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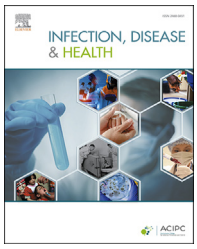

Research paper

Improving surgical site infection prevention in Asia-Pacific through appropriate surveillance programs: Challenges and recommendation

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KEYWORDS
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Abstract *Background:* Surgical site infections (SSIs) represent a substantial clinical and economic burden on patients and the healthcare system. The prevention of SSIs entails surveillance activities which lead to effective mitigation strategies, which are lacking across Asia Pacific (APAC). This manuscript aims to document gaps and challenges across APAC that affect the undertaking of a successful SSI surveillance activities and to provide recommendations on overcoming such challenges.
Methods: A targeted literature review with relevance to APAC identified a series of salient points pertaining to SSI prevention guidelines, implementation, surveillance and outcomes, which was discussed in July 2019 at the APAC Surgical Site Infection Prevention Symposium. An expert panel, comprising eight multidisciplinary experts from APAC and the USA, subsequently amalgamated the key discussion points from the Symposium and their clinical experiences in developing this article.
Results: The barriers to implementing a successful and effective APAC SSI surveillance program were identified as: (a) lack of standardized definitions, reporting methodology and

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accountability, (b) lack of fiscal resources, (c) reporting variability and under-reporting, and (d) lack of safety culture. Implementing an effective surveillance program in APAC will require countries to develop a well-designed and robust surveillance plan and ensure adequate training for staffs involved.
Conclusion: To improve SSI prevention in the region, it is imperative to encourage implementation of national programs with standardized methodologies and accountabilities. An ongoing APAC information exchange, including data and methodologies, will enable continuous learning within the APAC region.

Highlights

- Surgical site infections (SSIs) represent substantial clinical and economic burden on patients and healthcare system.
- The barriers to implementing a successful, effective APAC SSI surveillance include:
  - o Lack of standardized definitions, reporting methodology and accountability
  - o Lack of fiscal resources
  - o Reporting variability and under-reporting
  - o Lack of safety culture.
- Implementing effective surveillance program in APAC requires stakeholders to develop a well-designed, robust surveillance plan, ensuring adequate staff training.
- Ongoing APAC information exchange, including data and methodologies, will enable continuous learning within the APAC region

Introduction

Surgical site infections (SSIs), a subset of healthcare-associated infections (HAIs), are a major source of post-operative complications. Recent data from Australia indicate they comprise approximately 4.7% of HAIs [1]. Reported SSI rates from Australia and Japan vary according to surgical procedure: 3—22% after colorectal procedures [2,3], 1—7% after coronary artery bypass surgery [2] and 1—14% after orthopedic surgery [2]. SSIs represent a substantial clinical and economic burden on patients and the healthcare system, mainly attributable to increased morbidity, mortality and hospital expenditure. Data for HAIs from all public hospitals in two states in Australia between 2010 and 2012 showed that patients with SSI are estimated to spend an additional 14.2 days in hospital [4]. In the United States, the annual cost for SSI treatment is estimated to reach $1 billion, with 2- to 11-fold higher mortality rate compared with patients who do not have SSI, further highlighting the need to prevent SSI [5]. While collated data from Asia is not available, the additional cost due to SSI has been reported to vary between US$396—5237 [6,7].

SSI surveillance is a cornerstone of any infection prevention and control program. Specifically, surveillance utilizes systematic methods of collecting, consolidating and analyzing data concerning the distribution and risk factors for post-surgical infections; this information allows for implementation of changes to reduce SSI rates [8]. Surveillance activities can be coordinated by international bodies [9], nationally, across a group of institutions, or conducted within a single hospital.

Importance of surveillance in SSI prevention

The purpose of surveillance is to evaluate infection prevention initiatives. Initially, surveillance determines the magnitude of an existing problem (baseline rates), and can also identify modifiable risk factors (e.g. poor personal hygiene or nutrition, poor glycemic control), or lack of compliance to recommended presurgical, surgical and postoperative practices [10]. Regular audits of specific practices, such as preoperative showering, can also highlight important areas for improvement [10].

Ongoing surveillance serves as an effective monitoring system to alert stakeholders to concerning patterns and detect clusters or early signs of outbreak. Such surveillance data can then be used to inform hospital practices and procedures, and measure the impact of prevention and control efforts [11—13]. Surveillance also enables the assessment of infection cost and track cost-benefit over time [10].

Effective surveillance programs, with feedback of HAI data to important stakeholders, can improve patient outcomes [14—17]. A recent study of networks in 15 countries on three continents showed a significant and sustainable decrease in SSIs after joining a surveillance network [14]. Adoption of a standardized surveillance program, even in developing countries, is highly achievable through such a network, and can be expected to correlate with improved SSI rates [18]. Infection rates may increase again once surveillance is stopped [14], suggesting further importance of continuous surveillance in reducing SSI rates.

Aim of this article

Despite the effectiveness of surveillance programs in reducing the prevalence of HAIs [13], many countries still lack nationally coordinated programs. The WHO has reported that only 16% of developing countries have a functioning national surveillance system as assessed up to 2010 [19]. Obtaining accurate, good quality institutional and national data on SSI can be difficult in many areas across the Asia Pacific (APAC) region [13,20]. The aims of this article are to document the gaps and challenges across APAC that affect successful SSI surveillance activities and present expert recommendations on overcoming such challenges.

Methods

The APAC Surgical Site Infection Prevention Symposium held in July 2019 in Singapore, brought together more than 40 multidisciplinary healthcare professionals from across the APAC region with a special interest in reducing SSIs. The multidisciplinary expertise of this group included: microbiology, infection prevention, anesthesia, surgery, operating room nursing, healthcare epidemiology, quality and global health economics. The Symposium served as a platform to discuss evidence-based SSI prevention guidelines, policy, surveillance, challenges and practical implementation strategies, barriers to change and outcomes. Within this group of participants a core group of 10 expert opinion leaders (The authors) from across the APAC region (Australia, India, Japan, Philippines, Singapore and South Korea) and North America representing infection control, surgical sciences, quality services and nursing were engaged to lead the discussion for standardization of evidence-based practices to improve surveillance strategies within the Asia-Pacific region.

Prior to the Symposium, a targeted review of the literature was conducted on Medline by the key content experts. The objective of the targeted review was to: (a) Summarize the current state of SSI in the Asia Pacific (APAC) region based on four key areas: guidelines, implementation, surveillance and outcomes and (b) Identify gaps in the four key areas in the APAC region. The keywords that were include in the targeted search included: "surgical site infection", "infection control", "infection prevention", "guidelines", "implementation", "surveillance", "outcomes", "economic", "cost" and "Asia Pacific", "Asia", "China", "India", Hong Kong", "Singapore", "Japan", "Korea", "Taiwan", "Malaysia", "Indonesia", "Vietnam", "Thailand", "Philippines", "Australia", "New Zealand". The targeted search was limited to publication years 2009 — present, and in English language.

The review process resulted in capturing a total of 104 publications of which 59 were chosen for the current manuscript (Supplemental Table 1). Based on this review, a series of salient questions were formulated for discussion during the Symposium. SSI surveillance was revealed as a significant gap in APAC, and the current manuscript drafted in an effort to bridge this gap by incorporating participant expertise and a critical review of the findings from the targeted literature review. The expert opinion leaders from across APAC and North America further refined the content via electronic, arriving at a consensus over several months post-Symposium. The findings presented in this manuscript are an amalgamation of the targeted literature review, discussion points from the Symposium and observations and recommendations from the expert key opinion leaders based upon their clinical experiences.

Results

Current landscape in APAC: overcoming challenges to SSI surveillance

The APAC is characterized by a wide variation in cultures, geographies, resources, economies and healthcare landscapes and pathogen distribution patterns. The region has also been described as an important geographic source for emerging infectious diseases, including multi-drug resistant organisms and transmissible diseases [21]. It is thus imperative that well-structured and harmonized surveillance systems and channels exist to disseminate data for the prevention, control and reporting of such pathogens within the APAC region [21]. Importantly, for both resource-rich and resource-poor countries, active surveillance can be time consuming and resource intensive in both financial and human terms [11].

Our targeted literature review indicates that there is often an absence of active and sustained nationwide surveillance in APAC, suggesting that it may not be a high priority concern in many countries. Published reports of HAIs are often from individual hospitals and include only short-term prospective studies or point prevalence surveys in selected patient units of large hospitals. A national surveillance system enables hospitals to compare and benchmark their rates, and institute infection prevention policy towards best practices that ultimately reduce patients' risk of HAIs [22]. Similar to developing countries, some developed countries such as Singapore and Australia, also lack nationwide surveillance [13,23] (Table 1). This limits a true understanding of the epidemiology and patterns of SSI across the region. Challenges to successful SSI surveillance are multi-faceted, and require appropriate solutions to be implemented to ensure surveillance is not neglected, regardless of the context.

1. Resourcing challenges

Processes and resource allocation vary widely between countries and hospitals. Regardless of the setting, there are numerous economic, staffing, time and workflow challenges that render SSI surveillance and training difficult [13]. Human resources are often overburdened — personnel can spend a large proportion of their time satisfying surveillance protocols [28]. In the Philippines for example, SSI surveillance is considered an added burden to nurses and thus compliance is often minimal.

Lack of dedicated resourcing can compromise data accuracy. Particularly in resource-limited settings, infection control programs may require resources that manage multiple competing healthcare priorities [29]. Additionally, the lack of reliable microbiology support to confirm clinical

Table 1 Status of Asia-Pacific national SSI surveillance programs.

APAC countries	Status of national SSI surveillance
Australia	No national SSI surveillance program; some jurisdictions have state-wide SSI surveillance for specific procedures [13]. National initiatives, guidelines and standards for SSI are available but the effectiveness of these tools is difficult to measure without surveillance data.
China	The Ministry of Health requires hospitals to establish a HAI management committee. Hospitals must survey the prevalence of HAIs at least once per year and hire at least one professional per 200 —250 beds. They must also conduct hospital-wide surveillance and antimicrobial drug surveillance involving patients and medical staff [7].
India	No national SSI surveillance program. Recently, accreditation by the National Accreditation Board for Hospitals & Healthcare providers (NABH) is required for government health insurance; SSI surveillance is one of the basic requirements for accreditation by NABH.
Japan	Japan Nosocomial Infection Surveillance (JANIS) has been active since it was established in year 2000 [3,24]. It involves more than 800 hospitals and 200,000 surgeries per year. Japanese Healthcare-Associated Infections Surveillance (JHAIS) has been also active since 1998 [25]. It involves more than 100 hospitals and over 40,000 surgeries per year. Participation in these surveillance programs is voluntary. Data from these surveillance programs are utilized mainly quality improvement in participating hospitals.
Philippines	No national SSI surveillance program; the country has been tracking antimicrobial resistance patterns from 23 sentinel sites since 2008. HAIs data are part of annual reports submitted by hospitals to the National Health Insurance under the Department of Health but there is no standardized and structured method of reporting.
Singapore	No national SSI surveillance program; the Ministry of Health conducts surveillance of National Infection Prevention and Control Indicators [23].
South Korea	Korean Nosocomial Infection Surveillance System (KONIS) was established in year 2006 [26].
Taiwan	Taiwan Nosocomial Infection Surveillance (TNIS) was launched in year 2007 [27].

diagnosis of SSI is a common constraint to surveillance in resource-limited settings [11]. In such settings, the potential for SSIs may be perceived as incidental, leading to missed opportunities for the cost-benefit of infection control [29].

In a setting of scarce resources, a surveillance system with lower reporting requirements should be considered. One way to reduce reporting burden is to conduct a targeted surveillance, which focuses on the needs of the institution while keeping in mind that the ultimate goal of SSI reporting is to improve patient surgical outcomes by preventing the development of antimicrobial resistance due to inappropriate antimicrobial usage. Another way is to tackle one issue at a time — when a specific problem area appears to be largely resolved, resources can be re-focused in another problem area. Additionally, tools that can assess workload, such as the WHO's Workload Indicators of Staffing Need, can be employed to help quantify staffing needs based on the institutional infection prevention activities [30].

The use of validated and semiautomated or automated surveillance methods can also reduce workloads [31]. For example, a semiautomated SSI surveillance system in Korea uses electronic screening algorithms and chart review of selected cases, which has reduced the workload of infection preventionists [32]. While a semiautomated or automated surveillance system can save time and improve the quality of decision making in surveillance [33], its adoption in areas with limited resources or access to technology may be challenging.

2. Lack of standardized definitions, reporting methodology and accountability

The WHO advises caution when interpreting and extrapolating SSI data due to heterogeneity in definitions, surveillance methods, risk stratification and reporting [11]. There is a lack of standardized definitions that are relevant and appropriate to healthcare facilities in APAC [20,34,35]. There are also varying SSI surveillance methodologies, protocols, and degrees of validation and accountability that have evolved [36]. This variability limits the understanding of the true epidemiology of SSI in APAC [36].

The Australian healthcare standards require a surveillance strategy in each hospital [37]. However, there is a lack of surveillance training, standardized methodology, and use of risk adjustment within different surveillance programs, leading to variation in reporting quality. This suggests the need to implement a prescriptive, national program with standardized methodology and clear minimum expectations [36]. In Japan, the JANIS and JHAIS programs are based on the National Healthcare Safety Network system, which is regarded as the global standard methodology for SSI surveillance. In India, there is no prescriptive national surveillance program; although SSI surveillance data is available, it has not resulted in policy change for infection prevention and control [35]. In the Philippines, self-reporting of SSIs by surgeons remains the primary method of data accrual, except in hospitals with Joint Commission International (JCI) accreditation. SSI reporting and surveillance are included in the accreditation process by the National Health Insurance System, but

accountability of surgeon/institution for high incidence reporting is lacking. JCI-accredited hospitals fare better in conducting SSI surveillance because of the stringent rules from JCI and access to funding.

3. Variation in reporting

While manual surveillance of HAI by Infection Control Practitioners (ICPs) is generally viewed as the sentinel gold-standard, evidence demonstrates that consistency and reliability are often low. Lack of training, poor-quality documentation from patient records, lack of validation of data accuracy, and poor data interpretation skills can all lead to variation in reporting [36].

Different surveillance tools can also lead to variations in reporting. For example, the experience in Korea before 2015 dcumented severe under-reporting and low sensitivity with the Korean Nosocomial Infection Surveillance/Korean National HAI Surveillance (KONIS—SSI) web-based system. Subsequently, the Korean Surgical Site Infection Surveillance (KOSSIS) was trialed and reported data that were more accurate and consistent with JANIS and National Healthcare Safety Network (NHSN) data [38].

4. Under-reporting

SSI under-reporting compromises data integrity and has been highlighted as a challenge in some APAC countries [32]. While it is true that achieving highly accurate reporting can be challenging and costly [39], there may be concerns that reporting higher rates than benchmarks could lead to poor perception or even funding or medicolegal repercussions. It is important, therefore, to foster an organizational culture of transparency and data ownership, with support from surveillance personnel. One way to ameliorate these concerns is to build a system that measures and rewards improvement. In Japan, there is no repercussion for reporting high SSI incidence, which encourages reporting and minimizes under-reporting. Surveillance reporting in Japan is also incentivized through its inclusion as one of the conditions for additional national healthcare insurance reimbursement.

Several system factors contribute to under-reporting SSIs. For example, superficial infections can be difficult to identify [40], while organ space infections are more readily identified due to the required follow-up care. When reporting data, it is important to stratify by type of infection (deep vs organ vs superficial) [8]. Additionally, infections that occur post-discharge may be treated outside of the system without notification and can also be difficult, if not impossible, to detect and record [40]. One systematic review showed that around 60% of SSIs were detected after hospital discharge [41]; rates vary widely across settings and according to different definitions (13%—71%) [11]. In the Philippines and India, most of the detection and intervention (e.g. drainage, local wound care) often take place in clinics with no reporting capabilities to merge with inpatient records; antibiotics, if indicated, are usually purchased as an out-of-pocket expense and thus, there is also no reporting from a third-party payer.

Prospective surveillance with post-discharge follow-up is naturally associated with an increased incidence of SSI because case finding is more intense. The US Centers for Disease Control (CDC) has an inter-facility reporting form [42], which is used by the treating institution to report the infection to the facility where the surgery was performed even if a patient is subsequently treated for that infection at a different hospital.

Thorough, prospective surveillance with post-discharge follow-up is desirable but potentially not feasible in low-resource settings [43]. However, irrespective of the settings, there are useful tools to help patients identify and report signs of infection. Pilot studies in rural India and Cambodia show that successful surveillance in poorer settings can be feasible and highly valuable [44,45]. Creative solutions, such as reimbursement of travel expenses [45] or following up patients by mobile phones [44], have been successfully incorporated into surveillance activities even in low-income rural settings [44]. Challenges, such as lack of smartphones precludes the sending of wound photographs; and in areas with low literacy, oral rather than text communication may be necessary [44].

In summary, prevention of under-reporting requires unbiased, well-trained, dedicated personnel, active prospective surveillance, trust among surgical teams, and validated methodologies and tools.

5. Lack of safety culture

The success of SSI surveillance programs partially depends on the effort of healthcare professionals (HCPs) [13] and a strong safety culture serves as a strong foundation for its success. In the Philippines, the WHO Surgical Safety Checklist was adopted in 2008 but compliance is often perfunctory. Furthermore, safety culture, especially in complication reporting, is overshadowed by fear of repercussion or punitive action. Research shows that error reporting is a learning opportunity and anonymous reporting systems are useful to encourage transparency [46]. Correct reporting should be seen as a measure of improvement. Hospitals should also embed quality measures in their healthcare systems, which would encourage reporting so that proper investigation and necessary changes can be implemented. Periodic educational activities for medical staff on recognizing and reporting SSIs will help reinforce these in practice.

Discussion

Developing a sustainable SSI surveillance program for APAC

Fig. 1 documents the elements of an ideal SSI surveillance cycle [47]. Recognizing the various challenges to SSI surveillance in APAC, the authors propose a set of fundamental components of a surveillance program that can be initially implemented on a departmental and institutional level, which is critical to ensure timely action for unusual findings

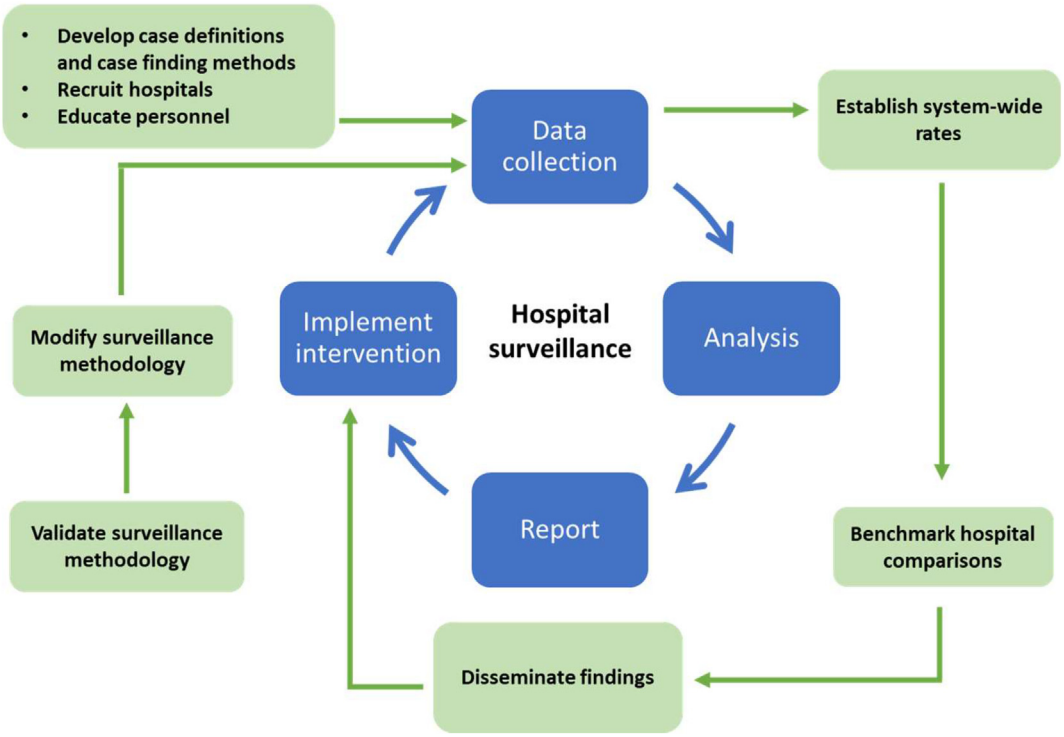

Figure 1 Elements of an ideal SSI surveillance cycle.
Adapted from: Edmond MB. National and international surveillance systems for nosocomial infections. In: Wenzel RP, editor. Prevention and control of nosocomial infections. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2003. pp. 109—19.47.

and to change behaviors in surgical ward. Subsequently, the program can be expanded to a national level upon gaining experience and confidence.

Elements of a successful surveillance program

Specific surveillance systems currently exist in selective APAC countries such as Japan [48] and in the state of Victoria in Australia [49] If a surveillance system is not yet established, a global standard system (e.g. the NHSN in the United States [50], or the European Centre for Disease Prevention and Control [ECDC] [51]) can be a good starting point.

Table 2 lists the fundamental elements of a surveillance plan. To be effective, surveillance systems should be well designed, accurate, epidemiologically robust, validated, consistent, timely and practical to implement within the local context [13,52]. A surveillance program can be 'whole house' (all SSIs monitored in the entire population at the facility) but preferably should be targeted (e.g. intensive care unit, certain surgical procedures). Standardized methodology and validated definitions to benchmark and compare rates should be used.

A cohesive team effort is also important. Infection prevention teams have traditionally spearheaded the role

Table 2 Fundamental elements of a surveillance plan for SSI.

1. Start with a targeted surveillance approach
2. Assess and define the study population or group at risk
3. Determine specific indicators to monitor
   - Indicators may include outcomes (e.g. SSIs or HAIs), processes (e.g. personnel compliance with hand hygiene or environmental cleaning) or events (e.g. reportable conditions, communicable diseases in personnel)
   - Where possible, select indicators that have been validated, nationally available benchmark data for meaningful comparison
   - Findings can be clustered on the basis of 1) type of surgery; 2) specialty; or 3) surgeon
4. Determine the time period for observation (prospective vs retrospective)
5. Determine surveillance criteria/case definitions and use them consistently
6. Establish methods for data collection
7. Determine methods for data analysis and calculation
   - E.g. for rates, both numerator and denominator information are required
   - Decide on the appropriate use of risk adjustment
8. Establish a mechanism to interpret and disseminate surveillance data
9. Periodically evaluate the surveillance plan and make revisions as needed to ensure the plan is meeting the facility's objective

of surveillance, but it is important to include surgeons on the team. While surgeons have no direct role in determining SSI rates within SSI surveillance programs, they need to be highly engaged in reporting and prevention programs; surgeons are the ones with authority to address any surgical issues that may be related to SSI occurrence. Staff should receive adequate training in surveillance programs, emphasizing consistency and accountability by assigning them specific tasks. Because of the impact of patient co-morbid risk on subsequent SSI rates. The operative surgeon plays a crucial role in embracing evidence-based mitigation strategies to improve patient outcomes [53]. Furthermore, infection preventionist should always place the surgeon and surgical team members at the "front of the line" when attempting to discern what factors may have occurred during the intraoperative period, enhancing the patient's risk for infection." Too often surgeons are left out of the loop during routine surveillance and therefore, the infection control staff miss a golden opportunity to align themselves with their surgical colleagues in an effort to understand the probable mechanistic etiology and/or pathogenesis of these serious infections."

Surveillance tools

Point prevalence surveys (PPS). Many hospitals within the APAC region, especially in more rudimentary settings, operate without electronic data monitoring (EMR). Point prevalence survey (PPS) is a cost-effective tool to estimate the burden of HAIs and associated risk factors [54]. It can therefore be undertaken as a starting point, even in the most rudimentary environment where resources are limited, in the absence of EMR, or where there are no existing SSI incidence data available.

PPS plays an important role in providing baseline information, highlighting important areas for review and leveraging behavioral change. For example, the PPS conducted by the Japan Society for Surgical infection in 2007 to investigate practices for colorectal surgery found that more than half of the patients received antimicrobial prophylaxis (AMP) for 3 or more days postoperatively. In order to change surgeons' practices, studies on the appropriate duration of AMP in Japanese patients were performed between 2008 and 2012 — evidence demonstrated the non-inferiority of 24-h versus 72-h postoperative AMP with regard to total SSI incidence [55]. However, for rectal surgery, the SSI incidence was higher with 24-h versus 72-h AMP. The overall findings were subsequently used to inform local guideline recommendations for SSI prevention following gastrointestinal surgery.

The ECDC provides a protocol for PPS of HAIs in acute care hospitals [56], which can be used as a basis when designing protocol. However, there is a concern that the definitions used in the protocol regarding laboratory and radiology criteria may not be applicable in developing countries; further work is currently being undertaken to address this concern.

Templates. Templates with detailed protocols and methodologies are also available to facilitate data collection. For example, the Joint Commission Resources (JCR) has a tracer methodology template system that can be purchased and used to do prevalence surveys. These tracer templates can be individualized for various departments and tasked to nurses.

Patient involvement in reporting

Patient-reported outcome measures (PROMs), now commonly collected, can positively affect patients' satisfaction levels and their ability to engage with HCPs [57]. Whilst patient reporting may not always accurate, it could add value to a surveillance program. Patient education/training may need to be undertaken to help patients detect signs and symptoms of infection. In the Philippine General Hospital, post-operative patients are given information on SSI red flags, a contact number of the infection control nurse and a self-reporting form; this improved communication and enabled earlier recognition and management of SSIs.

In the context of SSI, PROMs are quality indicators and can be reported by way of app-based checklists or transmitting photographs taken by the patient of their surgical wound to their healthcare worker for review. Telemedicine has a highly promising future for PROMs reporting — a recent systematic review has shown that it is a feasible method for remote diagnosis of SSIs, particularly in LMICs [58]. Telemedicine efforts, including text messaging and imaging via various messaging/chat applications, are being employed and evaluated in the Philippines, including for SSI reporting.

Next steps and the future of SSI surveillance

There are several challenges in implementing SSI surveillance in the APAC region, including lack of standardized definitions, reporting methodology and accountability; lack of resources; variations in reporting and under-reporting; and a lack of safety culture. To implement an effective and sustainable surveillance program, APAC countries need to come together and develop a well-designed and robust surveillance strategy that is practical to implement within the local context and ensure adequate training for staff involved in the program. Whilst further studies are recommended to establish the most efficient data collection methods and the most sensitive methods for SSI diagnosis/detection, the development of a pilot surveillance program may also be very helpful [11].

A successful SSI prevention recognizes the important roles of other stakeholders. Stakeholders need to be engaged when developing surveillance systems, particularly with issue relating to public reporting. Government-led initiatives can be used to advocate for and prioritize funding to sustain HAI surveillance and infection prevention and control programmes [35].

Conclusion

An APAC-wide, standardized SSI surveillance network will improve SSI prevention in the region, but it is important to encourage countries to implement national programs with consistent methodologies and accountabilities. An ongoing sharing of information among APAC countries, including

data, methodologies, barriers and interventions, allows each country to continue to learn from each other. It is hoped that this article can serve as a resource and provide encouragement towards improved SSI surveillance activities nationally and across the region.

The future of SSI surveillance, globally and in APAC, will see the integration of rapidly developing surveillance technologies, artificial intelligence (AI) tools and algorithms to maximize the use of electronic data, reduce the burden of data management and improve accuracy and sensitivity/specificity [13,59]. The role of automated computerized algorithms remains to be further explored [11], but will be useful in streamlining data collection. While there are concerns around future AI regulation, AI is the way of the future and there is a need to understand and shape how AI can be used constructively and avoid potential pitfalls.

Ethics

No ethics approval was required for this study.

Authorship statement

All of the authors PLR, ES, MC, KYL, MLL, KM, MS, WD, NYCY and CEE were responsible for the selection and review of the targeted literature. Authors PLR, ES, MK and CEE were responsible for the initial draft of the manuscript. All of the authors PLR, ES, MC, KYL, MLL, KM, MS, WD, NYCY and CEE were involved in the critical review, editing and final approval of the manuscript prior to submission.

Conflict of interest

PLR Russo, a member of the Ethicon (Johnson & Johnson) Advisory Board, Chair and Speaker at APAC Surgical Site Infection Prevention Symposium is President of the Australasian College for Infection Prevention and Control, member of the Australian COVID Evidence Taskforce Steering Committee, the Infection Control Expert Group to the Department of Health, the Australian Strategic and Technical Advisory Group on AMR, the Healthcare Associated Infection Advisory Committee to the Australian Commission on Safety and Quality in Health Care, and a member of the Australian College of Nursing. Recipient of a NHMRC Early Career Fellowship, and has received research funding from the Rosemary Norman Foundation, Cardinal Health, Australian College of Nursing and the Cabrini Institute.

ES has been invited as speaker and has on few occasions received honoraria from ETHICON and 3M.

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MS is a member of the J&J Ethicon Speakers Bureau.

WD is Director of Ethicon Global Health Economics & Market Access, a subsidiary of Johnson & Johnson, manufacturer of surgical sutures and wound closure devices.

AS was Associate Director at Johnson & Johnson.

NY is employed by Johnson & Johnson Medical Pty Ltd., Australia as Medical Advisor. Former recipient of NHMRC Dora Lush Biomedical Postgraduate Scholarship.

CEE is a member of the Ethicon Speakers Bureau.

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Appendix A. Supplementary data

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