

Perspective

The 17th International Congress on Infectious Diseases workshop on developing infection prevention and control resources for low- and middle-income countries



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SUMMARY

Hospital-acquired infections (HAIs) are a major concern to healthcare systems around the world. They are associated with significant morbidity and mortality, in addition to increased hospitalization costs. Recent outbreaks, including those caused by the Middle East respiratory syndrome coronavirus and Ebola virus, have highlighted the importance of infection control. Moreover, HAIs, especially those caused by multidrug-resistant Gram-negative rods, have become a top global priority. Although adequate approaches and guidelines have been in existence for many years and have often proven effective in some countries, the implementation of such approaches in low- and middle-income countries (LMICs) is often restricted due to limited resources and underdeveloped infrastructure. While evidence-based infection prevention and control (IPC) principles and practices are universal, studies are needed to evaluate simplified approaches that can be better adapted to LMIC needs, in order to guide IPC in practice. A group of experts from around the world attended a workshop held at the 17th International Congress on Infectious Diseases in Hyderabad, India in March 2016, to discuss the existing IPC practices in LMICs, and how best these can be improved within the local context.

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Introduction

Hospital-acquired infections (HAIs) are a major concern across all healthcare systems,¹ contributing significantly to patient morbidity and mortality, particularly in developing countries.² According to a multistate prevalence survey of healthcare-

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associated infections conducted by the US Centers for Disease Control and Prevention (CDC) in 2011, an estimated 722 000 HAIs occurred in acute care hospitals in the USA, with 75 000 of the patients dying during their hospitalization.³

Among HAIs, device-associated infections pose the greatest threat to patient safety, particularly in the intensive care unit (ICU),⁴ with higher rates observed in low- and middle-income countries (LMICs), as reported by the International Nosocomial Infection Control Consortium (INICC)³⁶ in 2016. The pooled rate of central line-associated bloodstream infection (CLABSI)³⁷ in medical-surgical ICUs of LMICs when compared to equivalent ICUs in the USA was found to be 4.1 vs. 0.8 per 1000 central line-days. Furthermore, the rate of ventilator-associated pneumonia (VAP)³⁷ was 13.1 vs. 0.9 per 1000 ventilator-days and the rate of catheter-associated urinary tract infection (CAUTI)³⁷ was 5.07 vs. 1.7 per 1000 catheter-days, with similar device use in the LMICs and the USA (high income country). This increase in HAIs has led to an increase in hospital length of stay, the emergence of bacterial resistance, and increased expenditure of healthcare dollars around the world.⁵

In response to the urgent need for infection prevention and control (IPC), as exemplified by the recent Ebola outbreak in West Africa, the World Health Organization (WHO) established a global IPC unit in 2016, which incorporates core elements of IPC structure, measures to combat antimicrobial resistance (AMR), and guidelines on the management of common HAIs such as surgical site infections (SSIs) and catheter-associated blood stream infections; this links up with the WHO Water, Sanitation and Hygiene (WASH) programme and with outbreak control. A decontamination and sterilization manual has also been published recently, along with a downloadable app.⁶

In LMICs, IPC programmes targeting HAIs are frequently underdeveloped and sometimes non-existent.⁷ The major challenges faced are not only due to limited financial resources, but also poorly placed and implemented systems, such as those for the purchase and distribution of supplies, management of health technology, cleaning/sanitation, and management of clinical waste.⁸ In addition, most LMICs do not have robust national or structured local support to uphold IPC programmes. Given the scarcity of resources, infrastructure and low compliance by healthcare workers, the implementation of adequate infection control activities including the protection of healthcare workers and visitors remains a significant challenge.

To address these issues, a group of infectious diseases experts from around the world, with representation from high-, middle-, and low-income countries, attended a workshop held at the 17th International Congress on Infectious Diseases in Hyderabad, India in March 2016, to assess the gaps in IPC programmes in LMICs, such as training and education requirements, and to identify approaches that could be better adapted to the needs of the individual countries, in order to guide IPC in practice. This article describes the highlights of that discussion.

The workshop

The workshop started with an introduction outlining the need for applied research and the development of practical IPC guidelines appropriate to the local context by the chairs of the Education and Publications Committee and the Research Committee of the International Society for Infectious Diseases (ISID). Participants in the LMIC workshop included representatives from select countries and regions: South Africa (represented by the Infection Control Africa Network – ICAN), the Democratic Republic of the Congo, Kenya, Chile, Venezuela, Jamaica, India, Nepal, Egypt,

and Cambodia. IPC gaps and needs were discussed at length. International guidelines were universally applied as the basis for IPC programmes in their respective institutions. Several programmes focus on the education of hospital personnel, particularly nurses and trainees, as a pivotal part of their IPC practices, in the form of formal classroom teaching followed by practical application in the specific clinical setting.

Several African countries such as Kenya, South Africa, Zimbabwe, Namibia, Sierra Leone, Liberia, and Egypt, to name a few, have national IPC programmes in place as part of their ministries of health, to uniformly guide healthcare institutions in their respective countries. These national programmes are responsible for issuing national IPC guidelines, training of healthcare personnel, and monitoring and evaluation. However, published data from a number of LMICs describing outcomes as a result of these national programmes are scarce. Although appropriate IPC measures have been adapted in various institutions, the focus group agreed that it was fundamentally the implementation of such programmes that posed a major challenge in achieving favourable results, meeting IPC goals and ensuring patient safety. In view of the recent outbreaks of Middle East respiratory syndrome coronavirus and Ebola virus, as well as HAIs and AMR, the lack of IPC implementation has been a subject of discussion and concern at various recent international meetings and is now getting the global attention it deserves.

Infection control and prevention resources and gaps in LMICs

The various IPC resources and gaps, as discussed during the workshop, are outlined below. [Table 1](#) presents key points discussed during the workshop.

Kenya

In 2013, Kenya formally established a national IPC programme within the Ministry of Health (MoH). This programme relies mostly on external funding for budget support. Coordination of the IPC programme is done by a multidisciplinary national IPC advisory committee, which is replicated at the county level. Kenya has a national IPC strategic plan for 2014–2018 and revised its national IPC policy and guidelines in 2015. To facilitate the implementation of the guidelines and bridge the knowledge gap in IPC, the MoH developed a 6-day face-to-face training course on IPC for front-line healthcare workers (nurses, clinicians, pharmacists, laboratory technicians, and microbiologists). CDC Kenya has supported the establishment of IPC work in collaboration with the US CDC, which has assisted in standardization of the project.

The implementation of IPC measures in Kenya has been compromised by changes in governance and the decentralization of health services. Surveillance data are available from sentinel sites, but are very limited from hospitals across the country due to inadequate laboratory capacity for diagnostics and under-utilized health information systems. The National Patient Safety Survey 2013 revealed a general lack of IPC knowledge and practices among healthcare personnel (An Assessment of Patient Safety Standards in Kenya—Summary Report of the Patient Safety Survey 2013, World Bank; Bridging the Knowledge Gaps, poster presentation at the 17th International Congress on Infectious Diseases in 2016). This was attributed to the lack of technical expertise in IPC at all levels, poor financing for IPC to ensure a continuous supply of commodities, and inadequate physical infrastructure. The lack of surveillance data makes it difficult to measure the burden of HAIs in order to advocate for more investment in IPC. However, the establishment of AMR units in the MoH and East Africa Public

Table 1
Infection Prevention and Control in Low and Middle Income Countries.

Topic	Key Points
IPC Current Status and Resources	<ul style="list-style-type: none"> • countries vary regarding type of IPC program at national level • The robustness of each program varies between LMICs. HAI surveillance existed in some participating LMICs, but few at national level • Several countries including South Africa and Kenya have created antimicrobial stewardship programs to monitor resistance
IPC Current Gaps	<ul style="list-style-type: none"> • IPC programs have significant financial expenses • While national IPC guidelines exist, implementation continues to be a struggle • There is inconsistent IPC practice and surveillance throughout each LMIC • Many healthcare facilities lack proper and consistent methods of communication for IPC efforts
Development and Enhancement of IPC Training Materials	<ul style="list-style-type: none"> • Training Materials should <ul style="list-style-type: none"> ◦ be free of charge ◦ be easily accessible (e.g. mobile app)
ISID Guide to Infection Prevention in the Hospital	<ul style="list-style-type: none"> • 5th edition of guide has over 7,500 downloads from more than 170 countries • Content generally oriented to North American and European audience
ISID Guide to Infection Prevention in the Hospital Enhancement for Global Audience	<ul style="list-style-type: none"> • Pictorial representations of IPC practices • Translate guide into regional languages • Maximize access and portability

Health Laboratory Network represents a promising development towards improving IPC efforts in the near future in Kenya.

South Africa

A robust national IPC programme has existed in South Africa since around the year 2000. National guidelines on IPC structure, standard and transmission-based precautions, and outbreak control have been implemented gradually since 2007. Prior to that there were individual provincial programmes. Guidelines for the prevention of SSI, CLABSI, CAUTI, and VAP, amongst others, have been introduced nationally, with a significant reduction in HAIs (Figure 1). Surveillance of HAIs and AMR is supported by a robust laboratory service. The MoH has established an AMR ministerial advisory committee and IPC is an integral part of this vital programme. Each healthcare institution, including community-based facilities, has a named IPC practitioner. A basic level IPC course (6 months) is offered to all healthcare workers, managers, and non-clinical staff. More than 89% of practitioners have been formally trained at the basic level. A diploma (1 year) or

postgraduate diploma in IPC (PDIC) (2 years part-time) is also offered. To date, 93 IPC practitioners have completed the PDIC. In 2015, the first two Masters in IPC graduated from Stellenbosch University, South Africa. The major drawback for IPC in South Africa is that it is not currently recognized as an independent subspecialty in the country, increasing the urgent need for structured career paths.

In response to traveller and pilgrim needs, a free IPC app for healthcare workers and the public has been developed by ICAN in collaboration with the Eastern Mediterranean Regional Office of the World Health Organization (WHO-EMRO). Another app to supplement the decontamination manual for healthcare facilities (WHO 2016) has also been developed and is available in Google and Apple stores.³⁸

Chile

A national programme directed by the MoH has been in place in Chile since 1982⁹; this programme was revised in 1993 and 2011. Other countries in Latin America have similar programmes. The

Overall Bundle Compliance

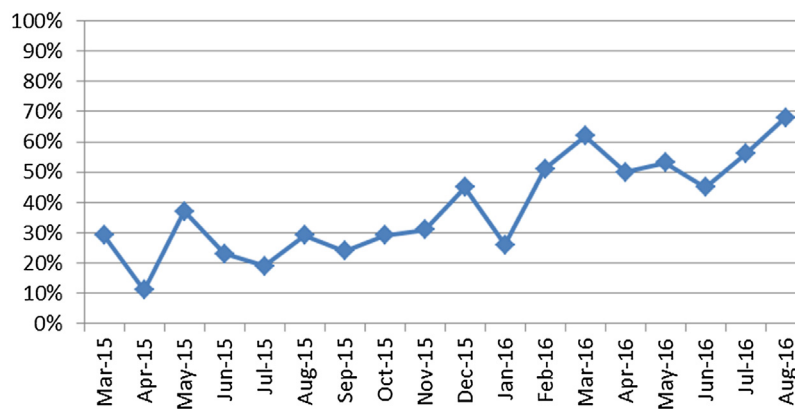


Figure 1. Overall bundle compliance since the introduction of the bundle for the prevention of surgical site infections related to C-section surgery at Tygerberg Hospital, Cape Town, South Africa in March 2015. Bundle elements include appropriate antibiotic prophylaxis, surgical site skin preparation and no shaving of the operative site. Cases of severe sepsis related to C-section surgery per 1,000 surgeries performed decreased by 47% between the two time periods March 2015–August 2015 and March 2016–August 2016. Data and analysis provided by Marina Aucamp, Clinical Programme Coordinator at the Unit for Infection Prevention and Control at Tygerberg Hospital.

Chilean Programme is mandatory for all hospitals, in both the public and private healthcare systems. The aim of the programme is to reduce nosocomial infection rates by formulating strategies based on the latest information from local, national, and international resources. The MoH also periodically posts updates on surveillance of infections associated with medical care, which assists in creating appropriate evaluation programmes (http://web.minsal.cl/sites/default/files/files2/Informe_Vigilancia_Epidemiologica_IAAS_2013.pdf).

Despite the robust IPC programme in Chile, there is room for improvement. Outbreak investigations are typically slow, especially if they require the collection and analysis of specimens, leading to delays in the implementation of appropriate measures. The communication between institutions is also not optimal, resulting in delayed recognition of common source outbreaks, a situation that could be improved through the shared use of online reports and databases. The obligatory notification of nosocomial outbreaks and MoH alerts has been implemented, but this is suboptimal. Most importantly, national policies on antimicrobial stewardship are yet to be addressed.

Venezuela

The IPC policies in Venezuela are based on the National Commission of Hospital-Acquired Infections created by the MoH in 1984. Epidemiological information is generated from some of the larger public and private medical institutions. All medical centres with more than 50 beds in the country are required to have an infection control committee presided over by the medical director of the institution. Formal specialized training courses for IPC personnel are offered at the teaching hospitals but are not formally endorsed by academic institutions such as universities or nursing schools.

However, neither general nor specific national guidelines to standardize IPC practices are available. Actions from the health authorities to ensure the application of good IPC practices are usually only reactive to specific epidemiological situations or outbreaks. The sterilization and decontamination of reusable medical instruments is not properly regulated. Also, the concept of IPC is not included in the regular curricula of medical or nursing schools, therefore reducing IPC exposure and knowledge during the formative stages of trainees.

Jamaica and the Caribbean

The IPC resources in Jamaica and the Caribbean are both government- and hospital-based. There is a good surveillance system for bacterial, viral, and fungal pathogens in the hospital environment, including confirmation of major epidemic viruses such as the influenza H1N1 virus, chikungunya virus, and most recently the Zika virus. There are local epidemiological investigations and reporting via the MoH in many Caribbean countries, with shared resources for countries that lack diagnostic facilities. More broadly, there is regional epidemiological reporting from the Caribbean Public Health Agency (CARPHA) and the Pan-American Health Organization (PAHO), which provides monthly and yearly updates.¹⁰ Weekly bulletins or updates are issued in Jamaica. Most Caribbean hospitals have IPC teams, which are more robust in teaching hospitals. In Jamaica, while traditional media is the mainstay for the dissemination of information about HAIs, social media has become important for public discourse. This was highlighted in the 2015 outbreak of bacterial infections among neonates (#deadbabyscandal).

Gaps in IPC resources are multifactorial and multilayered, including but not limited to (1) old facilities/infrastructure (some

buildings over 50 years old), which might compromise even the best IPC efforts; (2) insufficient funding (from governments) to manage IPC effectively; (3) training issues for different IPC team members; (4) union issues for different categories of staff (academic consultants vs. nurses vs. technicians vs. service staff); and (5) lack of information about resources. There may also be compliance issues related to cultural, financial, and environmental factors.³⁹ In managing IPC issues, there is the recognition that one size may not fit all, although most of the IPC strategies are modelled after North American and British standards.

Nepal

Nepal has an IPC reference manual that serves more as a resource for training purposes than for the actual development of IPC programmes.¹¹ There are some IPC-specific materials available for both HIV and waste management in the country¹²; however, comprehensive national guidelines on IPC, reflecting performance indicators, do not currently exist. As a result, over two-thirds of the healthcare workers in Nepal are deficient in specific training in IPC.¹³ The health sciences curriculum lacks an integrated IPC curriculum, with restricted options for professional development. Data on AMR surveillance, HAIs, and the functioning of hospital IPC committees are limited. Epidemiological data from private clinics and small hospitals are also not available. Unfortunately, private healthcare settings in Nepal consider standard infection control practices as a financial investment with no immediate profit and hence are not made a priority.

Egypt

Egypt established a national infection control programme in 1999.⁴⁵ Evolution of infection control in Egypt: Achievements and challenges), which has developed national guidelines that are revised and updated regularly. These guidelines are often adapted to meet specific requirements at university-affiliated and large healthcare facilities.

The Ministry of Health and Population, the Ministry of Higher Education, the Ministry of Scientific Research, national and international organizations, as well as civil societies in Egypt sponsor IPC implementation. IPC master degree programs are offered by several Faculties of Medicine in Egypt. The country is also in the process of establishing a national surveillance system for HAIs but is still in need of a country wide antimicrobial stewardship program. Egypt's progress in implementing IPC measures has been internationally acknowledged.⁴¹ The main challenge in Egypt is to narrow the gap between what is known and available and what is actually implemented. Changing the behaviour of healthcare workers would be of benefit in improving and sustaining adherence to infection control guidelines, with special importance given to the directors of the IPC programme to maximize utilization of the resources at their disposal and obtain the best possible results.

Cambodia

Since 2009, Cambodia has had policies, strategic plans,⁴² guidelines, and regulations in place for IPC, healthcare waste management,⁴³ and combating AMR.⁴⁴ A training curriculum for all healthcare staff was developed in 2012 and a curriculum for undergraduate students is currently under development. Cambodia has developed an IPC structure at the national level for all public hospitals under the responsibility of the MoH. Despite these efforts, there remains a lack of trained IPC professionals at all levels, as well as infrastructure in healthcare facilities to allow an enabling environment for good practices. The consumables and

supplies required to ensure an effective IPC programme remain suboptimal. Data collected from the few microbiology laboratories in government hospitals are not currently being analyzed or used by IPC committees for programme development. Also, IPC activities throughout the country remain inadequately funded.

Democratic Republic of the Congo

In the Democratic Republic of the Congo, there are no national programmes or guidelines to help direct IPC practices. In some tertiary care hospitals, the microbiologists and/or infectious diseases physicians guide IPC practices based on recommendations from the WHO and/or CDC. However, the MoH of the Democratic Republic of the Congo, through its General Secretariat of Public Health, provides disease-specific programmes (for example that for tuberculosis) with some guidance on the necessary IPC-related precautions to ensure patient safety. Through medical training and nursing schools, healthcare professionals acquire very basic knowledge on IPC-related topics. As with most other LMICs, the implementation of these insufficient measures is almost non-existent; for example, compliance with hand washing was as low as 9% in 2004 before a sensitization campaign was conducted at a general hospital in the Democratic Republic of the Congo.⁴⁰

Guidance for IPC resources from the workshop

To facilitate the implementation of IPC efforts in LMICs, educational materials should be made easily accessible and available for free in Web-based and mobile formats. The content needs to be simplified to reach a diverse workforce and will need to include graded recommendations, based on different levels of existing resources. As graded resources are developed, priorities for applied research and innovative approaches for IPC measures applicable in countries with limited resources will need to be defined.

The ISID guide for infection control in the hospital

The science of IPC is in constant evolution. The ISID published its first guide – *A Guide to Infection Control in the Hospital* – in 1998 to summarize the most up-to-date principles, interventions, and strategies for maximizing a reduction in healthcare-associated infections in hospitals.¹⁴ This guide is a popular, free resource for healthcare workers around the world and is updated every 4 years. The fifth edition was made available in print and in pdf format on May 15, 2015, and there had been more than 7500 unique downloads from 170 countries by May 9, 2016.

The working group made certain recommendations for the next edition of this guide. First, the guide must be widely publicized via various networks. The guide should include increased pictorial representation to make it easy to follow, the content should be simplified to include graded recommendations based on different levels of existing resources such as basic, standard, and high, should include assessments and checklists as examples to standardize the evaluation of practices, and finally the guide should be translated into regional languages for non-English speaking countries. The ISID will take the working group's recommendations into consideration when developing the next edition of the guide for infection control.

Discussion

Most IPC strategies are modelled after North American and European standards. Unfortunately, many LMICs have little to no representation in the current IPC English-language literature.

According to the discussions among the experts at the workshop, most LMICs have developed some sort of national IPC strategy for their healthcare facilities, however many LMICs lack the proper resources to properly implement such plans. Kenya, Cambodia, and South Africa, for example, have developed nationally recognized and continuously growing IPC programmes, which include both HAI surveillance and antimicrobial stewardship. Similarly, the national Chilean IPC programme is mandatory for all hospitals including both public and private healthcare facilities. Egypt, Venezuela, and Jamaica have also developed nationally recognized IPC programmes. It should be noted that most IPC programmes have been created by and are currently supported by the country's MoH.

In contrast, two of the countries represented at the working group – the Democratic Republic of the Congo and Nepal – both lack robust IPC programmes. In Nepal for instance, there is no national programme for IPC practice in healthcare facilities. Thus, healthcare providers and microbiologists have resorted to WHO and CDC guidelines for best IPC practices. Although these references may be useful, IPC practice may not be consistent on a national scale. In Nepal, an IPC reference manual exists but is used for training purposes and not for national regulations. Thus, IPC practices may differ throughout the country.

All of the representatives from LMICs indicated that there was a lack of infrastructure and administrative support, representing an important barrier to IPC programmes. In addition, proper implementation and regulation of IPC programmes continues to be a challenge. In Kenya, which has a rather robust IPC programme, inadequate laboratory capacity for diagnostics and underdeveloped medical records systems impede consistent IPC surveillance and data generation. IPC is nationally recognized in South Africa, yet structured IPC career opportunities are non-existent. Representatives from both Chile and Venezuela noted the lack of timely and consistent communication between healthcare facilities with regards to IPC matters. In Nepal, IPC programmes are expensive and do not provide immediate financial benefits and thus are not considered a priority in healthcare facilities. Lastly, in Cambodia, Jamaica, and the Democratic Republic of the Congo, financial support continues to be a limiting factor for IPC programme implementation.

The recent literature suggests various strategies to assist in the prevention of HAIs, including the implementation of bundles and other infection control measures. The INICC is a non-profit organization established in 15 developing countries to reduce infection rates in resource-limited hospitals by focusing on education and feedback from outcome surveillance (infection rates) and process surveillance (adherence to infection control measures). This consortium has described a multidimensional approach to infection prevention that has resulted in a significant reduction in HAIs when implemented in various LMICs, both in the adult population and the paediatric population.^{15–21}

To improve IPC implementation and evaluation efforts in LMICs, educational resources should be simplified, readily available, free of charge, and possibly include graded recommendations from basic through intermediate to advanced levels of IPC provision and resource. Ideally, there must be practices in place to evaluate the effectiveness of these graded measures in a given work environment. Such evaluation, as well as innovative measures for IPC that can more easily be applied in the LMIC setting, could be supported by the ISID research grant programme (http://www.isid.org/grants/grants_research.shtml) or other initiatives that support capacity building in LMICs. The ISID *Guide to Infection Control in the Hospital* serves as a free resource for IPC programme recommendations and improving programme implementation efforts. Future editions of this guide may be applied as an evidence-based, multi-modal, point-of-care mobile resource to assist in the prioritization

and implementation of local infection prevention strategies. Another important resource is the INICC multidimensional infection control approach.

The adequate implementation of infection control measures in the healthcare setting is more important now than ever. This article illustrates the current status of IPC programmes in selected countries, including the main gaps and challenges. It is important to have a systematic process to evaluate the IPC status in LMICs overall, and to ensure that basic IPC and AMR strategies are implemented. Open training resources and guidelines need to be easily accessible. Studies from LMICs are urgently needed to better describe the local epidemiology of HAIs and to identify successful approaches better suited to the needs of these countries.

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