



# **Infection Control Practitioners' Scope of Practice**

## **Literature Review**

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**Australian Commission on Safety and Quality in Health Care**

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## Executive summary

Health care associated infections (HAIs) cause substantial morbidity and mortality every year in the Australian health care setting. HAI reduction is a key goal of the Australian Commission on Safety and Quality in Health Care. This goal is shared by all Australian jurisdictions and by relevant professional organisations.

For the past forty or so years Australia's approach to HAI measurement, prevention and control has been based on local infection control and surveillance programs. These programs are typically coordinated by an infection control practitioner. Despite the longevity of this model little is known about its structure, effectiveness or sustainability. There is a paucity of information about the current and ideal skills, education and resources of ICPs in health care settings.

This review involved reviewing recent literature in order to better understand the critical elements and structure of an ideal infection control and surveillance program. The Commission recognises that ideal programs are critical to the long term success and sustainability of their proposed HAI initiatives.

This review notes wide variation in programs that are described from several different countries. Even within individual countries inconsistent structures and activities are reported. The literature fails to outline either an ideal program or reach consensus regarding the most appropriate skills, education and support for infection control professional.

In particular Australian reports are scarce. This presents multiple unanswered questions and opportunities for further research and investigation. Modern infection control and prevention programs all around the world appear to be loosely based on seminal work undertaken in the US in the late 1970s. Modern drivers impacting infection control programs are similar globally and largely include government lead initiatives and recommendations from formal professional bodies or self appointed groups of experts.

This review presents a snapshot of modern Australian infection control programs and identifies major factors that influence it. It also highlights areas that need improvement. Recommendations relating to those improvements are summarised in the following table. Most importantly this review reaffirms the inconvenient but inevitable previously made conclusions that no single, ideal and valid program model for reducing healthcare associated infections currently exists and that multi-level buy in and well articulated systems of governance are required for programmatic success. The role and function of the infection control professional require refinement yet in the interim this role appears to make a reasonable contribution to infection reduction activity and outcome.

**SUMMARY OF KEY RECOMMENDATIONS FOR ACSQH ACTIVITY**

- |  |   |
|--|---|
| 1. Activities required for an effective infection control program.                                 | <ul style="list-style-type: none"><li>• The Commission could use this review to:<ul style="list-style-type: none"><li>• incorporate generic best practice principles and to define a raft of suggested possible ICSP to incorporate at an organisational level depending on local need and capacity.</li><li>• recommend a minimum and uniform basic platform of ICSP activities which should be engineered into every Australian inpatient setting</li></ul></li></ul> |
| 2. Skills / knowledge / expertise required to undertake these activities.                          | <ul style="list-style-type: none"><li>• The Commission's best option for contributing to ICP workforce development and capacity building remains unclear.</li></ul>   |
| 3. Models (International and Australian) exist that fulfil an effective infection control program. | <ul style="list-style-type: none"><li>• Limited evidence makes it impractical for the Commission to make definitive recommendations regarding effective models.</li></ul>   |
| 4. Critical success factors and limitations of successful infection control programs.              | <ul style="list-style-type: none"><li>• Adaptation and implementation of elements such as governance, control assurance procedures, administrative and clinical buy-in may be prudent.</li></ul>  |
| 5. Infection control programs - sustainability and transferability.                                | <ul style="list-style-type: none"><li>• Transferability of some individual ICSP elements such as surveillance, is likely sustainable rather than transferability of whole ICSPs.</li></ul>  |
| 6. Gaps in the evidence base on the role of the Australian Infection Control Practitioner.         | <ul style="list-style-type: none"><li>• Unlikely that any Commission recommendations relating to this role can be substantiated through the literature.</li><li>• Multiple opportunities exist for either Commission, its designates or relevant and interested researchers to contribute to the field.</li></ul>   |
| 7. Mentoring support programs for infection control practitioners.                                 | <p>The Commission may wish to consider:</p> <ul style="list-style-type: none"><li>• the special needs for support and mentoring among regional, rural and remote ICPs</li><li>• how the current Australian workforce of experienced and qualified ICPs can be organised to develop and field test formal ICP mentoring to their less experienced peers.</li></ul>   |

## Background and introduction

The Australian Commission on Safety and Quality in Health Care (the Commission) recognises the importance of reducing HCAs as one of its priority programs. Major Commission initiatives to date relating to this priority include specific recommendations regarding HAI surveillance and the development and implementation of a national hand hygiene initiative.

After extensive consultation with a wide range of stakeholders from the Australian infection control community and on the advice of its HAI Implementation Advisory Committee the Commission acknowledges that achievement of its overall HAI program goal is almost entirely dependent on the capacity of (ICPs) to implement the Committee's recommended strategies.

Further, national surveys and workshops of ICPs undertaken by the Commission have shown that there is disparity in skills and resources between experienced and beginning ICPs and between larger metropolitan hospitals and rural centres. Little information is available regarding the skills and resources of ICPs in the private sector, in aged care and in residential health care settings. To better understand the role and function of a contemporary Australian ICP the Commission sponsored structured evidence based literature review of the scope of practice of health professionals who undertake infection control and prevention roles, including surveillance of HCAs in healthcare facilities. The Commission required review of both local and international quantitative and qualitative literature published within the last five years.

This literature review will likely inform the development of educational resources and toolkits to enable Australian ICPs to implement effective infection control and surveillance programs (ICSPs) and will also provide a general resource for those working on improving or researching in infection control.

## Structure

A table including a summary of the methodology key points and classification of each reviewed publication used to respond to the research questions is included in this review as an appendix.

## Research questions

1. What activities are required for an effective infection control program? (The focus should include inpatient healthcare facilities such as large metropolitan, district and regional / rural settings).
2. What skills / knowledge / expertise are required to undertake these activities (identified in question 1)
3. What models (International and Australian) exist that fulfil an effective infection control program including human and economic impact?
4. What are the critical success factors and limitations of successful infection control programs?
5. For which infection control programs is there evidence of sustainability and transferability?
6. What are the gaps in the evidence base on the role of the Australian Infection Control Practitioner?
7. What mentoring support programs for infection control practitioners exist? What are they? What are their strengths and weaknesses?

## **Method**

### **Scope**

This review was undertaken during July-September 2008. It included quantitative and/or qualitative peer-reviewed publications and other peer-reviewed and non-peer reviewed publications, opinions and reports published in English in the previous five years (2003-2008). Relevant seminal publications published earlier than 2003 and specific to Australian infection control were also reviewed.

### ***Search strategy***

Reviewers searched the AUSTRALIAN DIGITAL THESIS PROGRAM, CINAHL, Pre-CINAHL, Cochrane Library, ISI Web of Knowledge, Health Business Fulltext Elite, MEDTEXT, MEDLINE (PUBMED), OVID, PROQUEST and Google (Scholar) databases during this literature review.

Major search terms used included infection control and infection control practitioners, organization and administration. Hand searches were undertaken of the authors' professional library for relevant grey literature including policy, guideline or strategic directions.

Initially 113 pieces of peer-reviewed literature and conference abstracts were identified. The abstract or Executive summary of all references was screened for relevance to the specific issues addressed in the seven review questions and applicability to the Australian inpatient healthcare facilities including large metropolitan, district and regional or rural settings. Some publications were identified as being irrelevant or beyond the scope of the review and thus eliminated. Additional publications were identified from the reference lists of reviewed articles and included in the review. Twenty two pieces of grey literature were identified in the first search.

Where appropriate, the authors also used their comprehensive formal, informal and professional networks to identify and make contact with recognised national and international field experts, government and non-government professional associations and academic organisations for the purposes of general discussion regarding the role and scope of the infection control practitioner.

### ***Assessment and categorisation***

A slightly modified version of the simple classification system described and recently applied by Kings College London in their review of the impact of organisational and management factors on infection in British hospitals was used in this review. (Griffiths, Renz et al. 2008) The system attributed the following ratings to evidence according to the specified criteria.

- **SR+**: Systematic review of high-quality trials/ cohort studies (with risk adjustment) with a narrow confidence interval
- **SR**: Other systematic reviews
- **R**: Non-systematic reviews
- **RCT**: Randomised controlled trials
- **O+**: Observational study with good adjustment for risk and confounders
- **O**: Observational study without adjustment for risk/confounders and/or no report of sample size
- **Q**: qualitative studies
- **D**: descriptive studies
- **OP/EC**: opinion piece or expert commentary

### ***Quality of the evidence and limitations***

Given the inapplicability of performing randomised controlled trials in this field rigorous scientifically valid evidence is sparse. As well most of the published literature addressing ICSPs is either studies of time management, expert opinion, outcome studies or reports from international settings.(Haas 2006)



## **Section 1: Activities required for an effective infection control program**

This section includes a summary of the principal findings, issues and topics published in the literature relating to the key activities necessary for an ICSP. The section starts with a retrospective review of the development of ICSPs. Discussion of the more recent global and Australian trends and contemporary issues reported chronologically in the peer reviewed and grey literature follows. Readers should note that there is some overlap and interrelationships between literature relating to the activities required for an effective infection control program and that of next three sections addressing research questions 2, 3 and 4.

### ***Peer reviewed literature***

#### **The Development of ICSPs**

In 1974, the Centers for Disease Control and Prevention (CDC) initiated the ten-year Study of the Efficacy of Nosocomial Infection Control (the SENIC Project)(Haley, Quade et al. 1980; Haley, Culver et al. 1985)

The SENIC study had three specific objectives. These objectives were to:

1. determine the extent of nosocomial infections in U.S.A hospitals;
2. report on the implementation of the new ICSPs in U.S.A hospitals; and
3. establish whether the above programs were effective in reducing the risks of hospitalised patients acquiring nosocomial infections.

The SENIC study hypothesised that nosocomial infection rates could only be reduced if an ICSP had four components which were:

1. surveillance;
2. control including policy development, education and review of clinical practice;
3. an infection control nurse (ICN) to collect and analyse surveillance data in addition to having overall responsibility for co-ordinating the control program; and
4. active involvement of a physician or microbiologist in the program

The SENIC definition of surveillance activity included measurement of the infection rate, consideration of risk factors and provision of feedback to clinical staff. In contrast, control activities were those functions that were known to reduce the risk of infection including aseptic technique, appropriate cleaning, sterilisation and disinfection of used equipment and instruments.

The SENIC study was conducted in three stages. Phase 1, the Preliminary Screening Questionnaire, involved mailing a survey to 6586 U.S.A hospitals to establish to what extent they had adopted the above four components of an ICSP. The response rate to Phase 1 was 86%. Results from this phase

indicated that most (87%) of respondents had a systematic approach to collecting and analysing surveillance data. Most hospitals reported surveillance findings and 62% used their results to provide feedback and education to nursing staff. Results relating to control suggested that most hospitals had written policies for implementing specific patient-care practices although the proportion of hospitals monitoring compliance with recommended practices ranged from 56% to 80%. Less than half (42%) of the responding hospitals had an ICN that spent more than 20 hours per week exclusively on infection surveillance or control activities. Most (64%) responding hospitals had a physician or microbiologist who had an interest in IC and served as head of the ICSP. Few (16%) heads of ICSPs were trained in either infectious diseases or microbiology. The time they allocated to IC was minimal.

From the study population of 6586 hospitals, the samples for Phase 2, the Hospital Interview Survey, and Phase 3, the Medical Records Survey, were selected. These hospitals were stratified according to number of beds and medical school affiliation, as investigators believed these two variables were the best predictors of nosocomial infection rates. Separate groups of CDC data collectors participated in Phases 2 and 3 so that both groups would be unaware of the other's data (Haley 1980).

Phase 2 of the SENIC study was known as the Hospital Interview Survey. Phase 2 involved dispatching a group of 58 trained interviewers to a sample of 433 hospitals. The interviewers, who were also CDC staff members, undertook standardised interviews, usually in pairs, during October 1976 and July 1977 to obtain specific information about the hospital's ICSP. Data was obtained by interviewing twelve of the staff members in each hospital who were considered to have duties that would impact upon infection surveillance.

Areas examined during interview included:

- the characteristics and activity of the ICN, hospital epidemiologist and infection control committee (ICC);
- the methods of surveillance and outbreak investigations;
- monitoring of the environment;
- isolation practices;
- infection control team's (ICT) relationship with administration and other hospital departments;
- nurses' reports of patient care;
- staff training in IC;
- methods employed to change staff IC behaviour;
- housekeeping and disinfection activities; and
- the role of the microbiology laboratory. (Haley 1980)

Phase 3, the Medical Records Survey, involved 338 sample hospitals. In each hospital, a randomly selected sample of medical records of approximately 500 patients admitted as adult general medical and surgical patients during 1970 and 500 of the same type of patients admitted during the period April 1975 to March 1976 was reviewed. The 1970 period was chosen as it reflected a time

when hospitals most likely did not have an ICSP in place. Phase 3 involved 169,518 patients in 1970 and 169,526 patients in 1975-1976. The CDC employed and managed medical record analysts who reviewed each record for specific demographic and clinical data relating to nosocomial urinary tract, surgical wounds, and pneumonia or bacteraemia infections. Investigators calculated the frequency of nosocomial infections and specific measures of the nosocomial infection rate using total admissions and the days of hospitalisation as denominators.

Phase 3 determined that the overall U.S.A nosocomial infection rate was 5.7 infections per 100 admissions to acute care facilities. The number of nosocomial infections in the U.S.A was calculated to be 2.1 million annually (Haley, Culver et al. 1985). In addition, Phase 3 estimated the actual number of infections that were being prevented in each hospital by the ICSP and theorised the number that could be prevented if all hospitals had implemented those activities which had previously been demonstrated to be effective.

The results of the third phase of the SENIC study confirmed the original hypothesis that ICSPs could reduce infection rates. Investigators reported that an effective ICSP could reduce infections by 32%; however, to be this effective, the ICSP required four specific components. Each component was necessary and these were (Haley, Culver et al. 1985):

1. organised surveillance and control activities;
2. a trained, physician with an interest in IC;
3. a full-time ICN for each 250 beds; and
4. a system for providing feedback of surgical infection rates to surgeons.

In addition to the above findings, SENIC investigators found that most hospitals lacked an effective ICSP and therefore in 1975 only 6% of U.S.A nosocomial infections were actually being prevented (Haley, Culver et al. 1985).

Retrospectively, SENIC is considered to have directly impacted on five key areas of ICSPs. The five areas were:

1. preservation of the role of IC in hospitals;
2. rekindling of interest in surveillance;
3. change to outcome orientation;
4. increases in physician training; and
5. use of multivariate analysis in clinical decision-making.

More than thirty five years later, the SENIC study is widely acknowledged in the United States and abroad as the scientific basis upon which modern ICSPs are based. (Scheckler, Brimhall et al. 1998) SENIC confirmed the value of organised programs and in conjunction with the CDC's National Nosocomial Infection Surveillance System (NNIS), highlighted the contributions that epidemiologically sound surveillance makes to an ICSP program.

SENIC's complex and expensive methodology precludes it being repeated yet almost every piece of literature published in the subsequent years, (including

those in the previous five years examined as part of this literature review) addressing ICSP elements and/or the role and function of the ICP draws upon the SENIC findings. It could be argued that infection prevention and control's greatest study has more recently been a critical factor in retarding the growth and restructure of certain ICSPs. This is especially so in relation to ICP staffing ratios where the SENIC recommended ratio of one ICP per 250 beds is always the critical reference point. That is, any modern study reporting a lower ratio reports ICP staffing as inadequate.

The only major Australian study of activities required for an ICSP was reported in 1999 and included details provided by 644 then members of the Australian Infection Control Association (AICA). (Murphy and McLaws 1999) The authors found that the typical Australian ICP worked in an acute, publicly funded organisation with less than 251 beds. These Australian ICPs had backgrounds in nursing and spent most of their time undertaking HCAs surveillance. This seminal Australian work also reported the lack of uniformity in ICSP structure and function regardless of the type or location of setting in which an ICP was employed.

A study of 115 ICPs from just Queensland published a year later reported that ICPs were desirous of moving away from surveillance-based activity and adopting more strategic management approaches to their work including clinical monitoring and risk management. (Jones, Gardner et al. 2000)

No Australian and few international studies have examined possible differences in the organisation, roles and/or needs of rural and non-rural ICPs. Stevenson and colleagues reported a review of ICPs from small, rural hospitals in the west of the United States (US) finding that despite their ineligibility to participate in the CDC's NNIS system, almost every hospital ICSP had adopted NNIS HAI surveillance methodologies. The proportions of time allocated to various traditional ICSP activities reported by the study group were similar to those reported in Murphy's Australian study. Surveillance was again the activity for which ICPs allocated most of their time. (Stevenson, Murphy et al. 2004)

Developing valid and "ideal" ICSPs models that can be applied by ICPs has been undertaken in several countries and regions in the years following SENIC. These efforts are generally driven by either the government of the day or by national coalitions of expert ICPs and hospital epidemiologists. SENIC's influence especially in regard to staffing and recommended activities resonates in almost every proposed model. In 2004 the Canadian Health Department developed such a model making recommendations for hypothetical organisations in both the acute and long-term care sectors. (Health Canada 2004) Health Canada proposed staffing ratios of 3 full time equivalent (FTE) ICPs per 500 acute care beds and 1 FTE ICP per 150-250 long-term care beds. Recommended activities for both sectors included surveillance, education, outbreak management, policy development and occupational health.

The published literature clearly demonstrates the lack of homogeneity in ICSPs within and between countries. Three related studies of Thai ICSPs in provincial, regional and army hospitals demonstrate the substantial variations. (Jantarasri, Soparatana et al. 2005; Kananitaya, Senarat et al. 2005; Leela, Chittreecheur et al. 2005) ICPs in these settings typically performed surveillance, consultation, education, administration and quality assurance roles but less frequently met obligations for outbreak management and research activities which were part of the criteria set by the Thai government and against which their ICSP was assessed for hospital accreditation purposes.

Very few published studies measure the quality, cost or effectiveness of ICSPs. In a recent, novel, retrospective study of IC interventions over a seven year period Grant and Kim reviewed the nature of all IC consultations lasting longer than five minutes. They conclude that they were able to search and apply research to provide appropriate and customised responses. Further they assert that these responses potentially reduce HAI transmission especially if the ICP is permitted reasonable authority, resources, support and autonomy.

In a recent publication summarising strategic directions for its members, the US-based Association for Professionals in Infection Control and Epidemiology (APIC), proposed specific roles and attributes that will be critical for ICPs. These functions were proposed by a small group of US experts gathered in a 2-day think tank forum and have not been validated. They include a diverse and at times unrelated set of functions highlighting the expected trend for ICPs to become more business-like and strategic in their ICSP planning and delivery. The authors do not suggest mechanisms for developing or test ICP competence with these skills and tasks nor do they recommend a process for validation or measurement of their effectiveness. (Murphy, Carrico et al. 2008) Like much of the recent literature relating to core activities at best they represent expert opinion or commentary. The authors suggest in no specific order that the main attributes and roles of ICPs functioning in ideal future IC and prevention systems will be:

- understanding of the infectious disease process;
- conducting surveillance to identify risk factors and cases;
- providing data management;
- translating data into usable information (analysis and reporting);
- investigating infection epidemics or clusters;
- facilitating interventions to prevent/control transmission of infectious agents;
- observing health care workers' compliance with proven infection prevention measures and providing feedback;
- leading and managing programs to prevent and control HCAs;
- developing policies and procedures;
- providing education and training;
- performing research and/or applying research findings to practice;
- conducting product evaluation and selection;

- ensuring the infection prevention and control aspects of occupational health and environmental safety programs;
- ensuring emergency preparedness planning and implementation;
- promoting process and performance improvement; and
- providing consultation.

### ***Grey literature***

There are limited pieces of grey literature relevant to Australia and published in the past five years that specifically relate to the activities necessary for an ICSP. Most are either guidance documents from accreditation agencies or government reports or guidelines.

An early Australian document outlining specific elements of an ideal ICSP was the *“Fundamental for Infection Control Services”* published in 2001 by the Australian Council on Healthcare Standards (ACHS). (The Australian Council on Healthcare Standards 2001) The ACHS Fundamentals document is a complex document written specifically to reflect the standards and criteria outlined in the second edition of the ACHS *EQulP Guide* which was used by Australian hospitals seeking ACHS accreditation. The Fundamentals document did not specifically identify recommended ICSP elements but rather suggested activities that could be undertaken to identify, assess and control HAI risk. These activities included HAI surveillance, reporting injuries, surveillance of the environment, equipping isolation units, managing outbreaks and recommending substitution, warning and protective mechanisms where HAI risks were unable to be eliminated. There is little formal or informal reference to the ACHS Fundamentals document in Australian infection control literature or network activity. It has not been updated despite subsequent versions of EQulP Guides.

In 2002 the Victorian government published a comprehensive guideline defining the expected infrastructure and activities for effective prevention, monitoring and control of infection. (Acute Health - Quality and Care Continuity Branch Department of Human Services 2000) The guideline recommended the following as examples of activities to provide infection control service:

- development, implementation and review of policies, procedures and practice standards;
- ongoing education and education for all staff;
- provision of consultation;
- surveillance and investigation of HCAs, outbreaks and adverse events
- occupational health monitoring and programs;
- monitoring of antibiotic use, disinfectants, cleaning and instrument/ device reprocessing;
- meeting Accreditation requirements; and
- evaluating the effectiveness of the program.

It also recommended that an ICC be in place with multi-disciplinary input and that the infection control service have sufficient resources and clear lines of

responsibility including links with an infectious disease service. The ICT (ICT) model is outlined including one ICP per 250 acute care beds. Whilst the efficiency of this program structure has not been measured it seems to include the major elements recommended in contemporary peer-reviewed literature and grey literature.

The long overlooked issue of clinical governance in relation to infection prevention was highlighted in the British government's landmark publication "*Winning Ways*" in 2003.(Department of Health 2003) "*Winning Ways*" recognised for the first time that support of senior administration and appropriate local infrastructure and systems were critical in improving the behaviours of clinical staff. This concept also underpins more recent peer-reviewed literature discussed elsewhere in this literature review.(Anderson, Kirkland et al. 2007; Perencevich, Stone et al. 2007; Murphy, Carrico et al. 2008)

A major Australian initiative was the release in 2004 of the national *Infection Control Guidelines for the Prevention of Transmission of Infectious Diseases in the Health Care Setting*.(Australian Government Department of Health and Ageing 2004) This document cited findings from the SENIC study that up to one-third of HCIs could potentially be eliminated if an effective ICSP was in place. Further it recommended that those elements for the Australian healthcare setting were:

- an annual strategic business plan;
- a comprehensive infection control procedures and policy manual; and
- ICSP management and coordination by a suitably qualified professional, either a nurse, microbiologist or infectious diseases physician.

In a generic prescription targeting infection prevention programs for countries with immature systems of infection control and prevention, the International Federation for Infection Control (IFIC) recommends the following program elements; a yearly work plan, an ICC, an ICT, an IC Officer, an ICN, an IC Link Nurse system and an IC Manual.(Rasslan and Heeg 2007) The IFIC model includes and builds upon all of the previously cited ICSP recommendations by also recommending antibiotic stewardship, participation in development of tender documents, supporting and participating in research and reviewing and assessing infection risks associated with new equipment and devices.

Since the early SENIC study, ICPs in the US have undertaken periodic large scale practice analyses to better understand the skills and knowledge required to practice as an ICP and for the purpose of defining exam content for the US IC certification process. The results of several practice analyses are discussed further in the Section 2 of this literature review. However, results of the most recent 2001 analysis informed the six specific content areas upon which the exam is based and which are considered collectively to define the range of activities necessary in a contemporary ICSP.(Goldrick 2007; Nutty 2007) These are:

1. identification of infectious disease processes;
2. surveillance and epidemiologic investigation;
3. preventing/ controlling the transmission of infectious agents;
4. program management and communication;
5. education and research; and
6. infection control aspects of employee health.

The proposed US Joint Commission Hospital Accreditation Program expands even further on the other recommendations cited in the grey literature by including organisational preparation to respond to an influx of potentially infectious patients and provision of influenza vaccination to staff as assessable elements of performance. (The Joint Commission 2008) These recommendations reflect the increasing breadth, scope and complexity of modern ICSPs.

Also in the US, the Government Accountability Office (GAO) has revised its conditions of participation for hospitals seeking reimbursement under the Centers for Medicare and Medicaid Services so that organizations designate a person responsible for developing and implementing policies designed to control transmission of infections and communicable disease. This Standard includes and assigns specific responsibilities for ICSP oversight to the senior administrative staff of organisations.(United States Government Accountability Office 2008)

Additional and more recent directives from the United Kingdom (UK) government stipulate specific roles for Directors of Infection Prevention and Control which include increased participation in governance including production of an annual report on the state of HCAs.(General Health Protection - Department of Health 2008) Specifically this legislative based directive directs the IC programme to:

- set objectives;
- identify priorities for action;
- provide indications that relevant policies designed to reduce HCAs have been implemented; and
- report annually the progress of the organisation against ICSP objectives.

## ***Summary and analysis***

The peer-reviewed literature addressing activities required for an effective infection control program is scant. The recommendations it makes, other than in the seminal SENIC findings, remain largely untested. Their individual or collective value to modern inpatient ICSP design and delivery is unknown. Regardless, both recent publications and the grey literature continue to recommend these original activities. In the absence of proven efficacy the literature in this area is almost entirely composed of either descriptive studies or expert commentary/ opinion pieces. These documents have been interpreted by the field as programmatic recipes and as such the approach to



ICSPs is non-homogenised within Australia and on a larger global scale. As seen in the US and the UK, high level political and organisational drivers inevitably influence program structures and goals. As well they often initiate administrative or financial support.

Interestingly, the few non-US or non-UK international reports such as those from Thailand and the IFIC recommendations (Chaisombat, Moongtui et al. 2005; Jantarasri, Soparatana et al. 2005; Kananitaya, Senarat et al. 2005; Rasslan and Heeg 2007) illustrate the trend for HAI organisational and program strategies for large, acute care hospitals to “filter” down to smaller institutions and, in countries with less mature ICSP infrastructure, to larger institutions.

The major finding of this section of the literature review is that no one ideal ICSP model has yet been defined. As such it is very unlikely that the Commission's HAI activity will or should try to define such a model for Australia. Perhaps instead the Commission may use this review to incorporate generic best practice principles and salient elements of other national directives to define a raft of suggested possible ICSP activities that Australian ICTs and ICPS could incorporate at an organisational level depending on local need and capacity. Potentially, even more useful would be the Commission recommending a minimum and uniform basic platform of ICSP activities which should be engineered into every Australian inpatient setting.

## **Section 2: Skills, knowledge and expertise required to undertake these activities**

The key content of this section relates to skills, knowledge and expertise reported largely in descriptive studies or expert commentaries in the scientific literature. The section begins with an overview of findings from an early Australian study where these attributes were described among ICPs. It progresses to in-depth discussion of the reported trends from various US practice analyses and more recent qualifications offered to ICPs in the UK. Brief discussion regarding the role and preparation of the infection control doctor (ICD) is also included as are recommendations from relevant grey literature. This section concludes with an outline of the most recent joint recommendation from APIC, Certification Board of Infection Control and Epidemiology (CBIC) and the Community and Hospital Infection Control Association of Canada (CHICA) which outlines key indicators representing the multiple skills required of an ICP.

### ***Peer reviewed literature***

The only comprehensive Australian study of ICPs' skills, knowledge and expertise was undertaken more than a decade ago. It included two reports of ICP skills and knowledge. The first included a description of ICPs self-reported level of competence and their view regarding the qualifications required for professional growth and sequential promotion from "novice" to "expert" ICP. (Murphy and McLaws 1999) The 630 contributing ICPs failed to demonstrate any consensus regarding qualifications at any level other than that which they perceived themselves to hold at the time of being studied. The authors contest that this finding demonstrates the limit and unclear pathway for ICP professional development in Australia as well as the difficulties associated with developing, testing and implementing a meaningful system of assessing ICP competence and/or skill.

The second report from this Australian study reported the extent to which ICPs possessed and used their skills and resources to promote evidence-based practice. It found that fewer than a quarter of all ICPs undertook IC research and of that group just over a quarter published their findings. (Murphy and McLaws 2000)

Publications from the US and the UK tend to dominate the more recent literature addressing ICPs' skills, knowledge and expertise. Similar to the findings reported in Section 1 this dominance can be linked with the practice analyses and ICP certification in the US and with high level government reform in the UK. In 2005 Perry published a retrospective review of the UK ICP's development. (Perry 2005) This review includes thoughtful discussion on how core competencies for ICPs have been used to prepare individual job descriptions, direct on the job learning and also for the development of curricula for specialist training and education programmes. Perry asserts that

the ICN's functions currently remain largely unchanged from those recommended by the UK government in 1995 other than having expended in 2000 with the addition of core competencies recommended by the Infection Control Nurses Association. Respectively these include:

- identification and control of outbreaks;
  - education of hospital staff in infection control procedures;
  - preparation of policy documents and audit of implementation;
  - formulation of an annual programme of work including surveillance;
  - implementation of the annual programme;
  - provision of an annual report to the chief executive;
  - liaison with departments including occupational health and clinical teams;
  - monitoring of hospital hygiene;
  - advise on procedures for discharge and transfer of patients with infection or colonisation; and
  - advise purchasing and plans for building works.(Department of Health and Public Service Laboratory Service 1995)
- 
- specialist knowledge of microbiology, immunology, epidemiology practice to prevent and control infection and decontamination;
  - evidence-based practice;
  - teaching and learning;
  - management and leadership; and
  - clinical research.(Infection Control Nurses Association 2000)

Further Perry, like Murphy and colleagues, (Murphy, Carrico et al. 2008) recommends that ICPs upskill so as to develop more leadership rather than managerial skills and become more conversant with the language of business. King builds upon Perry's discussion of the recommended UK ICP core competencies and discusses how initial concerns that they would be used as tool to control ICPs has not eventuated but rather that they have been useful in ICP assessment for promotion and also as guidance for ICP education.(King 2005)

Goldrick provides an alternate view in her comprehensive review of the historical trends in ICP skill, education and competence requirements as demonstrated by repeated practice analyses.(Goldrick 2005) Table 1 reproduced from Goldrick's work demonstrates that substantial increases in ICP activity and essential skills since the initial findings of the SENIC study. The current six recommended practice areas are reflected in the CBIC examination content and importantly represent a 145% increase in ICP tasks today compared with the initial 1976 SENIC practice analysis. Goldrick makes several important points; notably that modern ICPs must have a comprehensive understanding of additional issues such as bio preparedness, and emerging infectious diseases. Additionally, restructure of US healthcare has brought ICPs additional responsibilities in non-acute care settings such as the community, ambulatory and day care centres.

Table 1:

**EVOLUTION OF INFECTION CONTROL PRACTICE. REPRODUCED FROM GOLDRICK, (2005).(Goldrick 2005)**

SENIC project		CBIC practice analyses			
1976*	1982 <sup>†</sup>	1987 <sup>‡</sup>	1992 <sup>§</sup>	1996 <sup>¶</sup>	2001 <sup>#</sup>
Practice dimensions: n = 5	Practice dimensions: n = 8	Practice dimensions: n = 8	Practice dimensions: n = 5	Practice dimensions: n = 5	Practice dimensions: n = 6
Number of tasks: N/A	Number of tasks: 60	Number of tasks: 67	Number of tasks: 95	Number of tasks: 127	Number of tasks: 147
Surveillance	Patient care practices	Patient care practices	Infectious process	Identification of infectious disease processes	Identification of infectious disease processes
Policy development	Infectious diseases	Infectious diseases	Surveillance/epidemiologic investigation	Surveillance/epidemiologic investigation	Surveillance/epidemiologic investigation
Training	Epidemiology and statistics	Epidemiology and statistics	Transmission of infection	Preventing/controlling transmission of infectious agents	Preventing/controlling transmission of infectious agents
Epidemic investigations	Microbiologic practices	Microbiologic practices	Management/communication	Program management/communication	Program management/communication
Consulting	Sterilization/disinfection	Sterilization/disinfection	Education	Education	Education and research
	Education	Education			Infection control aspects of employee health
	Employee health services	Employee health services			
	Management/communication	Management/communication			

SENIC, Study on the Efficacy of Nosocomial Infection Control; CBIC, Certification Board of Infection Control.  
\*Emori et al, 1980.  
<sup>†</sup>Shannon et al, 1984.  
<sup>‡</sup>Larson et al, 1988.  
<sup>§</sup>Bjerke et al, 1993.  
<sup>¶</sup>Turner et al, 1999.  
<sup>#</sup>Goldrick et al, 2002.

Recent US political initiatives such as legislation of mandatory state-wide surveillance and reporting has impacted ICPs by requiring them to be competent in standardised surveillance methodology including analysis and reporting of results. In a descriptive study of workforce requirements in the state of Virginia Edmond and colleagues found that to comply with proposed state mandates for HAI surveillance, on average acute-care organisations would require at least 1.7 additional FTE ICPs. (Edmond, White-Russell et al. 2005) Government directives and initiatives can have substantial impact on both the type and volume of ICP's work and as such significantly influence the skill mix and competencies ICPs require to perform this work.

In 2006 Hunt and Hellsten published an interesting opinion piece describing the limited uptake by Australian ICPs of a credentialing process designed and administered by an expert Sub-Committee of the Australian Infection Control Association (AICA).(Hunt and Hellsten 2006) The authors argued that credentialing was a valuable way in which Australian ICPs could demonstrate their competence for their own benefit as well as that of their employer and customer. Details regarding the requirements of AICA credentialing are not specified in the literature but rather available only through direct application to the AICA.

The literature reports the availability of various educational offerings recommended for ICPs and ICDs in the UK. These include post-graduate certificate, post-graduate Diploma or Masters level qualifications. Some qualifications are also available through distance learning modules. (Cookson

and Drasar 2006; Hay and Skinner 2006) Cookson and colleagues noted the need for course pre-requisites to take advanced prior learning into consideration. To this end the eligibility of candidates seeking entry to the UK-based Diploma of Hospital Infection Control is assessed according to previous qualifications, publications, presentations, involvement at hospital level, participation in policy development, association membership and infection control positions held as well as participation in national initiatives. Cookson notes that these criteria are designed to enable a wide range of candidates to access the course.

In addition to an increased understanding of business principles Perencevich argues that in order to gain administrative support and financial resources for their programs, ICPs and hospital epidemiologists must also understand and competently use economic arguments and justification including business case-analysis.(Perencevich, Stone et al. 2007)

Building upon her previous work regarding the US certification process in 2007 Goldrick published this White Paper to provide further rationale for certification and recertification.(Goldrick 2007) She asserted that the rapid changes in modern healthcare require ICPs to be competent and that certification demonstrates competences by testing appropriate ICP skills, abilities and knowledge. Further Goldrick suggests that it takes a minimum of two years for a beginner ICP to progress to a position of competence, hence the requirement of a minimum two-year practice pre-certification.

In their futuristic paper, discussed briefly in Section 1, Murphy and colleagues offer expert opinion regarding the principal skills, knowledge and attributes required in an ICP coordinating a future ICSP.(Murphy, Carrico et al. 2008) Their list is detailed, diverse and comprehensive. It includes:

- advanced facilitation, group process, and teambuilding skills;
- real-time analytic skills, such as those needed to perform point-of-care root cause analysis;
- refined understanding of complex systems, systems thinking, and a systems approach to problem solving;
- the emergence of new leadership skills and identification of personnel who have these skills;
- reciprocal responsibility for the development, implementation, and evaluation of technologies;
- ability to collaborate with, negotiate with, and influence others at all levels of the organization;
- program management and communication skills, including the ability to “market” infection prevention to others;
- capability to strategically plan and execute action plans;
- development of virtual teams that take advantage of the skills and experience of those individuals who are not in the same organization or geographic area; and
- skill in conveying a simple message and garnering support from others.

Friedman and colleague's paper outlining professional and practice standards is the most recent publication addressing ICP skills.(Friedman, Curchoe et al. 2008) It is a consensus document based on the untested opinion of experts. The experts recommend achievement and maintenance of the US-based certification status as the most appropriate and comprehensive qualification for ICPs. Additionally they recommend that the ICP is knowledgeable and skilled in relation to the following multiple areas:

- epidemiology, including outbreak management;
- infectious diseases;
- microbiology;
- patient care practices;
- asepsis;
- disinfection/sterilisation;
- occupational health;
- facility planning/construction;
- emergency preparedness;
- learning/education principles;
- communication;
- product evaluation;
- information technology;
- program administration;
- legislative issues/policy making; and
- research.

### ***Grey literature***

In most Australian grey literature that includes a recommendation on ICP qualifications the recommendation is at best only a generic comment such as "a suitably qualified" ICP must coordinate the ICSP. The meaning or requirements of "suitably qualified" are not specified. This is the case in documents published in Victoria, (Acute Health - Quality and Care Continuity Branch Department of Human Services 2000) and nationally. (Australian Government Department of Health and Ageing 2004) Interestingly the ACHS's 2001 resource tool, (The Australian Council on Healthcare Standards 2001) excludes any specific mention of an ICP. In more recent guidance however, ACHS stipulates that designated personnel with skills, training and experience be given responsibility for practical operation of the ICSP in organisations seeking ACHS accreditation (The Australian Council on Healthcare Standards 2006).

The IFIC recommends that an ICT has a range of expertise that covers IC, medical microbiology, infectious diseases and nursing procedures.(Rasslan and Heeg 2007).

A comprehensive list of required competencies is recommended by the UK Department of Health in 2004 for Directors of Infection Prevention and Control.(Department of Health 2004) These competencies address administrative, business and clinical domains and include:

- strategic thinking and decision making;
- leadership;
- planning and delivery;
- resource management;
- change management;
- team-working and communication;
- managing relationships; corporate commitment;
- holding to account;
- practice experience in dealing with and managing infection control;
- management of the infected patient;
- decontamination; and
- antibiotic usage.

The second edition of the UK-based Infection Control Nurses Association competencies is comprehensive and widely used in the UK by ICNs for purposes of self-assessment. Specifically, the ICNA's fifteen competencies guide assessment in four domains. They are detailed in the following table.

**Table 2: SUMMARY OF ICNA CORE COMPETENCIES REPRODUCED FROM INFECTION CONTROL NURSES ASSOCIATION *CORE COMPETENCIES FOR PRACTITIONERS IN INFECTION PREVENTION AND CONTROL* 2004.**

#### Domain One Specialist Knowledge

Area of Competence	Competency
<b>Infection Prevention and Control Practice</b>	The application of knowledge about infection practice to prevent and control infection in clinical and non-clinical areas
<b>Decontamination</b>	The application of the principles of cleaning, disinfection and sterilisation to promote safety
<b>Microbiology</b>	The application of microbiological knowledge to promote health through the prevention and control of infection and communicable disease
<b>Immunology</b>	The application of immunological knowledge to promote health through the prevention and control of infection and communicable disease
<b>Immunisation and Vaccination</b>	The application of the knowledge relating to the planning, practice and monitoring of immunisation and vaccination programmes
<b>Epidemiology</b>	The application of epidemiological knowledge to monitor and control infections and communicable diseases through the accurate interpretation of surveillance data
	The use of surveillance
<b>Demographics in Health</b>	The application of demographic knowledge to inform Infection Prevention and Control strategies

#### Domain Two Healthcare Governance

Area of Competence	Competency
<b>Research and Development</b>	Critical analysis of published literature related to Infection Prevention and Control

	The participation in research independently or collaboratively
<b>Clinical Effectiveness</b>	Using audit to monitor effectiveness
<b>Patient and Public Involvement (PPI)</b>	The use of communication skills to enhance patient and public involvement
<b>Risk Management</b>	The use of appropriate strategies and systems to identify and manage risk

#### **Domain Three Learning and Teaching**

Area of Competence	Competency
<b>Personal and Professional Development</b>	Development of own professional knowledge and skills through life long learning
<b>Facilitating learning in others</b>	Makes use of effective strategies to help others to learn about Infection Prevention and Control

#### **Domain Four Leadership and Management**

Area of Competence	Competency
<b>Leads in the Development of a proactive infection prevention and control service</b>	Leads work teams in the development of knowledge, ideas and work in infection prevention and control practice
<b>Managing an Infection Prevention and Control Service</b>	Uses a co-ordinated approach to ensure the service is managed effectively

Contrary to every other recommendation regarding skill, knowledge and competence published in either peer-reviewed or grey literature Standard IC01.01.01 of the proposed 2009 Joint Commission recommendations stipulates that an organisation identifies an individual with clinical authority over the ICSP however, the Standard also suggests that if an appointed individual lacks expertise in infection prevention and control, that they consult with someone who does have such expertise.(The Joint Commission 2008)

### ***Summary and analysis***

Similar to the findings of Section 1, Section 2 details substantial variation in the recommended or preferred skills, attributes and knowledge required by an ICP to coordinate an effective ICSP. Again published reports and recommendations are limited to the US, UK and a few Australian articles. The US trend remains solidly focussed in the exam-based certification process with exam content revised each five years subsequent to a large scale analysis of ICP practice. The UK recommendations are more recent having developed primarily in the last 5 or so years parallel with the major IC reforms of the UK national government. Additionally, the UK-based Infection Control Nurses' Association has defined practice through publication of their competencies which, although based on expert consensus and largely untested, allegedly assist ICPs in their own self-assessment process.

Different again, Australian ICPs have not to date embraced the method of credentialing offered by AICA although AICA has very recently undertaken



campaigns to better promote this system and make it more available to members. Given the lack of clarity and unpredictability of the Australian infection control workforce in terms of supporting and participating in any process for formal achievement and recognition of a model of minimum qualification, experience or competence the Commission's best option for contributing to ICP workforce development and capacity building is at this stage unclear.

### **Section 3: International and Australian models of effective infection control programs including human and economic impact.**

This section reviews scientific literature relating to infection control program models internationally and within Australia. The Commission's intent in seeking a review of this literature was to better understand what makes an ICSP effective and be familiar with models where those effects have been related to lower costs, better value for money or reduced human morbidity or mortality. The clinical infection control literature contains few rigorously-designed, randomised control trials that categorically demonstrate effectiveness of specific infection control interventions.(Haas 2006) Rather most of the clinical reports describe improved outcomes following multiple infection prevention interventions.

Despite extensive literature searching we were unable to identify any studies other than the SENIC study which were within the scope and criteria of this literature review. Most publications addressing large scale infection control programs described the typical national program based on an aggregate of detail from individual organisations. Alternatively some publications described one or a few (such as staffing, individual clinical improvement campaigns, introduction of a specific device or product) but not all specific elements that influence the effect of a program. Measurement of the costs and associated financial impact of an ICSP is a relatively new concept to the field and as such very few publications do it well. No recent publications measure "whole of program" human or economic effect.(Roup, Roche et al. 2006; Anderson, Kirkland et al. 2007)

Within these constraints this Section is limited to a review of several national descriptions of a typical ICSP and in particular a conceptualised ideal model proposed by investigators in the UK is presented.

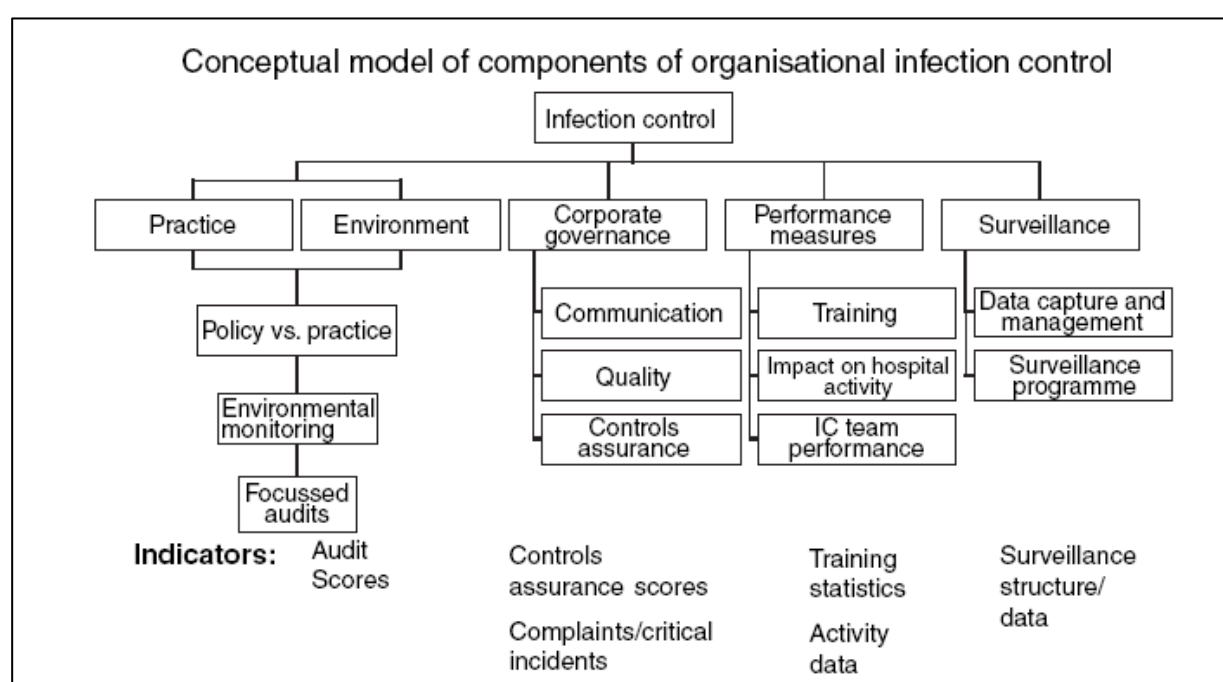
#### ***Peer reviewed literature***

In a 2003 expert commentary Reed and colleagues provided a superficial description of the organisation and interrelatedness of various components of Australian infection control.(Reed, Gorrie et al. 2003) They identify various government, non-government and professional bodies as being major drivers of change. Reed purports that organisations in the public and private sector essentially structure their ICSPs in the same way. He also acknowledges that there are no well-recognised, minimum obligations or professional standards for ICSPs in Australia. The paper concludes with a call for standardisation and nationalisation in two critical areas, national HAI surveillance and the provision of a federally funded reference laboratory.

In 2004 Watterson described a project where standardisation was also a key element in a 2-year effort to improve ICSP services across three

sites.(Watterson 2004) Watterson and colleagues developed indicators specific for assessing their programme. The indicators were diverse and comprehensive addressing the five pillars upon which the ICSP program was based. These pillars and indicators are detailed in Figure 1 below. Although Watterson does not comment on the economic or human effectiveness of the cited model she suggests that the indicators were instrumental in gaining senior management commitment and agreement regarding ICSP performance measures.

**Figure 1: CONCEPTUAL MODEL OF COMPONENTS OF ORGANISATION INFECTION CONTROL REPRODUCED FROM WATERSON AND COLLEAGUES.(Watterson 2004)**



The UK ICSP reforms have been well described in Sections 1 and 2. Spencer and Perry editorialise the role of the Director of Infection Control and acknowledge the clearly specified reporting lines, responsibilities and authorities of this position as being integral to each organisation's patient safety and HAI prevention achievements. (Spencer and Perry 2004)

The Flemish ICSP model described by Gordts is of interest in that unlike most other models is based in a legal decree.(Gordts 2005) ICSP staffing is set at minimum as detailed in Table 3 below and an organisation's ICC has a legal obligation to perform specific functions including HAI surveillance and follow up as well as implementation of national guidelines. The effectiveness of this model is not reported.

In a large European study investigators report results of an assessment of the organisation, resources and elements of infection control programmes in 32 countries. Although the study most likely suffers from self selection bias it

provides a good overview and demonstrates that more than three-quarters of participants had designated ICNs with specific training in infection control. The majority of hospitals had link nurse programs, prepared formal annual objectives, performed surveillance and reported rates to an ICC.(Struelens, Wagner et al. 2006)

In a large Korean study investigators assessed the status of ICSPs in 85 acute care hospitals each with more than 300 beds. Every hospital had an ICC and almost all had an ICP and an ICN. In 68% of Korean hospitals HAI surveillance was performed and of this 73% was targeted surveillance including ICUs. Surveillance accounted for almost half of the ICP's available time.(Oh, Chung et al. 2006)

Irish investigators reviewed ICSPs in 66 acute care hospitals noting major gaps including insufficient ICPs and ICDs. Nearly all of the hospitals had an ICC and less than 10% had a dedicated IC budget. Program efficacy was not measured.(Cunney, Humphreys et al. 2006)

A commentary published by Dutch experts describes recommendations of a small group of ICPs and medical microbiologists who attempted to reach consensus regarding ICP and medical microbiologist staffing requirements for Dutch ICSPs.(van den Broek, Kluytmans et al. 2007) The group's results are included in the table below. Interestingly, the Report indicates that there was substantial variation among individual group member's recommendations regarding medical microbiology needs. Closer agreement existed around the ICP staffing requirements. Subsequent Dutch researchers describe recommendations in Holland since 2004 which have guided a national network to support and undertake prospective and prevalence HAI surveys.(Troelstra 2007) Investigators suggest that similar information is gathered with both methodologies and that prevalence surveillance of HCAs is substantially less time consuming.

In 2007 Talbot and colleagues reported results from a descriptive survey of 134 private hospitals all within the same large US hospital chain.(Talbot, Tejedor et al. 2007) Findings suggested that almost all hospitals undertook some form of HAI surveillance however there was significant variation in the reported resources, methodologies and reporting practices. Few hospitals reported information back to clinicians at the bedside despite long-end recommendations from the SENIC study which recognises this as being a very important component of an effective ICSP.

A recent and thoughtful Korean report describes attempts by researchers in that country to measure the effect of ICSPs on the overall HAI burden.(Oh, Cheong et al. 2007) Measurement involved use of weighted and modified indicators from the SENIC study and four new indices relating to healthcare workers, resources, hand hygiene systems and quality improvement. Investigators noted that most indices performed poorly and they question the extent to which ICSPs have affected the HAI burden in Korea. In studying the Korean ICSP workforce they noted that most ICPs spent the majority of their time on control activities such as teaching and policy development rather than

monitoring performance through surveillance. They conclude that unless there is a FTE ICP surveillance is unable to be performed.

In 2007 Japanese researchers measured 5-year trends in ICSP activities and volume in 7 acute care hospitals. They found that ICPs allocated most of their time to either meetings/ conference (20.3%) or provision of internal education and training (20.6%). There was substantial variation in ICSP activities across the study sites.

**Table 3: REPORTED ICSP STAFFING LEVELS IN VARIOUS COUNTRIES**

Country	Recommended or Median ICP Staffing	Other Recommended Staffing Levels	Reference
Belgium	2.5 FTE ICNs per 1000 beds and	1 FTE IC physician.	(Gordts 2005)
Europe	2.33 FTE ICNS per 1000 beds	0.94 FTE ICD per 1000 beds	(Struelens, Wagner et al. 2006)
Ireland	1 FTE ICP per 248 beds		(Cunney, Humphreys et al. 2006)
Holland	1 FTE ICP per 178 beds	1 FTE Microbiologist per 806 beds.	(van den Broek, Kluytmans et al. 2007)
Korea	1 FTE ICP per 550 beds		(Oh, Cheong et al. 2007)
USA	1 FTE ICP per 191 beds		(Talbot, Tejedor et al. 2007)
Japan	1 FTE ICP per 315 beds		(Hayashida, Imanaka et al. 2007)
USA (New York state)	1 FTE ICP per 150.4 beds		(Stricof 2005)
Europe	4.2 FTE ICPS per 1000 beds	1.8 FTE ICD per 1000 beds	(Voss 2005)
USA (Maryland)	1.6 FTE ICPs < 200 beds 2.0 FTE ICPS > 200 beds		(Roup, Roche et al. 2006)

### ***Grey Literature***

No additional grey literature other than that cited in interrelated sub sections of the previous sections measured ICSP effectiveness. As such it is not described separately in this section.

### ***Summary and analysis***

Recent reports of Australian ICSP structure and/ or effectiveness are missing from the literature which makes legitimate comparison with international trends difficult. However, review of the literature overwhelmingly demonstrates that valid, reliable and well defined ICSP programs including recommended

lines of accountability and responsibility are not described. Almost all of the reports cited in Section 3 are either descriptive, non-experimental studies or expert commentary. This deficiency hinders global and national growth and consolidation of the IC profession. It also limits the ability of individual ICCs coordinating ICSPs on any scale to define, set and achieve specific HAI reduction targets.

Of interest are the attempts of several researchers in specific countries to describe the typical ICSP within their country or region. The one consistently reported element appears to be that of ICP staffing levels which is curious given that the debate regarding the most appropriate level of ICP staffing is contentious and largely unresolved. The range of values and denominators used to calculate reported ICP staffing ratios reflect this.

Given the paucity of evidence and even substantive information on ICSPS models or individual elements within an ICSP it is unlikely that the Commission or any of the individual Australian jurisdictions will be able to make justifiable recommendations regarding such models or elements within Australian healthcare delivery. The results of Section 3 reported above are potentially more meaningful when considered in conjunction with the results of the previous two sections.

## **Section 4: Critical success factors and limitations of successful infection control programs**

Key issues considered in this section include training curricula, relationships between administrators and members of the ICT, the recent UK IC reforms and models of governance. Similar to Section 3 the paucity of high quality research in the area of critical success factors and limitations of successful infection control program requires careful interpretation of this section of the literature review. This is especially important given the overwhelming proportion of expert commentary or opinion pieces published about this topic.

### ***Peer reviewed literature***

Recent publications discuss in depth the critical importance of having administrative support and buy-in for ICSPs. This buy-in includes but is not limited to provision of resources, role modelling and agreement on negotiated strategic targets.(Perencevich, Stone et al. 2007; Murphy, Carrico et al. 2008) The only published study of Australian administrators and their views regarding ICSPs and the role of the ICP was undertaken more than a decade ago.(Murphy and McLaws 2001) The study compared ICP and administrator viewpoints in Australia's most populated state regarding affirmative statements about ICSPs and resources. The investigators demonstrated reluctance among administrators to appreciate ICSP objectives, importance and resource requirements.

Additional limitations in Australian ICSPs were raised in 2001 where Oleson suggested that the absence of clear, strong national IC leadership was causing ambiguity and lack of outcome focus.(Olesen 2001) Olesen recommended definition of the scope of Australian ICSPs and exploration of the impact of ICSPs on patient outcomes. Ironically, that work remains incomplete globally and nationally within Australia.

In the UK during 2003, a period of substantial ICSP reform, Croxson and colleagues surveyed 176 ICNs and 93 ICDs from 200 National Health Service institutions to study ICSP organisation and funding.(Croxson, Allen et al. 2003) Overwhelmingly respondents reported failure of centralised mechanisms especially relating to funding allocation. As well some respondents reported ICPs having insufficient influence due to their non-central role in decision-making.

In 2004 two reports were published in regard to specific education for ICDs.(Cookson, Teare et al. 2004; Voss 2005) Cookson reported on the consensus recommendations of a small group of UK experts for each hospital to appoint a 1/3 FTE ICD. European concerns regarding the lack of designated specialised training and recognition for ICDs were reported by Voss and colleagues. They recommended a six-year post graduate

qualification. This group also recommended 1.8 ICD, 4.2 ICPs and 3.3 other ICT workers per 1000 beds.(Voss 2005)

As reported in Section 2 few valid publications explore the performance of ICSPs or IC departments. A systematic review undertaken in 2006 found just 12 reports none of which were published recently.(Haas 2006) Most of the reports related to time management, expert commentary, and reports of international models or studied other outcomes. Haas notes the absence of any valid recommendations regarding measuring ICSP performance or cost effectiveness and urges the field to test the impact of IC staffing and programs on HAI rates.

In their futuristic report described in detail in previous sections of this review, Murphy and colleagues describe detailed organisation cultural changes that will critically impact the effectiveness of future ICSPs.(Murphy, Carrico et al. 2008) These changes include acceptance that behaviours that increase infection are not tolerable, that preventing infections is everyone's responsibility and that they will be held accountable for same. Murphy also asserts that empowerment, including the right and expectation to stop activity that may increase infection risk is important.

The issue of empowerment is further explored by Koteyko and Nerlich within the context of the UK "Modern Matrons" model. (Koteyko and Nerlich 2008) The "Modern Matrons" was implemented by the UK government and essentially shifted responsibility for environmental cleanliness back to the organisation's senior nurse. As well the "Modern Matron" is expected to have a high level of visibility at the clinical level in an effort to improve frontline clinician's compliance with basic IC tenets. Koteyko's study compared the documented role of the "Modern Matron" to their actual performance in 11 organisations. Findings suggest that competing interests have limited the "Modern Matron"'s ability to spend time on the wards. As well the lack of formal empowerment of the Matrons to change other's clinical behaviour(s) and the organisational culture has limited their ability to influence HAI prevention and/ or control.

In yet another recent piece of expert opinion, the authors reflect upon the increased demands for accountability, transparency and provision of rapid solutions faced by healthcare organisations.(Edmond and Eickhoff 2008) These authors are specifically sympathetic to the plight of hospital epidemiologists and recommend upskilling of all ICT members with a particular focus on implementing change and developing teamwork. They also recommend ICSP review at least annually.

In a 2008 scoping review of 34 published articles researchers attempted to define the influences of management and organisational factors on inpatient HCAs.(Griffiths, Renz et al. 2008) Researchers recommended that strong leadership at the ward level and from administrators is critical in reducing HCAs. Clinical governance and training support are also important as is the need to target organisation-specific intrinsic risks.



### ***Grey Literature***

Grey literature outlining infection control programs is well described in Sections 1 and 2 above. These examples are mainly directives such as policy or guideline documents. They do not include measurement or interpretation of ICSPS success or limitations. Accordingly, they are not described separately in this section.

### ***Summary and analysis***

This section considered publications addressing factors associated with ICSP success and limitations. It highlighted the general decentralisation of ICSPs and the fragmented decision making associated with many IC-related issues. This results in ICPs and advocates of ICSPs such as the UK “Modern Matron”s having limited influence on changing clinician behaviours or organisational culture.

The literature reviewed in this section reinforces a key conclusion of Section 1, which is that there is no agreement between researchers and/or experts regarding the best or most effective way to organise or coordinate ICSPs, manage their funding or deliver their services.

The UK model promulgated by the government as part of their major IC reforms supports responsibility for infection control within clinical governance and control assurance procedures framework. This is a contemporary model that has some acceptance but its contribution to ICSP success is mainly untested.

The most recent literature reiterates the critical importance of administrative support and clinical buy-in. It also recognises buy-in and support beginning at the ward level as critical factors for successful ICSPs.

Whilst this Section is unable to present the Commission with an idealised model it does provide some interesting elements which may be of interest to the Commission and its stakeholders. It is the authors' understanding that few have been formally adopted on a wide scale in Australia, and to date there are no reports of their effectiveness in Australian ICSPs. Consideration, adaptation and implementation of some such elements by Australian IC teams may be prudent.

## **Section 5: Sustainable and transferable Infection control programs**

The fifth question to be answered by this literature review seeks identification of ICSPs that could transferable to the Commission's audience and sustainable within the Australian context. As stated previously there are limited historic reports and none recently describing critical elements of an ICSP that have been tested in real-time settings. Rather there are scant reports of specific elements that may be useful in the Australian setting and additionally there are a few components which are often cited in the literature as adding value rather than effectiveness, to the ICSP. Largely this value is perceived not economic, morbidity or mortality-related or consistent with specific outcome goals or measurements.

This section discusses these components and elements. The nature of grey literature precludes its relevance and contribution to this section.

### ***Peer reviewed literature***

Section 7 will explore the concept of IC liaisons or link nurses in greater depth however this component of ICSPs appears to have been widely and successfully implemented in several different regions of the world. Recently Simpkins reports the use of liaisons in an integrated health care system in the US and acknowledges the value of liaisons in assisting implementation and monitoring of specific IC practices as well as attracting potential ICPs to the specialty.(Simpkins, D'Alena et al. 2006)

In 2007 Pellowe comprehensively reviewed the major elements of the UK IC reforms.(Pellowe 2007) She outlines the intent of these reforms including endorsement of active surveillance, reduction of reservoirs and improved ICSP management and organization. The report recognises that cultural change, enabling and use of networks were critical elements. These appear to be both sustainable and transferable across healthcare settings in the UK. Their sustainability has been assisted by the development of multiple generic tools that are available to hospitals to assist in their implementation.

To assess the doable element of a proposed ICSP Herwarldt and colleagues undertook an assessment of the capacity of ICSPs in Iowa prior to the introduction of mandatory public reporting. (Herwaldt, Appelgate et al. 2007) They reported that existing resources and organisational structures were insufficient to meet the demands of collecting and contributing mandatory data. As well they cite substantial variation in applied surveillance methodologies as limiting the utility and accurateness of publicly reported HAI data.

Sieber proposes the inclusion of a re-designed link nurse program into ICSPs. The re-design should involve integration of patient safety and quality

components including but not limited to risk management, performance management, environmental health and safety as well as occupational health.(Sieber 2008)

Although futuristic, Murphy's proposed ideal ICSP system of the future contains specific elements that may ultimately prove to be transferable. (Murphy, Carrico et al. 2008) They are novel and expand the traditional ICSP scope, potential reach and impact. Their sustainability is also unknown. The complete list includes:

- infection prevention is integrated into every health care worker's job description;
- rewards and incentives are provided for preventing infections;
- prevention is designed into the ideal patient room;
- infection prevention education is standardized for all health care workers;
- the APIC broadens links to educators and other health care associations to partner on eliminating HAIs;
- performance improvement is a major aspect of the ICP's job description;
- "touchless" patient care technologies and alert/messaging systems are designed with infection prevention in mind;
- infection prevention functions and behaviours are standardized across health care settings;
- prevention strategies are "pulled" from the front-line health care workers when needed; and
- the emphasis on infection prevention is unified and organized in partnership with industry.

## ***Summary and analysis***

In the absence of efficacy data in terms of HAI reduction it is difficult if not impossible to identify ICSPs which are truly sustainable. In the literature reviewed thus far in Sections 1-5 some elements appear consistent over time, notably HAI surveillance and monitoring. As the scope and range of tasks expected of an ICSP increase considerably over time their sustainability is brought into question. Sustainability and transferability are even less clear given the fact that most ICSPs are reactive (politically or disease motivated) rather than proactive. Few have demonstrated sustainability.

A key way in which ICSP element transferability appears to be occurring is by filtering from large acute care settings all the way to small, non-inpatient settings. This is not specifically addressed in this review due to limitations of scope. There are other examples of ICSP filtering at national levels and adaptation internationally. The widespread use of NNIS definitions detailed in Section 1 and the IC link or liaison program are two such examples.

The literature reviewed in this section demonstrates that some transferability of individual ICSP elements is likely sustainable rather than transferability of whole ICSPs.

## **Section 6: Gaps in the evidence base on the role of the Australian Infection Control Practitioner**

Given that the only comprehensive review of Australian ICPs was undertaken more than 10 years ago there are substantial gaps in the literature relating to Australian ICPs.(Murphy and McLaws 1999; Murphy and McLaws 1999; Murphy and McLaws 1999; Murphy and McLaws 2000; Murphy and McLaws 2001) Subsequent reports have been scant and most are descriptive studies or expert commentary.

### ***Peer reviewed literature***

The only relevant Australian article published in peer-reviewed literature recently is that of Hobbs. (Hobbs 2007) Hobbs reports the results of a 2-day workshop in which a small group of Victorian ICPs participated in a facilitated brainstorm exercise. The workshop produced a proposed curriculum for ICP training based on duty areas reported by participants. These duty areas approximate to parts of the ICP's role. They include:

1. administrative duties;
2. policy and procedure development;
3. minimise transmission risks;
4. surveillance coordination;
5. adverse event management;
6. outbreak management;
7. immunisation;
8. education;
9. professional development activities; and
10. provision of expert advice.

### ***Summary and analysis***

There are no experimental studies, nor recent reports of Australia ICP activity, education, reporting structure, relationships with management, competencies or contribution to ICSP effectiveness. This is not unique to the Australian ICP context although given the relatively small numbers of Australian ICPs compared to other countries with mature ICSPs it is perhaps equally if not more important that these gaps be rectified.

The Australian IC community lacks valid and reliable evidence upon which to support claims for recommended staffing levels. As discussed in previous Sections other than the SENIC study all other staffing ratios have been determined by either panels of alleged experts or by comparing results of country-specific staffing surveys to the original SENIC 1 FTE ICP per 250 beds ratio. Without opportunity to demonstrate the impact of alternate ICP staffing levels in Australia, it is unlikely that administrators would support anticipated increases.(Murphy and McLaws 2001)

Two very obvious gaps in the evidence relating to the role of the Australian are comparisons between the activities, roles, expectations and influence of the inexperienced and advanced ICP. There is an absence of material reporting appropriate systems, tasks and education for entry-level ICPs.

Similarly there are no published reports on formal mentoring systems used by Australian ICPs at any stage of their IC career. Reviewers were also unable to locate any studies describing the specific role of an Australian ICP working in a non-acute setting. As well a comparison of ICP's roles in the Australian public and private sectors has not been performed.

Other gaps in Australian ICP evidence include:

- no Australian studies on the proportion of HALs that are preventable with various levels of ICP staffing or skill mix;
- scant economic analysis and/or studies of the cost benefit of employing ICPs with varying experience, skill or qualifications;
- comparisons of rural/ remote and metropolitan ICPs;
- obstacles to standardising/ nationalising ICP basic and advanced education including competency, credentialing or certification; and
- no description on the drivers for Australian ICPs to seek or reject credentialing or certification.

Given the scarcity of studies examining the role of Australian ICP there are two main implications for the Commission. Firstly, it is unlikely that any Commission recommendations relating to this role can be substantiated through the literature. Secondly, this situation presents multiple opportunities for either Commission, its designates or relevant and interested researchers to contribute to the field.

## **Section 7: Mentoring, support programs for infection control practitioners and their strengths and weaknesses**

This final section of the review describes the major findings and recommendations of the very few publications that deal with support for ICPs. Among these publications none describe support or mentoring for competent or advanced ICPs. Almost all relate to infection liaison or link nurse programs which are an uncomplicated form of quasi-mentoring programs for potential ICPs. A few describe support for rural or remote ICPs.

No examples of ICP mentoring programs were identified in the grey literature.

### ***Peer reviewed literature***

The first Australian peer-reviewed report to address the needs of rural and remote ICPs was published by Geary in 2003.(Geary, Allworth et al. 2003) Geary described results of a survey, scoping group and focus groups conducted to inform development of a zonal model for implementation in Central Queensland. Geary's work demonstrated the fragmented approach to ICSP in this region and identified resources and infrastructure that participants believed would improve their ICSPs. These included improved networking and communication opportunities as well as IC management plans and better technology. Geary conceptualised a zonal model that included a designated zonal Coordinator to standardise ICSP practice and provide support throughout the region.

An initiative designed to support the rural and remote ICP communication has been more recently reported by South Australian researchers.(Dusmohamed, Wilkinson et al. 2006) The article reports methods used to assess rural and remote ICSPs and engage local IC providers in a centralised communication model. The ICSPs were noted to be ad-hoc and uncoordinated with ICPs reporting insufficient time and competing roles. Participants embraced the centralised model which included regular regional network meetings and development of standardised policies and strategies.

Dawson, Vaughan, Cooper and Barnes each report their experiences implementing and supporting an IC link/ liaison program. Dawson reports positive experiences with the link nurses and acknowledges them as a valuable resource to observe and affect behavioural change among their ward level peers. The need to support link nurses through the provision of specific training and management support is also detailed. The issue of identifying link nurse education needs and development is further explored by Vaughan. Vaughan recommends the use of a practice portfolio for link nurses to assist and direct their individual learning. (Dawson 2003; Cooper 2004; Vaughan and Randle 2005; Barnes, Nennig et al. 2007)

In a descriptive account Cooper details how link nurses participating in interventions from the conceptual to delivery stages improve their enthusiasm for the project and also increases their IC knowledge.

### ***Summary and analysis***

Not surprisingly the literature relating to ICP support programs is scant and primarily descriptive. It is limited to a few reports of link/ liaison nurses programs which appear to add value and provide additional exposure for ICPs. Additionally, these programs may improve ownership of HAI risk at ward level and also function as potential pipeline for new ICPs to enter the profession. It is important to note that specific training and support is required by link nurses.

The other group of ICPs identified as needing specific support are those working in regional, rural and remote Australia. The unique Australian geography presents specific challenges which remain largely unexplored and unresolved.

There would most likely be value in the Commission considering the special needs for support and mentoring among these two special groups. The Commission may also wish to consider how the current Australian workforce of experienced and qualified ICPs can be organised to develop and field test formal ICP mentoring to their less experienced peers.

## Abbreviations and acronyms

ACHS	Australian Council on Healthcare Standards
AICA	Australian Infection Control Association
APIC	Association for Professionals in Infection Control and Epidemiology, Inc
HAI	Health care associated infection
ICC	Infection control Committee
ICD	Infection control doctor
ICN	Infection control nurse
ICP	Infection control practitioner/ professional
ICSP	infection control and surveillance program
ICT	Infection control team
ICU	Intensive care unit
SENIC	Study On Efficiency of Nosocomial Infection Control



## Glossary

Acute hospitals	Public and private hospitals providing services mainly to admitted patients with acute or temporary ailments.
Health care associated infection	Infections acquired as a direct or indirect result of health care.
Indicator	A key statistic chosen to describe (indicate) a situation concisely, help assess progress and performance, and act as a guide to decision making.
Infection control or infection control measures	Infection control aims to prevent the spread of pathogens between people in a health-care setting. Examples of infection control measures include hand washing, protective clothing, isolation procedures and audits of compliance with hygiene measures.
Infection control practitioners/professionals	Adopted initially in the U.S.A. in 1972 during the formation of the Association for Practitioners in Infection Control. In Australia, often used interchangeably with the term infection control nurse.
Infection control and surveillance programs	An organised program that includes surveillance, control measures and formal infection control policy.

## Appendix: Summary of literature included in this review.

### *Literature addressing question 1*

(Carrico, Rebmann et al. In press)	<p><b>Research purpose:</b> To identify fundamental infection prevention core competencies that must be mastered by each healthcare worker.</p> <p><b>Method:</b> Literature review, synthesis, use of expert Panel and Delphi process survey.</p> <p><b>Sample size:</b> 24 experts as members of Delphi Panel</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Produced set of 8 competencies suitable for testing and eventual use in defining curriculum content for healthcare workers.</p> <ul style="list-style-type: none"> <li>• Describe the role of microorganisms in disease</li> <li>• Describe how microorganisms are transmitted in healthcare settings.</li> <li>• Demonstrate standard and transmission-based precautions for all patient contact in healthcare settings</li> <li>• Describe occupational health practices that protect the healthcare worker from acquiring infection.</li> <li>• Describe occupational health practices that prevent the healthcare worker from transmitting infection to a patient.</li> <li>• Demonstrate ability to problem-solve and apply knowledge to recognize, contain, and prevent infection transmission.</li> <li>• Describe the importance of healthcare preparedness for natural or man-made infectious disease disasters.</li> </ul> <p><b>Evidence grading:</b> Q</p>
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<p>(Curchoe, Fabrey et al. 2008)</p>	<p><b>Research purpose:</b> To identify current practices among infection control professionals in the USA.</p> <p><b>Method:</b> E-mail survey.</p> <p><b>Sample size:</b> 1304 responses</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> No difference was noted in knowledge content and relevance to ICPs with 2 years experience and 7 or more years of experience thus concluded that advanced practice examination is not necessary.</p> <p>The authors identified 6 major content areas for ICPs.          (1) identification of infectious disease processes,          (2) surveillance and epidemiologic investigation,          (3) infection prevention and control,          (4) program management and communication,          (5) education and research; and          (6) infection control aspects of employee health.</p> <p><b>Evidence grading:</b> D</p>
	<p><b>Research purpose:</b></p> <p><b>Method:</b></p> <p><b>Sample size:</b></p> <p><b>Risk adjustment/ confounders controlled for:</b></p> <p><b>Confidence interval:</b></p> <p><b>Findings:</b></p> <p><b>Evidence grading:</b></p>

<p>(Murphy, Carrico et al. 2008)</p>	<p><b>Research purpose:</b> To detail proposed elements of idealised future state and systems for infection prevention.</p> <p><b>Method:</b> Think tank-like process.</p> <p><b>Sample size:</b> Not stated.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Primary attributes and roles of ICPs:</p> <ul style="list-style-type: none"> <li>• Understanding of the infectious disease process</li> <li>• Conducting surveillance to identify risk factors and cases</li> <li>• Providing data management</li> <li>• Translating data into usable information (analysis and reporting)</li> <li>• Investigating infection epidemics or clusters</li> <li>• Facilitating interventions to prevent/control transmission of infectious agents</li> <li>• Observing health care workers' compliance with proven infection prevention measures and providing feedback</li> <li>• Leading and managing programs to prevent and control HAIs</li> <li>• Developing policies and procedures</li> <li>• Providing education and training</li> <li>• Performing research and/or applying research findings to practice</li> <li>• Conducting product evaluation and selection</li> <li>• Ensuring the infection prevention and control aspects of occupational health and environmental safety programs</li> <li>• Ensuring emergency preparedness planning and implementation</li> <li>• Promoting process and performance improvement</li> <li>• Providing consultation</li> </ul> <p><b>Evidence grading:</b> OP/ EC</p>
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(Grant and Kim 2007)	<p><b>Research purpose:</b> To explore measurement of infection control consultation.</p> <p><b>Method:</b> A 7-year retrospective observational study of all consultations &gt; 5 minutes duration.</p> <p><b>Sample size:</b> 770 infection control consultations.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> ICP has to be able to provide accurate and customised responses to consultations which involve searching and applying research.</p> <p>Suggests that if a program is adequately resourced it becomes ingrained if given authority, support and autonomy to affect change.</p> <p>With dedicated resources the ICP is able to provide increased shorter consultations which should strengthen the program's ability to reduce transmission opportunities.</p> <p><b>Evidence grading:</b> O+</p>
(Chaisombat, Moongtui et al. 2005)	<p><b>Research purpose:</b> To study the roles of infection control nurses in Thai Army hospitals.</p> <p><b>Method:</b> Semi-structured interviews of ICNs from 6 hospitals seeking accreditation.</p> <p><b>Sample size:</b> 11 ICNs from 6 hospitals</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Not stated</p> <p><b>Findings:</b> All ICPs performed administration, education, surveillance, personnel health, consultation and quality improvement in IC. No capacity for outbreak investigation and research.</p> <p><b>Evidence grading</b> D</p>

(Jantarasri, Soparatana et al. 2005)	<p><b>Research purpose:</b> To evaluate the roles of ICNs in hospital development and accreditation and describe problems and obstacles.</p> <p><b>Method:</b> Interview and survey.</p> <p><b>Sample size:</b> 148 ICNs</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Not stated</p> <p><b>Findings:</b> 95% of respondents had a Bachelor's degree. The five tasks they performed were:</p> <ol style="list-style-type: none"> <li>1. describing nosocomial infection definition</li> <li>2. surveillance</li> <li>3. analysis of surveillance data</li> <li>4. presenting information to the ICC</li> <li>5. using reported information for planning purposes</li> </ol> <p>Only 10.4% performed a research role. Lack of knowledge, time and resources were cited as impediments to research.</p> <p>86% of respondents worked part time.</p> <p><b>Evidence grading:</b> D</p>
(Kananitaya, Senarat et al. 2005)	<p><b>Research purpose:</b> To evaluate the role of Thai ICNs in regional hospitals.</p> <p><b>Method:</b> Interview and survey.</p> <p><b>Sample size:</b> 16 ICNs</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> IC practice consistent with accreditation requirements but missing or insufficient for staff health, HAI surveillance and research.</p> <p><b>Evidence grading:</b> D</p> <ul style="list-style-type: none"> <li>• This is a poorly written paper with weak conclusions. It is one in a series of 4 whereby it appears the authors have attempted to get three almost duplicate publications (different by sample type only) from one piece of work.</li> <li>• The four papers are (Chaisombat, Moongtui et al. 2005; Jantarasri, Soparatana et al. 2005; Kananitaya, Senarat et al. 2005; Leela, Chittreecheur et al. 2005)</li> </ul>

<p>(Kirchner, Stover et al. 2005)</p>	<p><b>Research purpose:</b> To discuss challenges and benefits of implementing a standardised model for infection prevention and control across a multi-hospital system</p> <p><b>Method:</b> Not stated</p> <p><b>Sample size:</b> 14 hospitals</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Model consistent with state requirements was introduced and provided a minimum outline of what should be included in each IC program.</p> <p>Paper does not evaluate impact or discuss elements.</p> <p><b>Evidence grading:</b> Q</p>
<p>(Leela, Chittrecheur et al. 2005)</p>	<p><b>Research purpose:</b> To study ICN roles in provincial hospitals.</p> <p><b>Method:</b> Semi-structured interviews</p> <p><b>Sample size:</b> 11 ICNs from 9 hospitals.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Not stated</p> <p><b>Findings:</b> Only 25% of ICNs worked fulltime. Every hospital ICN performed all 8 roles set by the Department of Nursing of the Ministry of Health other than research and investigation of epidemic nosocomial infection which were performed by just over half of the ICNs surveyed.</p> <p><b>Evidence grading:</b> D</p>

(Health Canada 2004)	<p><b>Research purpose:</b> To develop a recommended and “validated” model for Canadian Infection Prevention and Control programs</p> <p><b>Method:</b> Iterative process involving recommendations by 3 expert sub-groups regarding key components and estimated resources in acute care. Long term care and community care.</p> <p><b>Sample size:</b> 27 experts</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Recommended components for the distinct settings were:  <i>Acute care</i> for a hypothetical 500 bed hospital - education, surveillance, outbreak management, policy development, communicable disease, occupational health, and program support.  Staffing ratio – 673 ICP days a year, 3FTEs per 500 beds.</p> <p><i>Long-term care</i> for a hypothetical 150-250 bed facility – surveillance, outbreak management, education, policy development &amp; implementation, occupational health, resident health.  Staffing ratio – 1 FTE ICP per 150-250 beds.</p> <p><b>Evidence grading:</b> OP/EC</p>
(Stevenson, Murphy et al. 2004)	<p><b>Research purpose:</b> To describe IC structure and resources in small rural hospitals in four Western US states.</p> <p><b>Method:</b> Written survey for self-completion</p> <p><b>Sample size:</b> 77 rural US hospitals with &lt; 150 beds.</p> <p><b>Risk adjustment/ confounders controlled for:</b> Not stated.</p> <p><b>Confidence interval:</b> No</p> <p><b>Findings:</b> Almost all hospitals had an ICP who spent a median of 10 hours a week on IC activities. Median ICP staffing ration was 0.63 FTE ICPs per 100 occupied beds. Most performed other activities. Major activities in rank order of frequency were surveillance and data management, 30%; developing policies and procedures, 15%; outbreak control, 12.5%; education and training, 18%; employee health, 20%. Less than 10% of ICPs were certified. Almost half of the hospitals employed a designated IC physician. Most hospitals used CDC Definitions despite being too small to participate in NNIS system. Almost all hospitals did hospital wide surveillance. In rank order other HAs surveyed were staff bloodborne virus exposures, SSIs, UTIs, MRSA, VRE and VAP.</p> <p><b>Evidence grading:</b> D</p>



<p>(Jones, Gardner et al. 2000)</p>	<p><b>Research purpose:</b> To gain a context-based description of the scope of practice of IC and to identify the relationship between actual practice and perceptions of best practice by ICPs.</p> <p><b>Method:</b> Mailed descriptive survey using a questionnaire.</p> <p><b>Sample size:</b> 115 members of Queensland IC Association</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> ICPs reported need for broader range of activities include strategic management, clinical monitoring and risk management, more environmental evaluation and more professional development. Suggestive of a move away from surveillance towards strategic management.</p> <p>ICP's role is expanding, surveillance remains an important component. Focus on infection control is moving beyond the large, acute care setting</p> <p><b>Evidence grading:</b> D</p>
<p>(Murphy and McLaws 1999)</p>	<p><b>Research purpose:</b> To investigate the role, function and attributes of Australians performing as ICPs</p> <p><b>Method:</b> Mailed survey</p> <p><b>Sample size:</b> 644 AICA members</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> The typical Australian ICP works in a public acute-care facility with fewer than 251 beds, has 6 years experience in the field, and has completed hospital-based nursing training. Surveillance was the activity that consumed most of the ICPs' time. The majority of ICPs had responsibilities in addition to infection control, and although they considered management to be supportive, additional clerical support was identified as an area for program improvement.</p> <p><b>Evidence grading:</b> D</p>

## Literature addressing question 2

(Friedman, Curchoe et al. 2008)	<p><b>Research purpose:</b> To define standards suitable for a range of practice settings and propose indicators for evaluating ICP competency.</p> <p><b>Method:</b> Not described</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> recommend the following as key areas for ICP's to have knowledge and skill:</p> <ul style="list-style-type: none"> <li>• epidemiology, including outbreak management;</li> <li>• infectious diseases;</li> <li>• microbiology;</li> <li>• patient care practices;</li> <li>• asepsis;</li> <li>• disinfection/sterilization;</li> <li>• occupational health;</li> <li>• facility planning/construction;</li> <li>• emergency preparedness;</li> <li>• learning/education principles;</li> <li>• communication;</li> <li>• product evaluation;</li> <li>• information technology;</li> <li>• program administration;</li> <li>• legislative issues/policy making; and</li> <li>• research.</li> </ul> <p><b>Evidence grading:</b> OP/EC</p>
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(Murphy, Carrico et al. 2008)	<p><b>Research purpose:</b> To detail proposed elements of idealised future state and systems for infection prevention.</p> <p><b>Method:</b> Think tank-like process.</p> <p><b>Sample size:</b> Not stated.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Key knowledge base, skills and attributes required of future ICPs include:</p> <ul style="list-style-type: none"> <li>• Advanced facilitation, group process, and teambuilding skills</li> <li>• Real-time analytic skills, such as those needed to perform point-of-care root cause analysis</li> <li>• Refined understanding of complex systems, systems thinking, and a systems approach to problem solving</li> <li>• The emergence of new leadership skills and identification of personnel who have these skills</li> <li>• Reciprocal responsibility for the development, implementation, and evaluation of technologies</li> <li>• Ability to collaborate with, negotiate with, and influence others at all levels of the organization</li> <li>• Program management and communication skills, including the ability to “market” infection prevention to others</li> <li>• Capability to strategically plan and execute action plans</li> <li>• Development of virtual teams that take advantage of the skills and experience of those individuals who are not in the same organization or geographic area</li> <li>• Skill in conveying a simple message and garnering support from others.</li> </ul> <p><b>Evidence grading:</b> OP/ EC</p>
(Goldrick 2007)	<p><b>Research purpose:</b> To provide a rationale for certification and re-certification.</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Extensive systemic change, increased need for competency and accountability requires ICPs to be competent. Certification demonstrates knowledge and skills for the specialty. Novice progresses to competent after 2 years, therefore certification only possible after 2 years of practice. ICP tasks have increased from 60 in 1982 to 147 in 2001. Certification an indicator of commitment to continual improvement.</p> <p><b>Evidence grading:</b> OP/EC</p>

<p>(Memish, Soule et al. 2007)</p>	<p><b>Research purpose:</b> Discussion of global value of certification.</p> <p><b>Method:</b> Expert opinion.</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Certified ICPs reported to be more aware of evidence and adept at applying it. CBIC only global certification agency. Modern ICP must stay current understand changes in healthcare and subsequent risks. Joint Commission International requires experience, training or certification. Practice standards have to be relevant.</p> <p><b>Evidence grading:</b> OP/ EC</p>
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<p>(Perencevich, Stone et al. 2007)</p>	<p><b>Research purpose:</b> Evidence-based guideline to assist hospital epidemiologists to understand and use economic analyses to justify the need for and benefits of effective infection control interventions and programs..</p> <p><b>Method:</b> Not stated</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Many programs lack economic expertise to compete financial analysis. Recommend stepwise or randomised rolling out of an intervention to measure impact in control environment. Recommended steps are:</p> <ol style="list-style-type: none"> <li>1. Frame the problem and develop A hypothesis about potential solutions</li> <li>2. Meet administrators</li> <li>3. Determine the annual cost</li> <li>4. Determine avoidable costs through reduced HAI rates</li> <li>5. Determine local costs associated with HAI</li> <li>6. Calculate the financial impact</li> <li>7. Include additional financial or health benefits</li> <li>8. Make the case for your business case</li> <li>9. Prospectively collect cost and outcome data once the program is in effect</li> </ol> <p>Use local administrative data or literature (adjusted for inflation) to calculate attributable cost.</p> <p>Optimal decisions about programs must incorporate economic impact of specific interventions.</p> <p><i>Literature is lacking in high-quality studies (randomised control trials) to support efficacy and cost-effectiveness of specific interventions. Many have methodological weaknesses that bias the cost-effectiveness.</i></p> <p>ICPs must be able to undertake business-case analysis for justification or for QI purposes. Expect that attributable cost estimates of HAIs and value of interventions will be needed for clinical decision making and for development of guidelines or other allocations.</p> <p><b>Evidence grading:</b> OP/ EC</p>
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(Cookson and Drasar 2006)	<p><b>Research purpose:</b> To outline changes to the eligibility for Diploma of Hospital Infection Control</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Initial criteria for Advanced Prior Learning excluded skilled and competent ICPs and doctors despite many years of standing.</p> <p>Important that a wide range of candidates have the opportunity for involvement.</p> <p>Eligibility revised to include consideration of:</p> <ul style="list-style-type: none"> <li>• Knowledge (based on qualifications publications, presentations)</li> <li>• Skill – involvement at hospital level, evidence review, association membership, policy development</li> <li>• Post held and experience – Full-time or part-time position and involvement in national schemes</li> <li>• Personal factors (not described)</li> </ul> <p><b>Evidence grading:</b> OP/EC</p>
(Hay and Skinner 2006)	<p><b>Research purpose:</b> To describe alternate qualification to Diploma in Infection Control.</p> <p><b>Method:</b> Report</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Outlines availability of Masters degree aimed at either infection control doctors or nurses. Involves multiple modules and candidates can exit at 3 levels – post graduate certificate, post-graduate diploma or Masters.</p> <p>Available for online delivery and individual modules can be taken as continuing professional development.</p> <p>Also details availability of distance-learning Master of Science in medical device decontamination.</p> <p><b>Evidence grading:</b> OP/ EC</p>

(Hunt and Hellsten 2006)	<p><b>Research purpose:</b> Report on revision of Australian credentialing process.</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Credentialing first available 2000, uptake minimal. Revision of process and reoffered in 2006 as a system of points accrued based on prior knowledge, experience and qualifications.</p> <p>Australian Infection Control Association considers credentialing as an option to demonstrate competence for benefit of individual ICPs, employing organisations and consumers of healthcare.</p> <p><b>Evidence grading:</b></p>
(Edmond, White-Russell et al. 2005)	<p><b>Research purpose:</b> Assess the size of IC workforce, estimate additional personnel needed to implement hospital-wide surveillance and evaluate current HAI surveillance methodologies.</p> <p><b>Method:</b> 1-page questionnaire mailed to IC Department of every acute care hospital in Virginia.</p> <p><b>Sample size:</b> 74 hospitals.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Mean only stated.</p> <p><b>Findings:</b> Every hospital did SSI surveillance, almost half surveyed CA-BSI in ICUs, 40% monitored VAP and most surveyed epidemiologically important MROs. Only 14% of hospitals had &gt; 1 ICP and at 86% of hospitals they had additional major responsibilities.</p> <p>Estimated that mean number of additional ICPs for hospital-wide surveillance would be 1.7 (0-8) which would cost additional \$USD 115 million.</p> <p><b>Evidence grading D</b></p>

(Goldrick 2005)	<p><b>Research purpose:</b> Not stated.</p> <p><b>Method:</b> Historic account.</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> 2001 Practice analysis identified six major practice areas:</p> <ol style="list-style-type: none"> <li>1. identification of infectious disease processes,</li> <li>2. surveillance/ epidemiologic investigation,</li> <li>3. prevention/ controlling transmission of infectious agents,</li> <li>4. program management/ communication,</li> <li>5. education and research; and</li> <li>6. infection control aspects of employee health.</li> </ol> <p>Respondents' qualifications were RNs (80%), degree or advanced degree (73%), certification (84%)</p> <p>Between 1976-2001 IC tasks increased 145% including emergency preparedness, biological warfare and pandemic preparedness/ emerging diseases. As well trend towards ICPs having responsibility for additional non-acute care settings.</p> <p>Cites HICPAC publication that no evidence that public reporting prevents or controls HAIs.</p> <p><b>Evidence grading</b> OP/EC</p>
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(King 2005)	<p><b>Research purpose:</b> Discussion on United Kingdom IC core competencies.</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> 2<sup>nd</sup> edition of competencies published in 2004 by ICN Association. The UK competencies for infection control are:</p> <ul style="list-style-type: none"> <li>• The application of knowledge about infection practice to prevent and control infection in clinical and non-clinical areas</li> <li>• The application of the principles of cleaning, disinfection and sterilisation to promote safety</li> <li>• The application of microbiological knowledge to promote health through the prevention and control of infection and communicable disease</li> <li>• The application of immunological knowledge to promote health through the prevention and control of infection and communicable disease</li> <li>• The application of the knowledge relating to the planning, practice and monitoring of immunisation and vaccination programmes</li> <li>• The application of epidemiological knowledge to monitor and control infections and communicable diseases through the accurate interpretation of surveillance data</li> <li>• The use of surveillance</li> <li>• The application of demographic knowledge to inform Infection Prevention and Control strategies</li> <li>• Critical analysis of published literature related to Infection Prevention and Control</li> <li>• The participation in research independently or collaboratively</li> <li>• Using audit to monitor effectiveness</li> <li>• The use of communication skills to enhance patient and public involvement</li> <li>• The use of appropriate strategies and systems to identify and manage risk</li> <li>• Development of own professional knowledge and skills through life long learning</li> <li>• Makes use of effective strategies to help others to learn about Infection Prevention and Control</li> <li>• Leads work teams in the development of knowledge, ideas and work in infection prevention and control practice</li> <li>• Uses a co-ordinated approach to ensure the service is managed effectively</li> </ul> <p>Initial concern that competencies may be used to control ICNs, these have been useful for regarding and also as a training model for novice ICNs.</p> <p><b>Evidence grading</b> OP/EC</p>
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(Perry 2005)	<p><b>Research purpose:</b> Not stated, a descriptive study of ICN development and future.</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Discusses how core competencies have been useful for individual job descriptions, work-based learning and development of specialist training programmes.</p> <p>Introduces the concept of “modern matrons” who have key responsibilities for standards of cleanliness and implementing evidence-based guidelines. In some organisations these roles are linked.</p> <p>The 1995 role is still applicable and includes: Identification and control of outbreaks</p> <ul style="list-style-type: none"> <li>• Education of hospital staff in infection control procedures</li> <li>• Preparation of policy documents and audit of implementation</li> <li>• Formulation of an annual programme of work including surveillance</li> <li>• Implementation of the annual programme</li> <li>• Provision of an annual report to the chief executive</li> <li>• Liaison with departments including occupational health and clinical teams</li> <li>• Monitoring of hospital hygiene</li> <li>• Advise on procedures for discharge and transfer of patients with infection or colonisation</li> <li>• Advise purchasing and plans for building works.</li> </ul> <p>PLUS</p> <ul style="list-style-type: none"> <li>• Involvement in contracting, engineering and estate issues</li> <li>• Decontamination of equipment and</li> <li>• Responding to litigation and complaints.</li> </ul> <p>Anticipated required skills are:</p> <ul style="list-style-type: none"> <li>• Leadership not management</li> <li>• Conversant with language of business</li> <li>• Increased productivity and expectation of success</li> </ul> <p><b>Evidence grading</b> OP/EC</p>
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(Murphy and McLaws 2000)	<p><b>Research purpose:</b> To establish a profile including the extent to which ICPs used skills and resources to promote evidence-based IC.</p> <p><b>Method:</b> Mailed survey</p> <p><b>Sample size:</b> 630 AICA members</p> <p><b>Risk adjustment/ confounders controlled for:</b> Partial</p> <p><b>Confidence interval:</b> Yes</p> <p><b>Findings:</b> Research relating to infection control was undertaken by 21.5% (135/628) of the sample, and 27.6% (37/134) of this group published their research findings</p> <p><b>Evidence grading:</b> D</p>
(Murphy and McLaws 1999)	<p><b>Research purpose:</b> To describe the perception of competence held by ICP and qualifications they consider necessary for progression.</p> <p><b>Method:</b> Mailed survey</p> <p><b>Sample size:</b> 630 AICA members</p> <p><b>Risk adjustment/ confounders controlled for:</b> Partial</p> <p><b>Confidence interval:</b> Yes</p> <p><b>Findings:</b> Overwhelming lack of consensus between ICPs regarding qualifications required at levels expert to novice other than their own level. The pathway for career progression is limited and assessment impractical.</p> <p><b>Evidence grading:</b> D</p>

### ***Literature addressing question 3***

(Hayashida, Imanaka et al. 2007)	<p><b>Research purpose:</b> measurement of hospital-wide patient safety and infection control activities and volume 5-year trends.</p> <p><b>Method:</b> Interviewed patient safety and infection control program leaders to define scope of practice. Developed a questionnaire based on the scope and distributed it to these staff as a survey for self completion.</p> <p><b>Sample size:</b> 7 acute Japanese hospitals.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> No</p> <p><b>Findings:</b> Scope and relevant proportion of infection control time per 100 beds was meetings and conferences (20.3%), internal review and walk rounds (10.1%), internal education and training (20.6%), external education and training (11%), standard manual development (3.4%), infection surveillance (15.9%) and others (18.8%)</p> <p>The range of infection control annual activity was 3,025-12,196 person hours or 1,141 hours per 100 beds, 613 per 100 staff.</p> <p>Infection control activities varied across sites</p> <p>ICP ratio was one per 315 beds which is lower than other published studies.</p> <p><b>Evidence grading:</b> O</p>
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(Oh, Cheong et al. 2007)	<p><b>Research purpose:</b> To develop new evaluation indices of infection control to evaluate Korean infection surveillance and control programs.</p> <p><b>Method:</b> Questionnaire-based survey of Korean acute general hospitals with &gt; 300 beds. Used weighted SENIC indices plus four new evaluation indices to assess infection control programs. These included healthcare workers index, resource index, hand hygiene index and quality improvement index.</p> <p><b>Sample size:</b> 164 hospitals.</p> <p><b>Risk adjustment/ confounders controlled for:</b> Multiple regression analysis</p> <p><b>Confidence interval:</b> Standard deviation &amp; inter-quartile range.</p> <p><b>Findings:</b> The mean number of beds for 1 FTE ICP was 550. the indices were reliable and valid Hospital epidemiologists and ICPs are not well trained and spend most time on control activities (teaching/ policy) rather than surveillance which could reduce HAIs. Low scores call into questions whether Korean ISCPs have affected HAI burden in Korea. Unable to determine impact of ISCPs on HAIs. As ICPs were more highly educated less reliance/ use of epidemiologists. Surveillance unable to be performed unless there is a full-time ICP.</p> <p><b>Evidence grading:</b> O+</p>
(Talbot, Tejedor et al. 2007)	<p><b>Research purpose:</b> To assess infection control practices in a large national cohort.</p> <p><b>Method:</b> Survey on enrolment to a national collaborative to reduce ventilator associated pneumonia and central line related bloodstream infections in ICUs. Included survey of infection control program.</p> <p><b>Sample size:</b> 134 private hospitals.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> No</p> <p><b>Findings:</b> surveillance routinely performed in most facilities. A single ICP per mean of 191 beds, 20 being ICU beds. 55% of hospitals had a certified ICP.</p> <p>Substantial differences in surveillance practice, resources, data collection methods and reporting processes. Infrequent reporting of data to clinicians at the bedside.</p> <p><b>Evidence grading:</b> D</p>

(Troelstra 2007)	<p><b>Research purpose:</b> To describe how Dutch infection control programs are organized.</p> <p><b>Method:</b> Description.</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Independent expert advisory body has recommended 1 ICP per 250 beds and 1 FTE medical microbiologists per 1000 beds. Since 2004 hospitals advised to perform surveillance. National network promotes and supports prospective and prevalence surveys. Prevalence surveys considered less time consuming for similar information.</p> <p><b>Evidence grading:</b> OP/ EC</p>
(van den Broek, Kluytmans et al. 2007)	<p><b>Research purpose:</b> To determine the needs for ICPs and medical microbiologists in Dutch hospitals.</p> <p><b>Method:</b> Group discussion and iterative scoring based on model hospital with 1370 beds, 280 000 nursing days, 39 000 admissions and 40 ICU beds. Considered that 1 ICP worked 1632 hrs per year.</p> <p><b>Sample size:</b> 16 ICPs and 10 medical microbiologists.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Mean times for ICP activity 242.1 hrs/ week and 53.8 hrs/ week for medical microbiologist. The model hospital required ratio of ICPs of 1 per 178 beds and one microbiologist per 806 beds. This is also 1 FTE ICP per 5065 admission or 36 364 nursing days. 1 medical microbiologist per 22 941 admission, 164 706 nursing days.</p> <p>Substantial variation 25% regarding medical microbiologist needs whereas for ICPs variation range was 10%.</p> <p><b>Evidence grading:</b> OP/ EC</p>

<p>(Cunney, Humphreys et al. 2006)</p>	<p><b>Research purpose:</b> Comprehensive survey to determine current resources for infection control, antibiotic stewardship and occupational health services in Irish acute care hospitals.</p> <p><b>Method:</b> Survey which had been distributed to Chief Executive Officers.</p> <p><b>Sample size:</b> 66 acute care hospitals.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Median 0.6 FTE consultant microbiologist in each hospital with onsite consultation (47%). Mean ratio of one ICP for every 222 acute care beds. The overall ratio for all beds was one ICP per 248 beds. Almost all hospitals (85%) had an infection control committee.</p> <p>Fewer than 10% had a dedicated infection control budget yet ¾ provided funding support for continuing education and attendance at meetings.</p> <p>Conclude that there are major gaps in resources and facilities including insufficient ICPs and infection control doctors. 15% of hospitals did not have ICPs.</p> <p>Support centralisation of infection control activities. Consider the absence of global consensus on minimum necessary resources as a handicap limiting lobbying of national authorities.</p> <p><b>Evidence grading:</b> D</p>
<p>(Moroz and Ward 2006)</p>	<p><b>Research purpose:</b> Describe project implementing Infection Control Liaisons.</p> <p><b>Method:</b> Abstract</p> <p><b>Sample size:</b> 1 community-based health system</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Volunteer infection control liaisons serve at the frontline of the organisation and drive the infection control program. Roles include writing publications, crafting policies, research, provide education and participate in surveillance and quality activities.</p> <p><b>Evidence grading:</b> OP/ EC</p>

(Oh, Chung et al. 2006)	<p><b>Research purpose:</b> To assess the status of infection surveillance and control programs in Korea and analyse trends.</p> <p><b>Method:</b> Nationwide mail survey sent to infection control nurse in each acute care hospitals with &gt; 300 beds between June-October 2003.</p> <p><b>Sample size:</b> 85 hospitals.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Not stated.</p> <p><b>Findings:</b> Every hospital had an infection control committee. 98% had an infection control nurse and 86% had an infection control doctor. 60% of hospitals had part time infection control nurse only. The nurses were highly educated (37% masters, 11% doctorate) .68% of hospitals performed surveillance and this accounted for almost half of their time. Targeted surveillance was performed by 73% and 88% targeted ICUs.</p> <p>Essential activities were surveillance, investigations, teaching, environmental monitoring, employee health and policies development and review.</p> <p>Infection control doctors spent little time on infection control other than as a consultant. They mainly provided patient care.</p> <p>The mean number of beds per hospital was 638 and most hospitals had only 1 ICP of which &gt; 50% were part-time spending approximately a quarter of their time on infection control.</p> <p><b>Evidence grading:</b> D</p>
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(Tsan, Hojlo et al. 2006)	<p><b>Research purpose:</b> Survey to assess the capacity and current practices of infection control and surveillance programs.</p> <p><b>Method:</b> 10-question survey developed by experts and converted to a web-based survey and distributed.</p> <p><b>Sample size:</b> 130 nursing homes.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> No</p> <p><b>Findings:</b> The median number of hours per week was 12. ICPs were highly qualified, 48% had PhD, 21% had a Masters and more than a quarter had bachelor degree. 89% used CDC definitions for surveillance, others used modified "McGreer" or "McGreer" definitions. Targeted surveillance was used most frequently for specific infections (86%) and specific organisms (82%). In rank order the most frequent infections surveyed were UTI, LRT, URT, skin and soft tissue, BSI primary, BSI secondary, GIT, SSI and eye.</p> <p><b>Evidence grading:</b> Descriptive</p>
(Struelens, Wagner et al. 2006)	<p><b>Research purpose:</b> To assess the organisation, resources and elements of infection control programmes in hospitals in Europe.</p> <p><b>Method:</b> Survey composed in English and completed by self selected sample of participants who had accepted invitations mailed from a professional membership directory.</p> <p><b>Sample size:</b> 169-acute care hospitals from 32 countries</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> No</p> <p><b>Findings:</b> Almost all hospitals had infection control committees. 79% of hospitals had infection control nurses who were specifically trained in infection control. Median ratio was 2.33 infection control nurses/ 1000 beds Median IC Doctor ration was 0.94/1000 beds. This is insufficient compared to SENIC and Canadian recommendations.</p> <p>Almost half of the hospitals had link/ liaison nurses. Almost ¾ had formal annual objectives and progress reports which in two thirds of hospitals were reviewed by senior management. 75% undertook surveillance and 66% reported regularly to the infection control committee. Problems implementing policies were reported by most hospitals.</p> <p>Self selection biases this sample and gives over representation of teaching hospitals.</p> <p><b>Evidence grading:</b> D</p>

(Gordts 2005)	<p><b>Research purpose:</b> Not stated.</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Belgium law decrees minimum requirement of 2.5 FTE ICNs per 1000 beds and 1 FTE IC physician.</p> <p>Since 2002 Belgian hospitals are organised by 9 regions which includes all hospitals in the same province, this facilitates synergistic projects and work practices.</p> <p>Since 2004 the ICC has a legal responsibility to:</p> <ul style="list-style-type: none"> <li>• Develop, implement and monitor organisation-wide strategy for standard and isolation precautions;</li> <li>• Survey HCAs</li> <li>• Develop and implement outbreak management</li> <li>• Follow up logistics relating to IC</li> <li>• Implement national IC guidelines</li> <li>• Contribute to and exchange with regional platforms</li> </ul> <p>Staffing recommendations need to consider beds, strategic objectives, organisational complexity and patient mix.</p> <p><b>Evidence grading</b> OP/EC</p>
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<p>(Quattrin, Pecile et al. 2004)</p>	<p><b>Research purpose:</b> To report existence and activity of Italian ICNs in national Health System hospitals.</p> <p><b>Method:</b> Structured questionnaire completed by hospital health directors.</p> <p><b>Sample size:</b> 463 hospital health directors</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Not stated</p> <p><b>Findings:</b> More than half of the hospitals had an ICN but less than a quarter had a FTE ICN. Almost half of the hospitals spent &gt; 7 infection control hrs a week per 100 beds.</p> <p>In rank order the tasks most frequently under taken by ICNs were nosocomial infection surveillance, health care personnel education, waste management, outsourcing contracts management, hospital infection control study groups management, application of law concern prevention risk on the job, environmental hygiene, sterilization guidelines/protocols definition, secretary activity, consultations on hospital infection control problem, data management and other activities. Some of these tasks are not related to infection control.</p> <p>Non-homogeneous approach to IC. Authors call for establishing specific targets and related budgets. Vocational training is the norm.</p> <p><b>Evidence grading D</b></p>
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(Spencer and Perry 2004)	<p><b>Research purpose:</b> Editorial commentary</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Outlines key UK government initiative including an action area relating to Management and Organization.</p> <p>This involves designation of a Director of Infection Prevention and Control responsible for:</p> <ul style="list-style-type: none"> <li>• oversee local control of infection policies and their implementation;</li> <li>• be responsible for the infection control team within the healthcare organization;</li> <li>• report directly to the Chief Executive and the Board and not through any other officer;</li> <li>• have the authority to challenge inappropriate hygiene practices as well as antibiotic prescribing decisions;</li> <li>• assess the impact of all existing and new policies and plans on infection and make recommendations for change;</li> <li>• be an integral member of the organization's clinical governance and patient safety teams and structures; and</li> <li>• produce an annual report on the state of healthcare-associated infection in the organization(s) for which he/she is responsible and release it publicly.</li> </ul> <p><b>Evidence grading:</b> OP/EC</p>
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(Watterson 2004)	<p><b>Research purpose:</b> Description of a 2-year project to improve infection control within a UK Trust</p> <p><b>Method:</b> Service was reviewed and indicators were developed at a stakeholder workshop and IC team expanded.</p> <p><b>Sample size:</b> 1 NHS trust including facilities over 3 sites</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Under the Controls Assurances Standard on Infection Control there are 16 criteria one of which requires development of key indicators.</p> <p>This trust assessed and revised their IC program and held a stakeholder workshop to develop appropriate indicators to assess their program. Developed a five pillar model (practice, environment, corporate governance, performance measurement and surveillance).</p> <p>Also reduced size of ICC and frequency of meetings. IC team was expanded and liaisons with specific "modern matrons" implemented.</p> <p>Using the indicators assisted harnessing commitment of senior management and agreement on performance measures.</p> <p><b>Evidence grading:</b> D</p>
(Reed, Gorrie et al. 2003)	<p><b>Research purpose:</b> Describes the organisation of infection control in Australian.</p> <p><b>Method:</b> Commentary</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Identifies major drivers as state governments, NMHRC, Australian Council for safety and Quality in Healthcare, AICA and Standards Australia.</p> <p>Suggests that in public hospitals the ICC oversees the IC programme, monitoring HCAs and developing policy. Essentially same structure in private hospitals. No accepted minimum standards or professional criteria for ICPs.</p> <p>Recommends move from state to national initiatives in two areas – national surveillance and centralised, federally funded reference laboratory.</p> <p><b>Evidence grading:</b> D</p>

***Literature addressing question 4***

(Roup, Roche et al. 2006; Anderson, Kirkland et al. 2007)	<p><b>Research purpose:</b> Estimate the cost of HCAs in a network of community hospitals.</p> <p><b>Method:</b> Literature review of published HAI cost estimates and survey of 28 hospitals.</p> <p><b>Sample size:</b> 28 community hospitals in the US.</p> <p><b>Risk adjustment/ confounders controlled for:</b> Partial control.</p> <p><b>Confidence interval:</b> Inter-quartile range reported.</p> <p><b>Findings:</b> The annual budget of most IC programs substantially less than the total cost to the hospital per year for HAIs. Median cost of HAIs was 4.6 times the budget for prevention and 8.5 times the amount per hospital paid to ICPs. Economics of HAIs needed as a metric. Literature reports citing usefulness of various prevention efforts is scant and reports of sustainability even less frequent. Need for much more additional research to explore the potential return on investment for infection prevention.</p> <p><b>Evidence grading:</b> O+</p>
(Griffiths, Renz et al. 2008)	<p><b>Research purpose:</b> To define organisational and management influences on infection control in inpatient settings.</p> <p><b>Method:</b> Scoping review of published direct evidence.</p> <p><b>Sample size:</b> Review of 34 articles</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> SR</p> <p><b>Findings:</b> To effectively reduce healthcare associated infections leadership is needed at ward level and by administration. Support for training, review and clinical governance is also necessary. Actions should target identifiable organisational risk factors.</p> <p><b>Evidence grading:</b> OP/EC</p>
(Edmond and Eickhoff 2008)	<p><b>Research purpose:</b> Discussion of trends and influences on infection control programs.</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p>

	<p><b>Findings:</b> Suggest that hospitals are facing greater levels of accountability, transparency and expectation that solutions will be rapid.</p> <p>Hospitals need to target all pathogens and specific local problems rather than succumb to external mandates. There is increased demand for hospital epidemiologists and insufficient time allocated.</p> <p>ICPS should upskill in teamwork development and implementation of interventions.</p> <p>Annual review of IC resources is necessary.</p> <p><b>Evidence grading:</b> OP/EC</p>
(Koteyko and Nerlich 2008)	<p><b>Research purpose:</b> To identify problems challenging the British model of “modern matrons” and their ability to prevent and control infections.</p> <p><b>Method:</b> Compared and contrasted the documented policies regarding the role and semi structured interviews.</p> <p><b>Sample size:</b> 11 policies and 11 semi structured interviews.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Modern matrons were given some empowerment but were still not empowered to change clinical behaviours of other professionals and/or the organisational culture.</p> <p>Competing interests limited the modern matron's visibility on the wards (a major Research purpose of the model).</p> <p>Significant challenge is finding balance between managerial and clinical tasks, interpersonal skills and authority over financial resources.</p> <p><b>Evidence grading:</b> Q</p>
(Murphy, Carrico et al. 2008)	<p><b>Research purpose:</b> To detail proposed elements of idealised future state and systems for infection prevention.</p> <p><b>Method:</b> Think tank-like process.</p> <p><b>Sample size:</b> Not stated.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Organisations need to accept:</p> <ul style="list-style-type: none"> <li>• clear guiding principle that no patient should experience a preventable infection;</li> </ul>

	<ul style="list-style-type: none"> <li>• behaviours that increase infection are not tolerated &amp; every infection or near-miss should be investigated;</li> <li>• Everyone recognises their accountability and responsibility to prevent HAIs;</li> <li>• Compliance and adherence is expected</li> <li>• CEOs clearly articulate expectations, set metrics for achieving goals and ensure adequate resources</li> <li>• Empowerment includes being able to stop activity that may increase infection risk</li> <li>• Transparency promotes rapid problem solving</li> </ul> <p>Local learning includes:</p> <ul style="list-style-type: none"> <li>• Real time infection surveillance and access to information;</li> <li>• Clear, concise, understandable and usable measures;</li> <li>• IC included in educational curricula and competency-based training of all HCWs</li> </ul> <p><b>Evidence grading:</b> OP/ EC</p>
(Haas 2006)	<p><b>Research purpose:</b> To explore the state of the science for performance measurement of IC departments.</p> <p><b>Method:</b> Literature review of strategies used to measure infection control department characteristics and performance.</p> <p><b>Sample size:</b> 12 articles</p> <p><b>Risk adjustment/ confounders controlled for:</b> Inclusion criteria specified.</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Papers were time management studies, expert opinion, outcome studies or reports of international models.</p> <p>Time management studies poor and reported ICPs working at 130% capacity. Need to include a process variable that measured the impact of IC activities.</p> <p>Delphi study recommended 1 ICP per initial 100 beds after which needs changed. Two consensus statements were general and lacked recommendation on measurement of the performance or effectiveness of IC programs or their cost-effectiveness.</p> <p>NNIS study from 2000 that in more than 200 hospitals surveyed the median ICP was one per 115 beds, 96% had at least 1 ICP per 250 beds.</p> <p>Study of Western regional hospitals reported 1.56 for every 250 beds with almost half of the hospitals having a paid physician working on infection control. This was important as it studied differences in rural hospitals.</p> <p>Need for updated studies testing the relationship between infection rates and staffing levels/ responsibilities.</p>



	<p><b>Evidence grading:</b> R</p>
(Roup, Roche et al. 2006)	<p><b>Research purpose:</b> To determine current resources and practices to identify potential assistance that the Health Department may offer.</p> <p><b>Method:</b> Self administered questionnaire sent to all inpatient facilities in Maryland.</p> <p><b>Sample size:</b> 27 acute care facilities, 247 long-term care facilities and 11 speciality organisations.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> No</p> <p><b>Findings:</b> Vast differences in ICP staffing, for &lt;200 beds level was 1.6 FTE, &gt; 200 beds had mean of 2.0 FTEs which was strongly correlated with acute care beds. In LTCF with 25-550 beds mean ICP was 0.3 FTE. ACHS had ICPs reporting to quality improvement programs whereas in LTCF most reported to nursing. Most ICPs had responsibility for activities outside of their facility but within the system. All speciality and acute care hospitals had at least one ICP who basic training whereas only 8% of ICPs in LTCF had training.</p> <p><b>Evidence grading:</b> D</p>
(Stricof 2005)	<p><b>Research purpose:</b> Report on surveys of IC program resources and responsibilities in New York state in 1999 and 2004.</p> <p><b>Method:</b> Mailed survey to IC in all acute care hospitals.</p> <p><b>Sample size:</b> 1999 N=202 and 2004 N=167</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Not stated</p> <p><b>Findings:</b> ICP ratio was 1 per 195 beds in 1999 and 1 per 150.5 in 2004. In 2004 most (32%) IC programs were integrated into quality assurance programs. Specific responsibilities included employee health, central supply, staff education, risk management, emergency preparedness and quality assurance. Bloodstream infections were the most frequently surveyed HAI, followed by surgical site infections, pneumonias and urinary tract infections.</p> <p><b>Evidence grading:</b> D</p>
(Voss 2005)	<p><b>Research purpose:</b> To gather information on curricula for IC physicians.</p> <p><b>Method:</b> Questionnaire survey of countries in European Society of Clinical Microbiology and Infectious Diseases Study Group on Nosocomial Infections.</p>

	<p><b>Sample size:</b> 12</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Discusses the absence of formal training and speciality recognition for IC doctors in Europe especially. The standard average for IC physicians and ICNs from 12 European countries (Australia, Belgium, Switzerland, Germany, Spain, UK, France, Hungary, The Netherlands, Poland, Serbi-Monte-negro and Turkey) was 1.2 IC physicians and 3.4 ICPs per 1000 beds. Participants requested increases for an ideal IC team to be 1.8 IC doctors, 4.2 ICPs and 3.3 other workers per 1000 beds. Proposes a 6-year post graduate medical training for IC doctors and mandatory continuing education or post-graduate study for doctors and nurses in the field.</p> <p><b>Evidence grading:</b> D</p>
(Cookson, Teare et al. 2004)	<p><b>Research purpose:</b> Report of a workshop convened to propose a job description for an infection control doctor.</p> <p><b>Method:</b> Workshop and facilitated discussion.</p> <p><b>Sample size:</b> Not reported</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Currently recommend 1/3 FTE ICD per hospital, recommended that the position account to the Chief Executive in regard to agreed target and Medical Directors. Agreement that infection control budgets need to be reviewed and are required.</p> <p>Focus not on targets but specific deliverables from education, surveillance, audit and risk management activities.</p> <p><b>Evidence grading:</b> OP/EC</p>
(Croxson, Allen et al. 2003)	<p><b>Research purpose:</b> Report of nationwide survey of United Kingdom ICPs regarding organisation and funding of IC programs.</p> <p><b>Method:</b> National postal survey of all ICNs and ICDs in English NHS hospital trusts.</p> <p><b>Sample size:</b> 176 ICNs and 93 ICDs from 200 institutions.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Not stated</p>

	<p><b>Findings:</b> Less than 50% of respondents had separate IT held budget. Few respondents felt that the ICC functioned well to help secure funding for IC. Centralised mechanisms had largely failed. In some institutions ICPs are not given central role in decision making and therefore have limited influence.</p> <p>Suggestion that improving organisation and practice of IC can reduce rates between 15-30%</p> <p><b>Evidence grading:</b> D</p>
(Olesen 2001)	<p><b>Research purpose:</b> Discussion regarding the importance of Australia adopting a clinical governance framework for IC.</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Observes that national leadership is lacking and unclear leading to ambiguity. Identifies that as non-members of the clinical care team, ICPs often have little influence on health practices. Call for programs to be targeted and outcome focussed. Requirement that scope of programs be defined and interrelationships between programme and patient outcomes explored.</p> <p><b>Evidence grading:</b> OP/EC</p>
(Murphy and McLaws 2001)	<p><b>Research purpose:</b> Describe administrators and clinicians responses to affirmative statements regarding the role of the ICP.</p> <p><b>Method:</b> mailed survey for self completion.</p> <p><b>Sample size:</b> 349 clinicians and 238 administrators.</p> <p><b>Risk adjustment/ confounders controlled for:</b></p> <p><b>Confidence interval:</b> Yes</p> <p><b>Findings:</b> More clinicians than administrators agreed that an effective IC program required a trained hospital epidemiologist in addition to an ICP and one ICP per 250 beds.</p> <p>Administrators were reluctant to fully appreciate or understand the objectives and importance of IC programs. Significant disagreement between clinicians and administrators regarding infrastructure and reluctance to agree where additional spending was required.</p> <p><b>Evidence grading:</b> D</p>

### ***Literature addressing question 5***

<p>(McGuckin, Shubin et al. 2008)</p>	<p><b>Research purpose:</b> To determine if nurses and ICPs know of and take responsibility for developing, implementing and monitoring protocols for evidence-based care.</p> <p><b>Method:</b> Electronic survey of 1776 ICPs and 1178 nurses attending their respective annual professional meeting in 2004-2005.</p> <p><b>Sample size:</b> 453 respondents.</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> Not stated</p> <p><b>Findings:</b> Conclude that the clinical impact of basic nursing practices needs to be understood in relation to measurement/ benchmarking and cost savings. CEOs and administrators need to be educated about this relationship.  Recommends better partnership between clinicians/ IC and administration and greater ownership of respective responsibilities.</p> <p><b>Evidence grading:</b> D</p>
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(Murphy, Carrico et al. 2008)	<p><b>Research purpose:</b> To detail proposed elements of idealised future state and systems for infection prevention.</p> <p><b>Method:</b> Think tank-like process.</p> <p><b>Sample size:</b> Not stated.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> The ideal IP system includes the following components:</p> <ul style="list-style-type: none"> <li>• Infection prevention is integrated into every health care worker's job description.</li> <li>• Rewards and incentives are provided for preventing infections.</li> <li>• Prevention is designed into the ideal patient room.</li> <li>• Infection prevention education is standardized for all health care workers.</li> <li>• The APIC broadens links to educators and other health care associations to partner on eliminating HAIs.</li> <li>• Performance improvement is a major aspect of the ICP's job description.</li> <li>• "Touchless" patient care technologies and alert/messaging systems are designed with infection prevention in mind.</li> <li>• Infection prevention functions and behaviours are standardized across health care settings.</li> <li>• Prevention strategies are "pulled" from the front-line health care workers when needed.</li> <li>• The emphasis on infection prevention is unified and organized in partnership with industry.</li> </ul> <p><b>Evidence grading:</b> OP/ EC</p>
(Sieber 2008)	<p><b>Research purpose:</b> To describe the integration of Patient Safety and Quality components into a traditional Infection Control Liaison Program.</p> <p><b>Method:</b> Report</p> <p><b>Sample size:</b> 1 hospital</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Redesign of Infection Control Liaison Program to include Risk Management, Patient Safety, Quality Improvement, Performance Measurement, Medical Staff Services, Environmental Health and Safety, and Occupational Health increased the range of information that could be distributed and increased participation in the program.</p> <p><b>Evidence grading:</b> OP/ EC</p>

<p>(Herwaldt, Appelgate et al. 2007)</p>	<p><b>Research purpose:</b> To assess current responsibilities and resources of ICPs in Iowa.</p> <p><b>Method:</b> Initial 28-question survey distributed at state-wide infection control meeting for immediate self completion. Subsequent targeted phone survey about infection control resources at critical access hospitals.</p> <p><b>Sample size:</b> 104 acute care hospitals (Survey 1) and 67 critical access hospitals (Phone Survey 2).</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> No, range only.</p> <p><b>Findings: Survey 1:</b> ICPs had mean 9 years experience. Less than 30% were certified. Almost all used CDC surveillance definitions. Smaller facilities did whole of hospital surveillance as size increased trend towards targeted surveillance. Responses to what would make job easier were surveillance software (29.5%), more time or staff (20%), education or access to educational resources (17%) and electronic medical records (9%).</p> <p><b>Survey 2:</b> ICPs had a mean of 9.7 years experience and &lt; 10% were certified.</p> <p>Substantial variation in surveillance methods and extent so mandatory public reporting may not provide meaningful data.</p> <p><b>Evidence grading:</b> D</p>
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(Pellowe 2007)	<p><b>Research purpose:</b> To review the United Kingdom's national response to HAIs.</p> <p><b>Method:</b> Review of key government initiatives.</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> 2003 UK government endorsed active surveillance and investigation, reducing reservoirs and management and organization. 2004 publication of epic evidence-based Guidelines based on systematic review of all current government guidelines. Realisation that implementation equally important thus developed Clinical Government Support Team programme from 2003-2005 to make organizational differences involving multi disciplinary teams. Initiatives included cultural change, enabling and use of networks.</p> <p>2007 provision of e-learning modules. 2006 also mandated Healthcare Commission to act as a "watchdog", annual appraisal and award performance ratings. Managers been directed to ensure that effective prevention and control is embedded into everyday practice and applied consistently. Core set of 12 policies must be in place. Multiple tools in place to assist hospitals to meet the demands of the Code.</p> <p><b>Evidence grading:</b> OP/EC</p>
(Simpkins, D'Alena et al. 2006)	<p><b>Research purpose:</b> Describe local liaison program</p> <p><b>Method:</b> Project report</p> <p><b>Sample size:</b> Two facilities in an integrated health care system.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Liaisons became IC resources for their areas. Liaisons also assisted by identifying barriers to successful implementation of IC practices and enhanced leadership to overcome same. Several ICPs indicated an interest in a career in infection control.</p> <p><b>Evidence grading:</b></p>

## Literature addressing question 6

(Hobbs 2007)	<p><b>Research purpose:</b> To investigate the scope of practice of Victorian ICPs.</p> <p><b>Method:</b> 2-day workshop where 12 “expert” ICPs brainstormed to develop a curriculum - DACUM technique.</p> <p><b>Sample size:</b> 12 “expert” ICPs</p> <p><b>Risk adjustment/ confounders controlled for:</b> No</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Substantial variation in workplace titles and reporting lines. Ten identified duty areas were:</p> <ol style="list-style-type: none"> <li>1. Administrative duties</li> <li>2. Policy and procedure development</li> <li>3. Minimise transmission risks</li> <li>4. Surveillance coordination</li> <li>5. Adverse event management</li> <li>6. Outbreak management</li> <li>7. Immunisation</li> <li>8. Education</li> <li>9. Professional development activities</li> <li>10. Provision of expert advice</li> </ol> <p>Authors also report a matrix of knowledge, skills and behaviours consistent with national nursing organization’s model.</p> <p>Reporting lines are problematic both upwards (due to lack of understanding by line manager of ICP’s role and scope) and downwards to and from liaison nurses.</p> <p><b>Evidence grading:</b> D</p>
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***Literature addressing question 7***

(Barnes, Nennig et al. 2007)	<p><b>Research purpose:</b> To report the development of a standard infection prevention and control preceptor program.</p> <p><b>Method:</b> Report.</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Expanding role of ICP, high vacancy rate and limited experienced staff required the development of a standardised internal training program for preceptors. The program lead to reduced vacancy rates.</p> <p><b>Evidence grading:</b> OP/EC</p>
(Dusmohamed, Wilkinson et al. 2006)	<p><b>Research purpose:</b> To summarise the approach used to develop a communication model for infection control in rural and remote health services in South Australia.</p> <p><b>Method:</b> Use of various enquiry methods (interviews, field visits, and forum) by South Australia Health Department to investigate and work with local stakeholders to explore possibility of implementing a centralised model for infection control communication.</p> <p><b>Sample size:</b> 1 Project Coordinator and senior administrators from 7 rural regions.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Hospital infection control programs were “ad-hoc”, uncoordinated, performed in isolation and without links to metropolitan services or peers.</p> <p>ICPs had insufficient time allocated for infection control and often performed multiple roles in addition to infection control.</p> <p>Interviewees supported regular meetings of a regional network and recognised how it would assist standardised regional surveillance, policy development, networking and strategic planning.</p> <p><b>Evidence grading:</b> D</p>

(Vaughan and Randle 2005)	<p><b>Research purpose:</b> Not stated</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Link nurse not an ICN substitute and should only undertake specific duties. Critical to success of their role is identifying their educational needs and development. A portfolio of practice and learning assists their learning and acts as a tool to explore areas of concern.</p> <p><b>Evidence grading:</b> OP/EC</p>
(Cooper 2004; Cooper 2004)	<p><b>Research purpose:</b> To identify if using an action research approach led to improvements in clinical practice.</p> <p><b>Method:</b> Participants applied to join the link nurse program. 20 participated in reviews and audits of hand hygiene related processes and reported quarterly to the ICN.</p> <p><b>Sample size:</b> 20 link nurses.</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Improvements in processes were noted. Link nurses felt ownership of clinical level infection control. Knowledge and confidence of link nurses improved. Competing workload demands was problematic.</p> <p><b>Evidence grading:</b> Q</p>
(Dawson 2003)	<p><b>Research purpose:</b> Discuss link nurses</p> <p><b>Method:</b> N/A</p> <p><b>Sample size:</b> N/A</p> <p><b>Risk adjustment/ confounders controlled for:</b> N/A</p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> Link Nurses are well placed at ward level to observe and influence colleague's practice. They are a valuable resource as they raise IC profile and improve communication, teaching and potentially research. Links require a specific training programme. Problems include overwhelming clinical workload and need for sustained management support. Link nurses may not also have appropriate authority.</p> <p><b>Evidence grading:</b> OP/EC</p>

<p>(Geary, Allworth et al. 2003)</p>	<p><b>Research purpose:</b> Report of infection control scoping and model implementation in Central zone of Queensland.</p> <p><b>Method:</b> Survey and scoping exercise as well as focus groups.</p> <p><b>Sample size:</b> 17 health service districts (12 regional/ rural and five metropolitan)</p> <p><b>Risk adjustment/ confounders controlled for:</b></p> <p><b>Confidence interval:</b> N/A</p> <p><b>Findings:</b> IC responsibilities and practices were diverse as were the types of qualifications of staff performing IC role. Links between aligned services were poor. Participants identified a range of processes and resources that they perceived would improve their programs including communication for outbreaks, signal surveillance, IC management plans and better networking, professional development and better information technology especially for rural and remote areas. Suggested matrix included development of a zonal coordinator role to standardise practice and support collaboration across the zone.</p> <p><b>Evidence grading:</b> D</p>
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