Be vigilant to the possibility of hospital-acquired infection in your babies. Be aware of all your babies' baseline activity and behavior so that you can pick up any early changes suggestive of sepsis. Trust moms. A mom who is worried about even a subtle change might be on to something, always thoroughly examine the baby. Our next challenge is to sustain the confidence of doctors in peripheral hospitals to manage babies sent back for weight gain at locations closer to home through sustained communication and being available for advice.

PREVENTING COVID-19 INFECTION IN A NEONATAL UNIT

Setting

A large public referral hospital in Cape Town, South Africa, with a busy high-risk obstetric service and a 132-bed neonatal unit.

Problem

Infection is a major cause of morbidity and mortality in the neonatal unit, exacerbated by overcrowding, suboptimal infection prevention and few isolation rooms. The lack of isolation rooms exacerbated challenges with the emergence of the COVID-19 pandemic in South Africa from March 2020.

Solutions

To overcome this challenge, we converted a postnatal ward into a dedicated COVID-19 obstetric ward to accommodate pregnant women with suspected or confirmed COVID-19 who also required interventions for antenatal, intrapartum and postnatal complications. Well neonates born to these mothers were kept in the dedicated COVID-19 ward. Mothers wore surgical or cloth face masks, practiced hand hygiene and breastfeed their neonates. These neonates were not tested for COVID-19 unless they became unwell.

Any neonates requiring admission to the neonatal unit for underlying conditions were managed as persons under investigation (PUI). They were nursed in closed incubators in a back room at the back of a designated neonatal ward. Nasopharyngeal aspirates were submitted for SARS-CoV-2 polymerase chain reactions (PCRs). The neonates were deisolated if either their own or their mothers' tests were negative.. A nasopharyngeal aspirate was performed to test for SARS-CoV-2. These neonates were deisolated as soon as either the mother's SARS-CoV-2 test or their own test was negative, thus creating space for the next neonatal PUI admission. Additional IPC measures included unit-wide visitor restriction (only mothers allowed to visit). PUI mothers were only allowed to visit once their COVID-19 status were confirmed negative. Women with confirmed COVID-19 were excluded for 10–14 days after onset of symptoms or a positive SARS-CoV-2 PCR, provided that symptoms had

resolved. These mothers were encouraged to expresse breastmilk. All staff and mothers were screened daily for symptoms of COVID-19 and wore surgical masks or cloth facecovers. Regular education and awareness sessions were conducted to reinforce hand hygiene, physical distancing and mask-wearing.

Lessons

Despite the many challenges posed by COVID-19, the pandemic provided an opportunity to refocus efforts to improve IPC in the neonatal unit by emphasizing the basic elements of good care: hand hygiene, environmental cleaning, patient isolation and exclusion of unwell staff and mothers.[11] We are confident that the lessons learned during the pandemic will help to prioritize patient safety for mothers and their newborns in low-resource hospitals.

ADDRESSING VECTOR-BORNE HEALTHCARE-ASSOCIATED INFECTIONS

Setting

Neonatal unit at a tertiary-care public referral hospital, in Gaborone, Botswana.

Problem

Flies are known vectors of various clinically-relevant pathogens and can lead to colonization and infection.[12,13] Insects are commonly present in our patient care areas, particularly during summer. In 2019, during a fly infestation in our neonatal unit, we encountered an extremely low birth weight neonate with persistent growth of *Enterobacter cloacae* on blood cultures, despite appropriate antibiotic coverage. Careful examination of the neonate's eyes, prompted by the mother's report of "something moving," identified naso-orbital myiasis. Although the identity of the insect larvae could not be confirmed, they were suspected to be fruit fly larvae. Fruit flies can carry pathogenic Gram-negative bacteria.

Solutions

The patient required removal of the "reservoir" (insect larvae) to resolve the bacteremia. This phenomenon, while rare among hospitalized neonates, is well described in the literature and is associated with outdoor exposure, close animal contact and poor supervision of patients under sedation for assisted ventilation in LMICs. We engaged pest management services who were ill-prepared to recommend sustainable pest control strategies appropriate for a neonatal unit. Thus, the neonatal clinical team addressed this problem through temporizing measures such as keeping doors and windows closed, repairing insect screens, and keeping food out of the unit. Finally, LED light insect traps were acquired locally. These interventions dramatically the reduced the number of insects visible in the unit.

Lessons

This case emphasizes that vector control is a critical, yet often overlooked, arm of infection control, especially for acute care settings in LMICs. LED light insect traps may an effective temporary mitigation measure until more sustainable environmental remediation measures are implemented.

REDUCING CATHETER-RELATED BLOODSTREAM INFECTIONS IN A PEDIATRIC HEMATOLOGY-ONCOLOGY UNIT

Setting

Pediatric hematology-oncology ward within a Brazilian children's hospital.

Problem

Catheter-related bloodstream infection rates (CRBSIs) were abnormally high during 2019 and first semester of 2020, ranging from 9.1 to 26.3 infections per 1000 central venous catheter days. These elevated rates were driven in part by 2 outbreaks (one due to *Burkholderia. cepacia* and another due to *Serratia marcescens*). The infection control team had conducted surveillance for nosocomial infections in the ward every 5 weeks since the beginning of 2017, with no significant changes to healthcare personnel, environmental and hospital supplies.

Solution

A multidisciplinary crisis office was established that included the hospital's general, medical and nursing directors, all members of the infection control team, medical and nursing chief of the onco-hematology ward, heads of hospital maintenance and hospitality service. An extensive investigation was undertaken to identify the cause and then reduce CRBSI during the following months. In this phase, overall compliance around catheter insertion and care was good. The next step was training of physicians and nurses about preventing CRBSI during insertion and maintenance, which did little to change CRBSI rates. As extrinsic contamination of intravenous fluids and medications was suspected, environmental swabs were then collected. The likely reason was the inadequate space shared by many healthcare workers, in close proximity to the nurses station. Positive samples were found in the sink of the nursing station and sink, shower and hygienic shower in one of the suspected rooms. Another focus, the internal sink syphon, was identified in this room. Thereafter, the unit was closed for rigorous cleaning. The syphon was removed and a new area was identified for the nurses station to reduce congestion. The unit was then approved to admit patients again. Over the following months, the rate of CRBSI decreased to 4.0 per 1000 central venous catheter days.

Lessons

A global approach is necessary to reduce CRBSI,[14] including periodic review of routine hospital practices, workflow of healthcare personnel, periodic analysis of water supplies and administrative support. Reduction of CRBSI was possible only by systematic investigation and intervention in several areas at the same time.

DEALING WITH CARBAPENEM-RESISTANT *ENTEROBACTERALES* IN A TERTIARY CARE CENTER

Setting

Pediatric units within a large tertiary-care teaching hospital in Bangkok, Thailand.

Problem

Sharply increasing rates of carbapenem-resistant organisms were noted among hospitalized children with Gram-negative infections. In 2017, 22% of *K. pneumoniae* and 4% of *Escherichiae coli* isolates were carbapenem-resistant.[15] National rates of carbapenem-resistance were lower; in 2019, the national antimicrobial resistance surveillance center of Thailand reported that 10.1% of *Enterobacterales* were carbapenem-resistant *Enterobacterales* (CREs).[16]

Solution

To prevent the spread of CRE in our hospital, standard IPC bundles were implemented. These included patient placement, contact precautions, use of personal protective equipment and environmental cleaning. Despite limited resources, we applied multiple

interventions. First, as we had a limited number of single-bed isolation rooms, we used transparent partitions to designate areas for CRE patients and to remind healthcare workers to comply with strict contact precautions before entering the area. Next, to ensure constant availability, infection control liaison nurses on each ward prepared supplies such as disposable gowns, 4% chlorhexidine liquid soap, chlorhexidine pads, disinfectant wipes, disposable laundry bags and disposable cartons near patients. Isolation was continued until a patient had 2 consecutive negative rectal swabs for CRE, which were typically performed every 2–3 weeks.

REDUCING HIGH BLOOD CULTURE CONTAMINATION RATES IN PEDIATRIC WARDS

Setting

A large public referral hospital in Blantyre, Malawi, with 28,000 children admitted each year.

Problem

We noticed that a large number of blood cultures were growing contaminants. While contaminants are less concerning than pathogens, their detection can lead to potentially unnecessary treatment and prolongation of hospitalization while the bacteria are identified. Additionally, their detection raises concerns about broader infection control practices.

Solution

We considered a number of different root causes including blood sampling technique, use of gloves, and the absence or inadequacy of handwashing. However, it was when waiting for a ward round to start and idly watching the ward play lady, which an unexpected risk was identified. She was making cotton wool balls out of a large roll of cotton wool. A pinch of cotton was taken and rolled in her hands to make a ball. These cotton balls were used for cleaning the skin site before blood sampling. Everyone who made the cotton balls was asked to wear gloves during this task, and the contamination rate decreased.

Lessons

While a review of infection control processes is important in identifying suboptimal practice, we should always use our eyes to stay aware of what is going on around us in our healthcare settings. The solution may be very simple.

OVERALL LESSONS LEARNED

While textbooks and peer-reviewed articles are essential strategies to disseminate broadly emerging knowledge about preventing HAI and improving patient outcomes, we sometimes overlook how much we can learn from the experiences of others. This is particularly true in settings lacking some of the resources that are assumed to be in-place by evidence-based guidelines and best-practice statements. By sharing these narratives, we highlight the creativity and perseverance that characterize the work done by colleagues in resource-limited settings to prevent both common HAI, such as CRBSI, as well as less common events, such as hospital-onset vector-borne infestations. We hope this supplement fosters future efforts to build connections across geography to support our shared goals of eliminating HAI in children.

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