CONTENTS

In This Issue

This is the third and final issue for 2018. We continue in transition from publishing three issues a year to the concept of publish as ready. This has resulted in delays to processing and publishing, so we extend our apologies to both authors and readers. We currently have some twenty articles in review and delays are also occurring in this area in finding willing and receptive reviewers. We would appreciate authors suggesting reviewers as they submit articles.

On behalf of Yaping Liu we extend seasons greetings to you all and look forward to a first in 2019 in our new livery!

In this issue the editorial alerts you to our interest in articles that might address lessons learned from over twenty-five years of health reform. Most of us have experienced that reform what have been the lessons learned for you? The editorial also provides insights to proposed reform and transformation of PHC services in Hong Kong. This Report is a valuable reference point for us all irrespective of the health system in which you work.

Our first article is a review article by Karalis and Barbery that suggests that implementing high reliability organisation principles can enhance safety and quality in healthcare. They undertook a systematic review that suggests that this is a slow and challenging process to implement but does suggests positive results.

Pain and colleagues provide us with a research article that evaluates the state-wide implementation of an allied health workforce redesign system utilising the Calderdale Framework. The context is Queensland and they define and discuss key factors in the implementation redesign.

James and colleagues provide a research article to assist in guiding local quality improvement in a children's intensive care unit in Victoria, Australia. They undertook a significant retrospective study over an extended period. They emphasise that the risk of adverse events in a Paediatric Intensive Care Unit (PICU) is high and that the monitoring of these events as part of quality improvement enables targeted interventions to improve patient safety.

Isouard and Martins provide a research article that examines the characteristics of health service managers and the changes in those characteristics over a decade from 2006 to 2016. The findings traverse the trends across groups of health managers over time suggest areas for further research and provide opportunities to those interested to use the data in other research over time.

Screenu from India provides us with a research article that examines health care infrastructure development in rural India. It provides insights to the reader into how services are organised and structured in rural India and the challenges they face in improving both access, workforce and quality of those services.

Finally, Yaping provides our much appreciated library bulletin to assist you in selecting your further readings.

David Briggs

Editor

Asia-Pacific Journal of Health Management ACHSM

Editorial

Health Reform: What have we learned and were to next!

Recently I was talking to a colleague of mine from Hong Kong and he reminded me that Hong Kong had had 28 years of health reform. A period just slightly longer than we had known each other. We are deeply imbued in the management and organisation of health services and health systems and, therefore public health policy. He suggested that there should be a lot of learning for us all from that period and, he was exploring how that might happen. I agreed with the idea and the need to think it through. I also recognised potential for the Journal to play some role in that suggestion. Most national health systems have undergone extensive reform so there should be a lot of learning for all of us from that reform.

The discussion is at a time when Honk Kong has released a health system research report titled 'Fit for Purpose: A health System for the 21st Century - Research Report' published by the 'Our Hong Kong Foundation'. [1] I was drawn to this Report substantially as a result of the above discussions, secondly because of my contact and familiarity with the Hong Kong health system and because it does not take long, only a few pages, before you appreciate that the central theme of the Report is a proposed transformation and focus on primary healthcare (PHC) for Hong Kong. Not only that, it is replete with international context, frameworks, models and case studies around this topic. It adds newer language of health reform for us to consider, something of interest to the author of this editorial. [2] The Report context is sufficiently broad for it to be relevant in a range of national health systems. I commend the document to you for more detailed reading and reference.

In addressing the need to transform PHC the Report states that we need to change the health system to be 'fit for purpose'. The challenge is, can the system meet its intended purpose? It refers to changing contexts, needs, knowledge and technologies. It talks of transforming to primary care - led integrated care. [1, p.3] The Report talks about supporting 'all of our citizens over their life course' [1, p.4], re-orientating the health system for the "community of persons" [1, p.5] and a system where 'patients are facilitated to take ownership over their own health'. [1, p.5]

The Hong Kong health system, like many others are addressing the challenge of fragmentation in health systems, unbalanced and segmented provision, inadequate medical-social collaboration and community care. Themes explicit in the qualitative data of the Report are that healthcare is not keeping pace with changing needs and this is when the science, technology, diagnostics, communication and service models enables services to be more accessible in communities. A further theme was the critical aspects of financing, funding and payment systems as critical tools to facilitate systems operation, reduce barriers and improve governance. [1. P,53-71] Another suggestion that piqued my interest was the suggestion that primary care-led integrated person-centred models of service delivery be organised around primary care hubs nested within community networks'. I think both virtual and as entities. Again, this editor is a supporter of networks of practice as an approach to cross sectorial boundaries and to bring service providers and access to services together.

The Hong Kong health system, despite some of the Report content is well regarded and this venture into PHC led reform is consistent with some of the positivity about that system and consistent with international trends. One of the key authors is Professor Eng Kiong Yeoh, GBS, OBE, JP who is currently Professor of

Public Health, Director at the JC School of Public Health and Primary Care of The Chinese University of Hong Kong and Head of Division of Health System, Policy and Management. He was the first Chief Executive of Hong Kong Hospital Authority and former Secretary for Health, Welfare and Food of the HKSAR Government. Together with colleagues he has presented us with rich data, international content, case studies and the qualitative perceptions of stakeholders. The Report calls for responses and discussions, but the Chief Executive of Hong Kong Carrie Lam is already moving in the direction of the Reports key recommendations and is committed to enhancing district-based primary healthcare services.

No doubt there will be interesting debates about the proposals within Hong Kong. However, the concept of district health services is a notable feature of progressive health systems such as that of Thailand where strategy, policy and research is at the national level and service delivery is at the local district level and, increasingly involving cross sectorial approaches. For PHC to be successfully transformed it needs to be underpinned by community engagement and be consistent with theoretical concepts of localism and the principle of subsidiarity. [3]

My challenge to you in writing this editorial is firstly to encourage you to read the Hong Kong Report. Secondly to alert you to the fact that we intend to encourage articles in 2019 that might provide us with reflections and learnings from the history of health reform. Given my interest in the language of health reform I would also suggest that you should delve into that language to add into your writing some of my favourite terms – 'what problem are we attempting to resolve' [4] – whose interests are being served [5] and now are our health systems, services and organisations and are we 'fit for purpose'. [1]

DS Briggs

Editor

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The Common Barriers and Facilitators for a Healthcare Organization Becoming a High Reliability Organization

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ABSTRACT

Background: Implementing high reliability organization principles can enhance quality and safety in healthcare. Evidence-based instructions on how to effectively change the organizational culture in healthcare setting are required.

Objectives: A systematic review investigating methods, facilitators, and barriers to assist healthcare organizations in becoming a high reliability organization.

Method: Literature searches were performed in PubMed, MEDLINE, CINAHL-Complete, EMBASE, and Scopus for articles published between January 2012 and October 2017. The included articles were case reports, case studies, and protocol development studies on implementing high reliability organization principles. The articles were appraised using a modified Critical Appraisal Skills Programme tool. Thematic synthesis was conducted using manual coding.

Results: Of the 14 eligible articles nine were case studies, four were case reports, and one was a framework development report. The study populations varied from whole healthcare systems to a single department of a hospital. The most common methods were supportive leadership, staff education, and analysing the safety events and sharing the knowledge. Cost was one of the barriers. Remuneration came in reduction of safety events and costs avoided.

Conclusion Implementing high reliability organization principles in healthcare settings is slow and challenging, but doing so improves quality, resilience, and safety, thus increasing productivity.

Keywords: high reliability organization, healthcare, quality improvement, patient safety, medical error.

INTRODUCTION

Improving patient safety and quality of care is a high priority within the healthcare organizations. However, there is a long way to go. Medication errors cost $1.2 billion annually to the Australian hospital system. [1] Furthermore, it has been estimated that one third of deaths in USA are due to medical errors and [2] about 40% of patient injuries in hospitals are preventable. [3]

Some organizations manage risks better than others. A distinctive characteristic to all high reliability organizations (HRO) is that they operate in uncertain, high-risk environments

without serious accidents. [4] Furthermore, they prioritize safety over other performance pressures and create an environment in which potential problems are anticipated, detected early, and responded to early enough to prevent serious consequences. [4]

The five principles of HROs' are: preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise. [5]

Organizations preoccupied with failure understand that even small errors can be clues of bigger failures in the system. Thus, they encourage people to ask questions and report errors or mistakes. [6] Furthermore, they recognize the expectations and situations where practices are performed may fail. [7] These situations include recent changes in supervision, delegation of tasks without follow-up, shortage of staff, and lack of proper communication between the staff. [8]

HROs resist simplifying explanations to problems. Instead, they develop more complete, detailed, and wider view of the situation. [9] HROs are sensitive to operations by supporting the routine work in front line, and by viewing near-misses as opportunities to better understand what went wrong and how it could be prevented in the future. [10-12] HROs are committed to be resilient in unexpected situations. [13] They can preserve functioning despite the presence of adversity, they recover from untoward events, and learn from previous unexpected events. [14, 15] HROs defer to expertise when an accident has happened. That means the authority migrates to the people with most knowledge and experience instead of those highest in hierarchy. [16-18]

HROs are able to achieve the balance between safety and production. HROs and healthcare organizations both operate in uncertain, high-risk environments. Adapting HRO principles in healthcare can help healthcare organization to improve their safety and quality performance. [19] The amount of published reports of applying HRO principles in healthcare is slowly increasing but to our knowledge, there is no current systematic review of the common barriers and facilitators for HRO principles in healthcare.

The aim of this systematic literature review is to provide a knowledge synthesis of HRO processes in healthcare and thus help the leaders in healthcare organizations to decide whether to pursue HRO status. The specific objectives for this literature review are 1) to discover the means to achieve HRO status, 2) to detected possible challenges, and 3) to evaluate the long-term benefits a health care organization can gain by achieving and maintaining the HRO status. The conclusions in this systematic literature review are based on 14 peer-reviewed journal articles published during the last five years.

METHODS

The systematic literature review focused on identifying common barriers and facilitators of healthcare organizations successfully transitioning to a high reliability healthcare organization by addressing the following questions:

1. How can a healthcare organization achieve a HRO status?
2. What are the long-term benefits of maintaining HRO status?

Search strategy

A PRISMA systematic literature review framework was used to increase the transparency and reliability of the review. [20] The literature search was conducted in PubMed, MEDLINE, CINAHL-Complete, Embase and Scopus databases in order to uncover medical, international biomedical, and management literature. The search was conducted between 4 November 2017 and 6 November 2017. PICOS framework was used for developing focused literature search strategies. PICOS stands for population, interest, comparison, outcome, and study design. [21] In this case, population was healthcare organizations. Interest was implementing high reliability concept and comparison was the situation before the change. Relevant outcomes were to understand the approaches, challenges and benefits health care organizations have had while implementing high reliability concepts.

The search terms included: HIGH + RELIABILITY + ORGANIZATION, HIGH + RELIABILITY + ORGANIZATIONS. Where possible, the exclusion criteria were used for limiting the search in databases. To include as many relevant articles as possible, further resources were detected by scanning bibliographies of matching articles and by using “similar articles” function in PubMed and “related documents” function in Scopus. The journal articles found during searching were stored and organised in Endnote X8 software (Clarivate Analytics, USA).

After removing the duplicate articles, titles and abstracts of studies were screened for potential eligibility. The articles that met the inclusion criteria were selected and entered to the final analysis. Full texts of potentially eligible studies were retrieved for final analysis in which the articles were assessed against the inclusion and exclusion criteria. The studies rejected from final analysis were not clearly relevant to the subject of this review or were not accessible online.

Eligibility criteria

The literature review focused on the key requirements for successful transition process and the long-term influences. Thus, the included articles are case reports, case studies, and a protocol development study. Expert opinions and comments were excluded as well as editorials because of their low quality of evidence. For convenience, articles had to be published in English and be available in electronic format. Other formats and languages were excluded. Only peer-reviewed journals were included because they have a degree of control and credibility. To ensure currency, the review focused on literature produced within the last five years (between 1 January 2012 and 31 October 2017). Articles had to focus on implementing the HRO principles in healthcare. (Table 1)

Table 1. Inclusion and Exclusion criteria applied in the review.

Criteria	Inclusion	Exclusion
Population	Healthcare organization	Organizations outside healthcare
Interest	High reliability organization concept	Not related to high reliability organization concept
Study design	Systematic literature review Case report Case study Development of protocol	Expert opinion Expert comment Literature review
Publishing date	1.1.2012-30.11.2017	Before 1.1.2012
Language	English	Non-English
Availability	Full text available online	Full text not available online

Data extraction and quality assessment

The following data was abstracted from the articles; title, author, year, characteristics and location of the organization, study design, type of intervention, outcome measures and their definition according to individual studies, follow-up time, the author(s) conclusions, and study limitations. (Table 2 and Table 3)

The quality of the included studies was evaluated by using a modified CASP cohort study checklist (Critical Appraisal Skills Programme, United Kingdom). [22] This evaluating tool was chosen because most of the selected articles are observational cohort studies and this tool is easy to use. (Table 3)

Synthesis of results

This systematic literature review used thematic synthesis to conceptualise the collected information of the included articles because the original articles did not address the research questions directly. In thematic synthesis, after data extraction, the data is coded to descriptive themes and finally, analytical themes according the study questions are developed. [23] Thematic synthesis was conducted using manual coding whereby the selected papers were read line by line and coded into themes.

Table 2. Characteristics of the included articles.

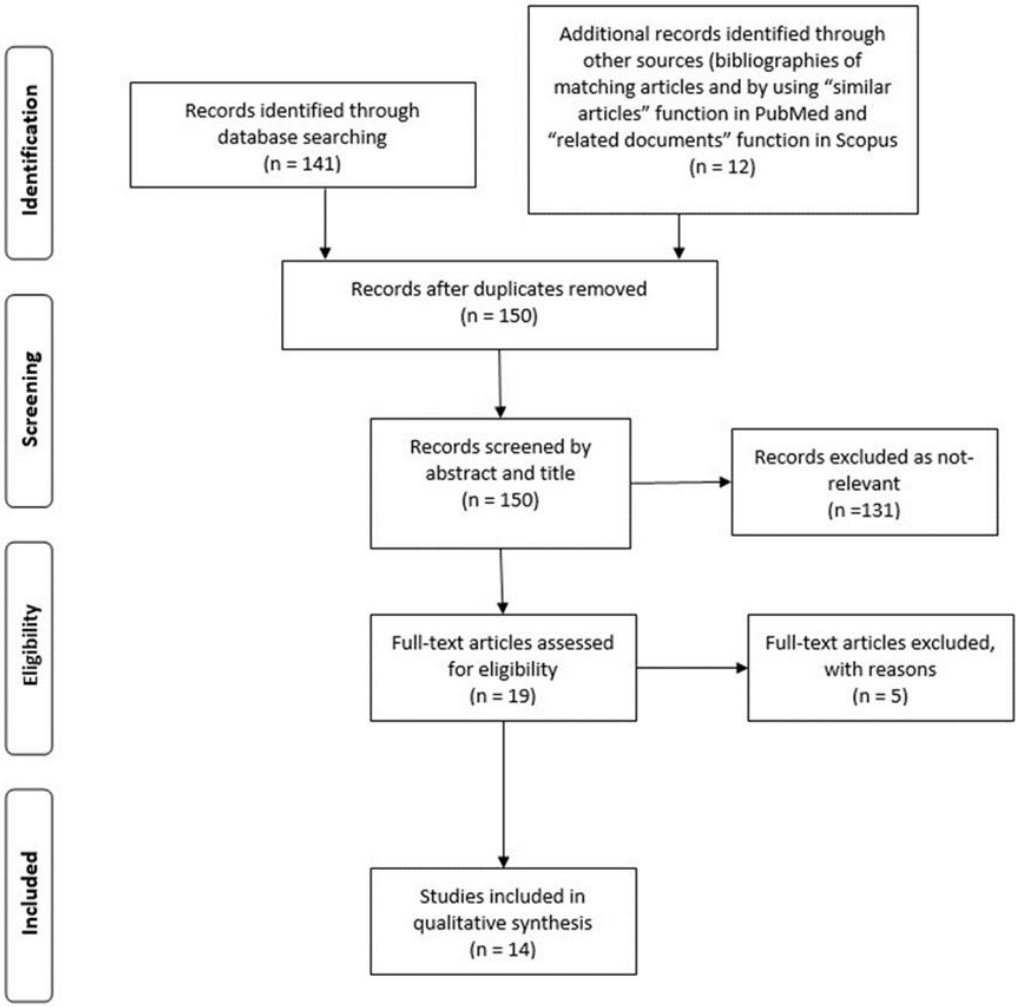
Reference number	Study	Study design	Follow-up time	Country	Population
33	Aboumatar et al., 2017	Case report	9 years	USA	1 academic medical centre
28	Brilli et al., 2013	Quasi-experimental time series	3 years	USA	1 Urban Hospital
37	Chassin & Loeb, 2013	Iterative testing to develop a framework	n/a	USA	Hospital leaders
29	Hales et al., 2012	Participatory action research using prevention-appraisal-failure method	1 year	USA	5 intensive care units in 1 hospital
35	Hendrich & Haydar, 2017	Case report	6 years	USA	1 healthcare system in different states
32	Hilliard et al., 2012	Case study	3 years	USA	1 hospital
24	King et al., 2017	Case study	1 year	USA	54 different military healthcare providers and hospitals
30	Lyman et al., 2017	Participatory action research using learning history method	n/a	USA	1 intensive care unit
25	Lyren et al., 2016	Case study	3 years	USA	6 tertiary care hospitals
31	Muething et al., 2012	Case study	4 years	USA	1 urban hospital
27	Peterson et al., 2012	Case study	1 year	USA	1 hospital
34	Pronovost et al., 2015	Case report	3 years	USA	A 40-site primary care practice, 8 ambulatory surgery centres, 2 home healthcare companies, an insurance company, and an international health company that manages over 14 hospitals around the world
36	Saunders & Brennan, 2017	Case report	9 years	USA	11 hospitals
26	Woodhouse et al., 2016	Case study	5 years	USA	Radiation oncology department at a university hospital

Results of the literature review

The initial literature searches generated 153 journal articles. After removing duplications, 150 articles remained. These articles were screened by abstract and title, reducing the list to 19 articles. After applying inclusion/exclusion criteria to the full text of these articles, the number of articles in the final literature review was 14. The PRISMA flow diagram guided this process. [20] (Figure 1.)

All the included articles were from the United States. Nine articles were case studies, [24-32] four articles were case reports [33-36], and one article was a framework development report. [37] The study population varied from whole healthcare systems covering several hospitals [24, 34, 36] to a single department of a hospital. [26, 30] The follow-up time varied between one and nine years. (Table 2) None of the included articles fulfilled all the modified CASP checklist criteria. Most of the articles demonstrated deficits in identifying confounders and considering them in the study design. (Table 3)

Figure 1. Prisma flow diagram.



Thematic synthesis of the results

The synthesis of results identified nine themes for interventions: supportive leadership, introducing reporting system, analysing safety events and sharing the knowledge, staff education, development of patient safety and quality team, implementing evidence-based practices and standardized processes, hiring people fit to the culture, incorporating information technology, and implementing the five concepts of HRO (unspecified).

Six themes for measuring the outcomes were identified: safety culture, employee engagement, safety events and hospital acquired conditions, cost, number and duration of equipment failures, and patient experience. (Table 4)

In addition, three main themes for facilitators and five themes for barriers for a health care organization becoming a HRO were identified. The facilitators were: fewer safety events, less hospital acquired conditions, and cost avoidance. The barriers were: measuring wrong outcomes, choosing wrong interventions, different disciplines do not co-operate, financial barriers, and increased workload. (Table 4) The themes are discussed in detail below.

Interventions

The key factor, found in the literature, for successfully transforming to a HRO is support from the leaders. Leaders should be role-models and coaches for the staff. [26, 30, 33, 37] This requires education in specific methods to continuously reinforce error prevention behaviour and change management. [25, 33, 37] Many organizations demand their executives to have education in Lean/Six Sigma models. [33, 34, 36] All leaders should be engaged in structured safety rounds, implement routine safety huddles, and participate in organizational safety briefings. [25, 32] Leaders should work closely with the budgeting team for budgetary decisions to be in line with departmental and organisational quality and safety goals. [32, 33, 37] To assess the return on investment, business cases for each target variable should be developed. Ideally, the business case defines the problem and opportunity for each target variable, identifies root causes, and estimates costs and savings. [24]

Another necessary act is to implement an on-line reporting system for adverse outcomes, near misses, and risky situations. [24, 26-28, 32, 33, 37] Then, baseline on the selected outcome variables should be measured so that progress can be monitored, and resources appropriately deployed. [24, 25] After, a root cause analysis process should be implemented to identify and rectify causes of errors. [25-28, 31-34, 36, 37]

An important part is mandatory education for the staff and students. [28, 32, 37] The goals are to improve knowledge regarding human errors and to raise awareness of high-risk situations. [26, 30, 31, 33] Furthermore, separate training modules teamwork and communication skills are useful. [31, 34] Education is also required to implement certain safety behaviours such as standardized handoffs, safety checks, and peer- and self-checking. [25-27, 30, 36] The tools and skills learned should be reinforced through constant practice, and regular feedback by safety coaches. [25, 27, 30, 31]

Table 4. Thematic data synthesis.

Analytical themes	Descriptive themes	Reference number
INTERVENTIONS		
Supportive leadership	Education of leaders	24, 25, 30, 32, 34
	Participating leaders	25, 32
	Role models and coaches	26, 30
	Budget reallocation	24, 30, 33, 35
Introducing reporting system		24, 26, 27, 28, 31, 32, 33
Analysing safety events and sharing the knowledge	Sharing the results	24, 25, 27, 30, 31, 32, 33, 35
	Root-cause analysis	25, 26, 27, 30, 31, 32, 33, 34, 36
	Observing and analysing risky situations	28, 31, 34
	Open disclosure	35
	Direct feedback	30
	Audits	30
	Huddles	25, 30
	Peer review	26, 32
Staff education		24, 25, 26, 27, 28, 30, 31, 32, 34, 36
Development of patient safety and quality team		28, 31
Implementing evidence-based practices and standardized processes	Check-lists	26, 36
	Identifying roles, practices and	24
	Standardized processes	32, 36
	Evidence-based practices	24
Hiring people fit to the culture		30, 36
Incorporating information technology		30, 36
Implementing five concepts of high reliability organization mindfulness		29
OUTCOME MEASURES		
Safety culture		26, 27, 28, 31, 32, 33
Employee engagement	Attendance to education	26, 33
	Documentation of the care plan	36
	Accuracy in medication history collection	36
	Number of failed nurse-supervisor	29
	Improper notification of physician	29
Safety events and hospital acquired conditions	Organizational quality and safety objectives	33, 34, 36
	Patient harm index	25 28
	Adverse drug events	24, 27, 28
	Unnecessary blood transfusions	30
	Length of intubation time	30
	Asthma core measures	27
	Hospital mortality	28
	Number of patient discharged alive	29
	Serious safety event	24, 26, 27, 28, 31, 32, 33
	Hospital acquired conditions	24, 27, 28, 30, 34, 35
Cost	Per domain of harm	28
	Per patient	29
	Cost avoidance	24, 32
	Average bed occupancy	29
	Patient length of stay	29, 36
Number and duration of equipment failures		29
Patient experience		29, 34
FACILITATORS		
Fewer safety events		25, 27, 28
Less hospital acquired conditions		24
Cost avoidance		24
BARRIERS		
Measuring wrong outcomes		26
Choosing wrong interventions		24
Different disciplines do not co-operate		34
Financial barriers		25, 29, 34
Increased workload		33

Measuring the impact

The review identified several things that can be measured to monitor the change. Each unit should choose the ones most suitable and descriptive. To track the overall process and encourage the staff to sustain the change, the improvement rate can be calculated by comparing the current quarter's or six months´ rate to the baseline. [24, 37] Different safety events and hospital acquired conditions are the most used measurements. [24-35] Another common measure is change in safety culture. [26-28, 31-33] Staff engagement can be measured for example by measuring the education level of the staff. [26, 33]

Facilitators for a health care organization becoming a HRO

The article by King et al. reports almost 16% decrease in hospital-acquired conditions and approximately 13.5 million US dollar cost avoidance in two years. [24] Lyren et al. report 40% reduction in serious harm events in five years, [25] while Peterson et al. report 68% reduction in serious safety events already after one year. [27] Hilliard et al. report 70% reduction in serious safety events after three years. [32] The article by Brilli et al. reports 85% decrease in the number of serious safety events per three months and they estimate that cost of preventable harm decreases 22% for calendar year in three years after implementing the new HRO strategy. [28]

Barriers for a health care organization becoming a HRO

The articles report several challenges to develop a HRO. An approach to developing a HRO that works in one unit might not work in another one even within the same organization. [24] It is important to choose carefully what to measure in each unit. For example, if serious safety events are rare, it takes a long time to prevent one event and thus, it takes long time to see the difference. To keep the staff motivated it would be better to measure something that occurs more frequently such as hospital acquired conditions. [25] Each unit should be involved in determining how to implement processes and protocols in practice. [24] Chassin and Loeb have developed a framework with 14 components for the healthcare organizations toward a HRO status. [37] Organizations can use this model to check their current stage of maturity in four different levels and plan the next steps. [37]

Healthcare organizations are multidisciplinary teams and people should have knowledge of many different disciplines to effectively collaborate. Careful attention should be paid on training so that disciplines complement rather than compete. [34] After education, staff requires longitudinal learning opportunities that incorporate mentorship and coaching to effectively apply taught concepts and methods within their work environment. [33]

Time and cost are challenges to many organizations. Especially, because it takes more than a year to see benefits in cost. [29] Thus, it is important to align the HRO development targets with financial targets from the beginning. [24] Detection of the development targets and properly collecting the base values are the foundation of the HRO process. [24] However, it can be very time-consuming. [25] Another situation where time is required is education. Time to attend education requires someone else doing the job of those away or work to be postponed. [33] Moreover, education itself costs and often, more staff must be hired to implement the new strategies. [25, 34]

DISCUSSION

The findings of the systematic literature review of 14 articles suggest several interventions in

all organizational levels for healthcare organizations to achieve HRO status. The most common types of interventions are Staff education, supportive leadership, creating a reporting system, and analysing the safety events and sharing the knowledge. [24-28, 30-36] The main barriers for organizations are time, cost, and focusing on wrong methods and outcomes. [24, 25, 27, 28] Benefits come in reduction of serious safety events and cost avoidance. [24-26, 29, 33, 34]

Staff education is especially important in healthcare organizations because the high workforce turnover rate creates a demand for constant education and induction for new workers. [38] Supportive leadership decreases the turnover rate and increases employee engagement in change. [39, 40] The importance of supportive leadership can be seen in circumstances where there is a lack of support. Healthcare workers routinely observe unsafe conditions, behaviours, and practices, but often fail to bring those problems to information. [41] One reason is the intimidating behaviour healthcare workers are exposed when reporting safety problems. [42] In fact, the leading system-based cause for errors is a culture in which concerns are not reported because of the fear of intimidation. [27]

Another situation when support is required is after education of HRO principles, when the staff discovers that things are not as they seem and that there is much to learn. In units where there is not much problems with adverse events, the staff turnover rate and exhaustion can increase if the staff does not understand the reason for change. [43] However, in an environment where patient harm has been a recognized problem before, the safety process decreases exhaustion and staff turnover rate because now they have tools to solve the problems. [43]

Even though root cause analysis was used in several of the selected articles it should be implemented with caution. It is important to understand that reasons for errors can be very complex and using a simple root cause analysis might not detect them all. [44] Furthermore, root cause analysis is useless if risks detected are not properly eliminated and if the feedback loop does not work. [45] However, together with opportunity analysis, root cause analysis can demonstrate possible cost savings. [46]

Adverse events in healthcare are a huge problem worldwide, with medical errors being the 14th leading cause of morbidity and mortality in the world. [47] Moreover, it is estimated that 15% of the hospital expenditure in OECD countries is spent on treating medical errors. [48] To support healthcare leaders in making medical care safer, this systematic literature review answers to the demand for evidence-based recommendations for healthcare leaders on how to transform healthcare organization to a HRO. [49] The methods detected here are considered crucial in creating a safe healthcare environment. [50]

The literature review has some limitations. The quality of the selected papers was not high. Most of the articles included are case reports and case studies, and all are from the United States. Furthermore, most of the articles do not consider confounding factors possibly influencing the results. These factors can influence the reliability and generalisability of the results. Another limitation is that studies might have been excluded from the review due exclusion of articles not available online and published in other language than English.

In conclusion, based on the evidence gathered in this analysis, and within the study limitations, the journey towards becoming a HRO is challenging but cost effective. It is important to educate the future leaders to create an atmosphere of trust where everyone with their skills and knowledge is appreciated and encouraged to question, ask, and report problems. To support an evidence-based journey towards HRO status in healthcare, future studies should focus in healthcare settings outside the United States and attention should be paid in study design, methods, and identification of confounding factors.

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Table 3. Quality assessment of included studies a.

Study	Clear focus	Representative population	Exposure accurately measured to minimise bias	Outcomes accurately measured to minimise bias	Important confounding factors identified	Confounding factors considered in design and/or analysis	Complete enough follow-up	Preciseness of the results	Reliability	Generalisability
Aboumatar et al., 2017	+	+	-	-	-	-	+	-	-	+
Brilli et al., 2013	+	+	+	+	-	-	+	+	+	+
Chassin & Loeb, 2013	+	-	-	-	-	-	n/a	n/a	n/a	+
Hales et al., 2012	+	+	+	n/a	+	-	+	+	+	+
Hendrich & Haydar, 2017	+	+	-	-	-	-	+	-	-	+
Hilliard et al. 2012	+	+	+	+	+	-	+	+	+	+
King et al., 2017	+	+	+	+	-	-	+	+	+	+
Lyman et al., 2017	+	+	+	+	-	-	+	+	+	+
Lyren et al., 2016	+	+	-	+	-	-	+	+	+	+
Muething et al., 2012	+	+	+	+	-	-	+	+	+	+
Peterson et al., 2012	+	+	+	+	-	-	+	+	+	+
Pronovost et al., 2015	+	+	-	-	-	-	+	-	-	+
Saunders & Brennan, 2017	+	+	-	-	-	-	+	-	-	+
Woodhouse et al., 2016	+	+	+	+	-	-	+	+	+	+

[a]Modified from CASP cohort study check list (CASP, Critical appraisal skills programme, 2017)

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Evaluation of the State-Wide Implementation of an Allied Health Workforce Redesign System: Utilisation of the Calderdale Framework

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ABSTRACT

Background: Increasing demand for allied health services is driving workforce redesign towards greater productivity within budgetary constraints. To date, there has been limited research into workforce redesign tools at an organisational level. The aim of this article was to evaluate an implementation of The Calderdale Framework for state-wide service delivery workforce redesign within allied health settings across Queensland.

Method: A multi-phase methodology with mixed methods of data collection was used. This included analysis of documents, staff surveys, and semi-structured, in-depth interviews with staff from work units utilising the Framework across the state.

Findings: The primary mechanisms for implementation were staff training and provision of centralised resources. Across the state, all health services engaged in training and most completed associated workforce redesign projects. However, the number and type of projects varied across the state as did the successful projects. Feedback from staff indicated the structured nature of the framework was viewed positively, but was time intensive to perform. Local contextual factors heavily influenced workforce redesign success.

Conclusion Key factors pertaining to state-wide workforce redesign include: providing coordinated and centralised systems to support staff, ensuring adequate training, prioritising the development of key local staff, and proactively managing local contextual factors.

Keywords: allied health, workforce redesign, evaluation

INTRODUCTION

Allied health professionals are key service providers within Australian health care settings. As with other providers, they face numerous challenges to respond to current and future health care needs. Issues such as ageing populations, increased rates of long term chronic illness, higher consumer expectations, increasingly complex treatment technologies, and the pressure to maintain safety and quality are widely reported.[1] Such challenges necessitate more streamlined processes, a more flexible workforce, and greater productivity (while improving quality and managing budgetary constraints).[2] Allied health managers and policy makers may respond by identifying strategies to maximise impact and effectiveness of allied health professionals and their practice.

Promising strategies to maximise the flexibility of the allied health workforce include, delegation of tasks to therapy assistants, [3] and sharing of tasks between different allied health professions. [4] However, implementing these strategies is challenging for numerous reasons, including limited staff engagement, the absence of frameworks and insufficient guidelines. [5]

Examples of service or workforce redesign exist, although the broader implications of implementing them are rarely presented or explored. [6] This is surprising, given the substantial financial, human and organisational resources involved to implement the changes. [6] Despite inclusion of successful contextual factors for change (e.g. effective leadership, meaningful evaluation and attention to the organisational and the cultural context), [6] many workforce redesign initiatives were not sustained. Therefore, sustainable change may require a comprehensive framework with clear and specific strategies.

The Calderdale Framework (CF) may be such a framework. CF is a tool to facilitate safe and effective workforce redesign within multi-disciplinary teams. [1] It is a seven-step, clinician-led process, used to improve the way a healthcare team works with specific focus on planning and implementing therapy assistant roles and/or inter-professional skill sharing. [1] CF provides a mechanism for workforce redesign through a formal, risk managed and structured framework. It includes systematic methods for service and task analysis, to assist in developing new roles, identifying new ways of working, and facilitating service redesign. CF is underpinned by three levels of training: Foundation, Facilitator and Practitioner; each reflecting increasing levels of expertise.

CF was chosen by the Allied Health Professions' Office of Queensland (AHPOQ) to facilitate workforce redesign for new models of care. CF was offered to all 16 Hospital and Health Services (HHS) across the state with the opportunity to opt-in to have their staff trained and/or to have CF projects implemented within their services. The aim was for state-wide coordination, including support networks, sharing of resources, and training, leading to standardisation of workforce redesign across the state.

Aims and objectives

The aim of this study was to evaluate the implementation of CF across Queensland Health between 2011 and 2015 by documenting the context and mechanisms of implementation as well as the associated outputs, at both a state-wide and HHS level. Specific questions to be addressed were: 1) Is

CF fit for purpose as a tool for workforce re-design and reform; 2) Does training and workforce development processes support implementation of the CF; and 3) Are the support systems and processes (e.g. documents and resources, coordination/communication) appropriate for state-wide and local implementation of CF?

METHODS

Methodology

This evaluation was conducted between July 2015 and April 2016. The evaluation was commissioned by AHPOQ via a competitive process to: assess the performance of CF structure and approach as an enabler of local workforce re-design; and guide decisions by AHPOQ about continuation or amendments to state-wide implementation. Governance of the evaluation included oversight by the Chief Allied Health Officer or Project Lead, the establishment of a steering committee of Directors of Allied Health in participating HHSs.

The evaluation was based on the concept from realist evaluation [7] to understand what causes change. The evaluation was a retrospective examination of the initial CF implementation in Queensland from 2011 – 2015 and used a multi-phase, mixed methodology for data collection. Methods included: an email survey of CF-trained staff, qualitative analysis of training documents, and semi-structured, in-depth interviews with AHPOQ staff, CF-trained staff, and clinicians and managers from work units using CF.

Insights into the mechanisms of CF implementation across Queensland Health were obtained through review of key documents, and via interviews with AHPOQ staff. The process of CF implementation, including training, coordination, network management, and the provision of support was documented. State-wide contextual factors and outputs were noted alongside CF training and project completion across the dispersed HHSs from AHPOQ records and survey outcomes.

In-depth interviews were conducted using a purposive sample of relevant stakeholders to explore local mechanisms, contextual factors and outputs of CF implementation across the state. In total, 18 interviews were completed from eight HHSs as shown in Table 1. Interviews were conducted with six facilitators, five managers, four clinicians and three practitioners.

Each interview focussed on local CF projects including discussion of the aims, outcomes, barriers and strategies. Interview questions explored components of the framework as a workforce redesign tool. The interviews were completed and recorded by the project officers, ranging from thirty minutes to one hour. Participants were provided with a unique code to reflect their involvement with the various CF projects. These included CFTS for CF trained staff (both facilitators and practitioners), CFMA for managers of CF projects and CFCL for clinicians without formalised training who participated in a CF project. Interviews were transcribed verbatim for thematic analysis.

Table 1 – Qualitative interview participants sample

HHS	Context	Practitioner	Facilitator	Clinician	Manager
1	Community		√	√	√
2	Hospital		√	√	√
3	Subacute Rehabilitation		√	√	√
4	Inpatients / Outpatients		√	√	√
5	Hospital	√	√		√
6	Community		√		
7	HHS-wide	√			
8	HHS-wide	√			

An online survey of 36 CF facilitators across the state identified factors relevant to local CF projects. Survey questions included:

- Project location, aims and focus
- Project dates and information about early cessation
- Funding received
- Average time spent on implementation
- Outputs, outcomes, service delivery changes implemented or anticipated
- Sustainability of workforce changes over time

Survey data and training databases were analysed using frequency counts. Qualitative data was analysed thematically by two members of the evaluation team (SP and a research assistant) using NVivo Software to code and categorise data. Initially, SP (a trained CF Facilitator) and the research assistant examined one of the transcripts together to code key concepts from interviews and establish agreement on the coding process. Next, several transcripts were coded separately, then reviewed together to ensure consistency of coding practice. The project officer (SP) examined the remaining transcripts using the agreed processes. Finally, the project officer and research assistant discussed the codes, grouped data into categories and formed the main themes across the interviews. SP's CF experience allowed the analysis to be completed within context, while the research assistant was new to the framework providing independence in coding.

Ethical approval for the study

Approval was granted by The Prince Charles Hospital Research, Human Research Ethics and Governance Unit (HREC/15/QPCH/227) on 26th August 2015. The opt out process allowed Directors of Allied Health across the state to exempt their HHS from the project. No HHS refused to participate

RESULTS

Mechanisms for CF Implementation

The primary mechanism for state-wide implementation of CF was training. Initial training at Foundation and Facilitator level was provided to 53 and 22 staff respectively by Effective Workforce Solutions (CF license holders) in 2011 and three staff were provided the advanced Practitioner level training. Newly trained Practitioners provided ongoing Facilitator training and subsequent Foundation level training was provided by in-house CF Practitioners or Facilitators within the HHSs. Two CF Practitioners allocated a proportion of their time to CF implementation supported by their HHS and the other CF Practitioner was an AHPOQ staff member with allocated time to support implementation. Table 2 contains details of staff training by year. Interest in CF Foundation and Facilitator training was sustained over the data analysis period with course completion rates improving over time.

Table 2 – CF staff training numbers by year

		CF Facilitator Training			
	Number of staff that completed CF Foundation Training	Number of staff that completed CF Facilitator Training	Number of staff that commenced but did not complete CF Facilitator Training	Number of staff still completing CF training at time of review	Number of staff that completed Practitioner Training
2011	53	8	14	-	2
2012	22	6	4	-	-
2013	20	5	3	-	1
2014	37	-	-	22	-
2015	40	-	-	9	-
Totals:	**172**	**19**	**21**	**31**	**3**

The secondary mechanism of CF implementation was the establishment of a centralised system for monitoring CF, sharing resources, training coordination, and peer support. These systems were:

- Coordination, administration and review of the CF Facilitator training.
- Coordination of the development and validation of clinical task instructions (CTIs) plus their publishing and distribution.
- Production of information sheets and guidelines.
- Establishment of the CF Facilitator support network.
- Managing communication and CF enquiries.

Qualitative data demonstrated the centralised support provided by AHPOQ was integral for projects at local levels. Interviewees also acknowledged the value of the state-wide CF facilitator network during their projects. Some HHSs also established local CF Facilitator networks, if sufficient Facilitators, to share ideas and provide peer support. Respondents discussed the benefit of shared resources, e.g. local / draft clinical task instructions (CTIs) and training packages, through the shared network drive with many using existing CTIs for their local projects. Pre-existing CTIs were invaluable because they reduced implementation time and burden on clinical staff. An example statement was: 'We've got numerous CTIs, either formalised or in development or being used in HHS, that we can draw on because we've got the network' (CFTS9)

Staff conducting local projects found CF a structured workforce tool to provide practical steps to follow throughout implementation. Interviewees reported the framework, as well as the associated tools, guided challenging conversations about professional roles and boundaries. An example statement was: 'I actually see that The Calderdale provides the framework that actually supports that conversation, because I've seen that conversation outside of a Calderdale framework and it is messy'. (CFMA5)

The time required to implement the CF process was a significant challenge reported by staff. Service redesign through the seven stages of CF was highly structured and detailed, which meant attending to every detail took considerable time. An example statement was: 'I feel like quite a raw process because we've had to go back to basics and look at all the different aspects of clinical care that we need to make sure that everyone's aware of because it hasn't been done before. So that in itself has been a big task' (CFCL2).

Direct and indirect CF activities were necessary, but time-intensive. The direct workload of implementing CF itself was time-intensive but additional time was required for arranging meetings, aligning diaries for staff to attend CF-related meetings, and building staff engagement in the CF process. An example statement was: 'It's been really challenging I think, to routinely be able to set aside the time' (CFTS7).

Formal project and evaluation plans were key success factors of CF implementation. Project plans that included details regarding governance, time lines, anticipated outcomes, facilitator roles and team expectations were considered superior. Evaluation plan was considered important to establish credibility and clear outcomes: 'So the evaluation was important all the way through mostly for the credibility and reporting side but also just to monitor how things were going.' (CFTS2). Interviewees commented that CF did not equip

clinicians with skills for project management and evaluation (such as managing difficult conversations and managing change), and may have reduced project completion rates.

Context

CF training across the state is shown in Table 3. All HHS had at least one staff member attend Foundation training, 15 of the 16 HHSs had staff attend Facilitator training and two HHS had CF Practitioners. The third CF Practitioner was an AHPOQ staff member. All CF Practitioners were employed in unrelated roles, meaning CF activities were performed in addition to their substantive role.

The state-wide organisational restructure was the primary contextual barrier identified by staff during interviews. Queensland Health was decentralising to a regional HHS structure during the time CF was implemented across the state. This restructuring was perceived to confounded engagement in CF by 'change-weary staff' resulting in a negative impact on CF implementation and project completion rates. Two example statements were: 'We've since had more restructure and operational reporting lines for the game changed and so, you know, a few complexities around all of that. (CFTS7)'; 'The biggest problem is that we're asking people to change and the very change weary and change wary involvement. I'm asking people to just change one more thing. At the moment in Queensland that is a very big ask.' (CFMA1)

Two additional contextual barriers to local engagement in CF were identified from the interviews. First, high turnover of staff and numerous others on parental, or other leave meant continual orientation and awareness-raising for new staff was required to maintain staff engagement. Many new staff were in acting positions. An example statement was: 'It's all very well and good, we might do this and put some time into training someone but they might then leave and then we start all over again, and how do we manage the workload of the team that's associated with that.'(CFTS5). Second, defensiveness around specialist positions, teams and roles was identified. Staff raised concerns that dilution of professional autonomy and identity may occur with skill sharing. An example statement was: 'But that was the team being very rigid and wanting to be perceived as a high specialist team. So, they were more difficult to get to embrace the skill sharing.' (CFTS1).

The number and location of CF projects across the state is shown in Table 4. Most HHSs commenced one or two projects, and HHS with higher numbers of CF trained staff tended to initiate a greater number of projects.

Table 3 - Calderdale Framework training outputs by HHS / Division (Oct 2011 – Nov 2015)

HHS / Division	Calderdale Framework Practitioners	Foundation workshop participants	Facilitator training program			
			Commenced	Completed workshops and all assessment	Not yet completed assessment or left Queensland Health	In training period between workshops
HHS-1		2	3	0	1	2
HHS-2		20	5	1	1	3
HHS-3		12	6	2	1	3
HHS-4		1	2	0	2	0
HHS-5	1	23	5	2	0	3
HHS-6		8	3	1	1	1
HHS-7		1	0	0	0	0
HHS-8		1	2	0	1	1
HHS-9		1	4	1	1	2
HHS-10	1	47	10	5	0	5
HHS-11		23	11	2	5	4
HHS-12		3	4	2	1	1
HHS-13		5	6	2	3	1
HHS-14		4	4	1	0	3
HHS-15		14	2	0	1	1
HHS-16		7	3	0	2	1
AHPOQ	1	0	0	0	1	0
Totals	**3**	**172**	**71**	**19**	**21**	**31**

Table 4 - Calderdale Framework projects reported by HHS (Oct 2011 – Nov 2015)

HHS / Division	Total number of Facilitators / Practitioners (who commenced training)	Total Calderdale Framework Projects Implemented	Completed Calderdale Framework Projects	Ceased Calderdale Framework Projects	Ongoing Calderdale Framework Projects
HHS-1	3	2	0	1	1
HHS-2	5	3	1	2	0
HHS-3	6	2	2	0	0
HHS-4	2	1	0	1	0
HHS-5	6	6	3	0	3
HHS-6	3	2	1	1	0
HHS-7	0	0	0	0	0
HHS-8	2	3	1	0	2
HHS-9	4	1	0	1	0
HHS-10	11	10	4	1	5
HHS-11	11	6	2	4	0
HHS-12	4	1	0	1	0
HHS-13	6	2	1	0	1
HHS-14	4	1	0	1	0
HHS-15	2	1	0	0	1
HHS-16	3	2	0	1	1
AHPOQ	1	AHPOQ Practitioner's projects were reported in HHS-1 (1), HHS-2 (1) and HHS-7 (1) HHS data			
TOTAL	**74**	**43**	**15**	**14**	**14**

Structured workplace processes associated with CF were perceived as positive outcomes. Interviewees noted there was a benefit from a sense of confirmation brought about by the CF processes. An example statement was: 'It was just nice to kind of have it in writing, to know that you're doing the right thing and that somebody else had ticked you off and that sort of thing' (CFCL1).

Interviewees discussed improved efficiencies, such as reduced length of stay and fewer hospital readmissions resulting from their projects. Greater efficiency was reported in the survey. An example statement is: 'I think is the outcome that's the most valuable in terms of efficiency, that any part of that Calderdale framework frees the clinician up to do tasks that can't be delegable and to do the things that they should be doing and tasks that can be delegated can be delegated to someone who was more appropriate. So, for me it's always the efficiency' (CFMA3).

Improved staff satisfaction and enhanced skills and abilities were reported as benefits of CF implementation. 'And they also felt that it enhanced their own skills, they felt a lot better, you know, to be able to deliver more to patients and that it wasn't really cumbersome or burdensome doing that.' (CFTS1).

Qualitative data revealed two additional outcomes which were not primary outcomes of CF. They were: improved team dynamics; and a cultural shift towards greater acceptance of skill sharing and delegation practices. The cultural change manifest as a greater understanding, awareness and acceptance of skill sharing and delegation. An example statement was 'But really it was a culture change for the staff of how they're going to work' (CFMA4). An improved understanding of other professional roles within the team, and increased communication between allied health staff and improved teamwork was reported. For example: 'They really felt that they were having a lot more team awareness, a lot of more open lines of communication.' (CFTS6)

DISCUSSION

This evaluation explored the mechanism, context and outcomes of CF implementation in Queensland Health. It is the first evaluation of implementation of CF at a state-wide level. The intent of introducing CF in Queensland Health was to provide a framework for workforce projects to enhance allied health service delivery. The findings suggest state-wide coordinated training as a primary mechanism to implement CF was successful, as was the establishment of centralised support systems. Despite consistent uptake of training, contextual factors such as organisational restructure challenged local implementation. CF was perceived as a strong facilitator of workforce change.

A key mechanism of implementation was training by CF Practitioners to build capacity, and maintain sustainability. This mechanism agrees with the literature regarding system-based workforce redesign. [6] The central organisation of capacity building and training allowed Facilitators to be trained in all but one HHS. Ongoing interest in CF training remains strong with numerous staff commencing CF training in recent cohorts and continuing to enrol since the completion of this evaluation. The number of facilitators trained, or in training, suggests substantial 'change

commitment' by the individual HHSs. Change commitment is an indicator of organisational readiness for change and leads to a collective capability to change. [8] The centralised systems and resources provided by AHPOQ endorses the work of McGrath and colleagues [9] who noted that clinical redesign processes can successfully scale up to a state-wide approach with due attention to careful planning and centralised systems.

Some external contextual factors were possibly a barrier to consistent implementation of CF across the state. During implementation, Queensland Health was administratively devolving to newly established regional HHSs. The devolvement caused significant service delivery changes as individual HHSs developed their own priorities. Some HHS also experienced significant structural changes leading to 'change weary' staff. Devolvement was a barrier to project completion because of less time, ability and staff motivation to participate in CF projects. Devolvement may have contributed to the proportionately lower completion rates of Foundation and Facilitator training from early cohorts compared with later cohorts.

Various internal contextual factors contributed to inconsistency of CF implementation across the state with projects in some areas flourishing and others struggling. Key staff in individual HHSs where CF workforce change was achieved, seemingly had considerable influence over the uptake of training and implementation. Therefore this 'top down' support at a local level, combined with a groundswell of newly trained CF staff resulted in a blended 'top down-bottom up' approach which facilitated completion of CF projects. [5] Potentially, key staff used local knowledge and personal relationships to enable project 'buy-in' by clinicians involved with the workforce change project in turn providing mentoring and support to build capacity building in regional or rural areas. [10] In addition, key local staff in some of the regional and rural HHSs may have close working relationships with executive management providing top down assistance with project support and commitment.

There were common challenges to overcome in all HHS regardless of whether they flourished or struggled. These challenges included staff retention / turn-over, staff attitudes, and the time intensive nature of CF. The perception was that the detailed structure of CF was an enabler, but following the seven steps was a barrier due to extensive time requirements. The time commitment may have contributed to the low project completion rate. Fifteen projects were completed, plus several ongoing projects at time of review. Outcomes of completed projects have resulted in workforce redesign as expected by the framework developers. [1] Maintaining staff engagement along the time-consuming redesign process was very difficult suggesting possession of project management skills to overcome this challenge will be required in the future.

LIMITATIONS OF THE STUDEY

The data for this summative evaluation were collected through interviews and surveys with relevant allied health staff. This study was sponsored by the Allied Health Professions Office of Queensland and so perspectives from medicine and nursing were not included and may be a limitation of this study. Future research would benefit from including medicine and nursing to determine if CF was appropriate for health service workforce redesign.

CONCLUSION

State-wide implementation of workforce redesign frameworks such as CF require centralised systems supporting clinicians to develop CF skills, development of key local staff, and the proactive management of local contextual factors. Successful projects were associated with 'bottom-up' processes, which emphasised staff engagement, and local management support. Despite limited ability to make firm conclusions from the outputs arising from state-wide implementation of CF, staff consistently reported positive changes in workplace dynamics.

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Declarations of Interest

All authors are employees of Queensland Health. SP has completed CF Facilitator Training and has published research associated with her local CF project implementation.

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Table 5 - Calderdale Framework projects 2011 - 2015: reported outcomes

Outcome	Number of projects with this reported outcome	Outcome summary across Calderdale Framework projects
Change in waitlist times	**4**	Majority reported decrease in waitlist times
Changes in occasions of service (including new:review)	**5**	Various changes in occasion of service (OOS) reported across projects including - reduced number of speech pathology inpatient reviews reduced OOS in allied health outpatient department statistically significant increase in % new OOS for Physiotherapy and Occupational Therapy staff increased number of allied health referrals increased number of client appointments within same client cost
Changes in task or time and motion (e.g. audit of tasks or time allocated to specific tasks)	**1**	An increased use of existing therapy assistant reported.
Change in health care costs / resource use (excluding travel)	**1**	Improved efficiencies were noted with reduced costs per client appointment noted with an associated increased number of client appointment within a fixed budget constraint.
Change in staff role changes	**7**	Majority reported embedding trans-professional practices within allied health services A few reported an increase in delegation to supporting staff.
Change in clinical outcomes	**2**	A video-conference-delivered, and assistant-supported falls and balance group showed similar outcomes to traditional therapy models. Another project reported that there was no significant difference in clinical outcome between skill sharing and conventional uni-professional practice in a community based elderly population
Changes in staff satisfaction / feedback	**9**	About half the projects reported a general staff satisfaction associated with the new models of care associated with Calderdale Framework implementation, A few specifically reported that Calderdale Framework improved teamwork, communication and understanding of each other's roles, A few projects reported staff satisfaction as indicated by their commitment to the new models of care and their confidence to carry out their new roles within these systems.
Changes in client satisfaction / feedback	**3**	A few projects reported a high client satisfaction regarding the new allied health services, One project reported more specifically that clients experienced improved services and access to care post Calderdale Framework implementation.
Length of stay	**1**	One project achieved comparable outcomes in length of stay between clients admitted on weekends compared with those admitted on weekdays.

Asia-Pacific Journal of Health Management ACHSM

Adverse Events Sustained by Children in The Intensive Care Unit: Guiding local quality improvement

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ABSTRACT

Objective: To determine the frequency, nature and consequence of adverse events sustained by children admitted to a combined general and cardiac paediatric intensive care unit (PICU).

Design: Retrospective analysis of data collected between January 1st 2008 and December 31st 2017 from PICU.

Setting: The Royal Children's Hospital, a paediatric tertiary referral centre in Melbourne, Victoria, Australia. The PICU has thirty beds.

Results: During the study period, PICU received 15208 admissions, of which 73% sustained at least one adverse event with a frequency of 67 adverse events per 100 PICU-days and 3 per admission. One adverse event was sustained for every 35 hours of care. The risk of an adverse event was highest in children less than a month of age, or if mechanically ventilated, a high Pediatric Index of Mortality (PIM2) score, longer PICU length of stay, had a pre-existing disability or a high risk adjustment for congenital heart surgery (RACHS) score. Those patients who sustained an adverse event, as compared to those who did not, were mechanically ventilated for longer (80 hrs Vs. 7 hrs, p=<0.001), had a longer PICU length of stay (131 hrs Vs. 35 hrs, p=<0.001), had a longer hospital length of stay (484 hrs Vs. 206 hrs, p=<0.001) and had a higher mortality rate (3% vs. 0.1%, p=<0.001).

Conclusion: Whilst admission to PICU is an essential aspect of care for many patients, the risk of adverse events is high and is associated with significant clinical consequences. Monitoring of adverse events as part of quality improvement enables targeted intervention to improve patient safety.

Keywords: quality improvement, paediatric, intensive care, adverse events

INTRODUCTION

Critically ill children requiring admission to a pediatric intensive care unit (PICU) are at risk of adverse events; from the procedures and technology associated with critical care medicine, and from their underlying disease and its progression.

Adverse events arising as a consequence of care in an intensive care unit (ICU) were first described by Abramson and colleagues [1] in 1980. Despite improved survival and outcome of critically ill children cared for in PICU, adverse event rates remain high [2-4]. Specific data relating to the nature of adverse events

that occur is needed in order to improve the safety of patients and optimise the quality of care delivered in the PICU.

The aim of this study was to analyse the frequency, nature and consequence of adverse events arising during PICU admission at our institution. We report how the frequency of central line associated bloodstream infection (CLABSI), ventilator associated pneumonia (VAP) and accidental extubation rates, key performance indices reported by most ICUs, changed over the study period to highlight progress in patient safety.

The study received ethical approval from the institutions Human Research Ethics Committee (HREC 34221C).

MATERIALS AND METHODS

The Royal Children's Hospital (RCH), Melbourne serves the population of the States of Victoria, Tasmania and southern New South Wales, Australia. The combined general and cardiac PICU has thirty beds and admitted 1719 patients in 2017 (7593 patient days).

Three dedicated data collection nurses from the PICU quality, data and research team prospectively record data on patient admissions, adverse events sustained subsequent to admission and discharges in the 4D database STATIC, an intensive care specific relational database. Data related to PICU admissions and subsequent adverse events was extracted from 1st January 2008 to 31st December 2017 for analysis. Adverse events were recorded as being major or minor in nature and patients grouped by age, pre-existing function, severity of illness on admission (Paediatric Index of Mortality, PIM2), risk adjustment for congenital heart surgery (RACHS) and by length of PICU stay.

Definitions

An adverse event is defined as an injury resulting from a medical intervention [5,6] or an unfavorable consequence of disease. A list of adverse events was compiled by amalgamating hospital and publically available sources [7,8] (Supplemental Table 1). Adverse events were defined as major if they resulted in significant medical or surgical intervention, permanent disability, or unexpected or preventable death, as decided by routine monthly departmental morbidity and mortality review meetings.

A ventilator associated pneumonia (VAP) was identified using a combination of radiologic, clinical and laboratory criteria in a patient intubated and ventilated within 48 hours of onset, as defined in Victorian State guidelines [9]. Our definition of central line associated bloodstream infection (CLABSI) is a laboratory confirmed bloodstream infection in a patient where a central line is in place for greater than 48 hours, as defined by the Australian Commission on Safety and Quality in Healthcare [10]. We define accidental extubation as a premature and unplanned removal of the endotracheal tube by the action of either the patient or a healthcare professional.

Pre-existing function is assessed at admission using the modified Glasgow outcome score (MGOS), a global assessment tool of independent living and social integration for children older than one month of age [11]. The pre-existing function obtained by the MGOS divides children into five categories: normal, functionally normal (physically and intellectually normal) but requiring medication or medical supervision, mild disability but likely to lead an independent existence, moderate

disability and dependent on care, and severe disability and totally dependent on care.

Statistical analysis

Analyses were performed using Stata v13.1 (StataCorp. College Station, TX). Continuous patient outcomes were compared using Mann-Whitney U tests and binary outcomes using Chi-squared tests.

RESULTS

Over the ten-year period, 10417 patients accounted for 15208 admissions to the PICU. Of all admissions, 73% sustained at least one adverse event during their admission at a frequency of 67 adverse events per 100 PICU-days and 3 per admission (Table 1). One adverse event was sustained every 35 hours of care. Thirteen percent of adverse events were major (Table 2). Major adverse events occurred 8 times per 100-PICU days, 0.4 times per admission and for every 288 hours of care.

Of all patients admitted to PICU during the study period, 10028 (66%) required mechanical ventilation and these patients had a higher incidence of adverse events (57%) compared to those not requiring mechanical ventilation (16%). The proportion of patients sustaining an adverse event was highest in those less than a month of age (89%). The likelihood of an adverse event increased as PICU length of stay increased and adverse events were sustained more frequently in patients with higher RACHS and PIM2 scores as well as higher pre-existing disability (Table 3).

Those patients who sustained an adverse event during their PICU admission, as compared to those who did not, had (if ventilated) a longer mean duration of ventilation (80 hrs vs. 7 hrs, p=<0.001), had a longer mean PICU length of stay (131 hrs vs. 35 hrs, p=<0.001), had a longer mean hospital length of stay (484 hrs vs. 206 hrs, p=<0.001) and had a higher mortality rate (3% vs. 0.1%, p=<0.001)(Table 4). Patients who sustained a major adverse event, when compared to those who sustained none, had an even longer mean duration of ventilation (212 hrs vs. 7 hrs, p=<0.001), had a longer mean PICU length of stay (300 hrs vs. 35 hrs, p=<0.001), had a longer mean hospital length of stay (921 hrs vs. 212 hrs, p=<0.001) and had a higher mortality rate (4.4% vs. 0.2%, p=<0.001) (Table 4). The relative risk of death if any adverse event was sustained was 10.7 (95% CI 6.5 – 17.6) and 28.5 (95% CI 17 – 47) if the adverse event was major.

Supplemental Table 1 outlines the specific adverse events by category and whether the adverse event was the result of a medical intervention or an unfavourable consequence of disease. The relative risk of death if an adverse event was the result of a medical intervention was 19 (95% CI 11 – 32) and 11 (95% CI 7 – 18) if the adverse event was an unfavourable consequence of disease (Supplemental Table 2). The frequency of adverse events by RACHS score, PIM2 score, pre-existing patient function, age and PICU length of stay are detailed in Supplemental tables 3-7.

During the first two years of the study period, the central line associated bloodstream infection (CLABSI) rate on our ICU was 2.75 per 1000 central line days. This decreased to 1.9 per 1000 central line days in the last two years of the study period p>0.05). Similarly, the incidence of ventilator associated pneumonia (VAP) was 3.55 per 1000 ventilator days in the first two years of the study, decreasing to 1.2 per 1000 ventilator days in the final two years

(p>0.05). The incidence of accidental extubation was 0.33 per 100 ventilator days at the beginning of the study period and 0.44 per 100 ventilator days by the end (p>0.05).

DISCUSSION

While sick children undoubtedly benefit from having access to a PICU [12], once admitted they are at risk of adverse events arising from both their illness and the care they receive. In this study, patients less than one month of age, those requiring mechanical ventilation and with high RACHS or PIM2 scores, as well as those with pre-existing disabilities were more likely to sustain an adverse event. Patients who sustained adverse events were found to have longer PICU stays, but we are unable to determine whether longer stays are attributable to the consequences of adverse events or whether adverse events are more likely to occur during a longer PICU admission. That adverse events were sustained more frequently in the youngest of patients is not surprising considering that procedures are often more challenging in this population. Similarly, those children whose illness is the most severe, with high PIM2 scores or following more complex cardiac surgery, are more likely to suffer from unfavorable consequences of their disease and are more likely to require multiple procedures. Compared to patients who did not sustain an adverse event, those who did were mechanically ventilated longer, had a longer PICU length of stay, longer hospital length of stay and were at higher risk of death.

The frequency of adverse events that we report is consistent with data from other PICUs. A previous single-center PICU study reported that 59% of their patients suffered at least one adverse event, at a rate of 52.7 per 100 PICU-days and 1.95 per patient [2] and a multicenter PICU study found an adverse event rate of 28.6 per 100 PICU-days and 2.03 per patient [3]. Reported rates from adult ICU literature range from 14% to 31% (4.5 to 10 events per 100 ICU-days) [13-15]. Hooper and Tibballs [16] investigated the incidence of adverse events in our PICU over a three-month period in 2011 by examining 60 randomly selected patient records and identifying adverse events using a Trigger Tool. They found the incidence of adverse events was 59.9 per 100 PICU-days, consistent with our finding of 67 per 100 PICU-days.

Hospital-acquired infections have been highlighted in recent years as a particularly important aspect of patient safety [17] and are used on our PICU as key performance indices. Despite this they were the leading cause of adverse events on our PICU. Deviations from safe practice standards are associated with higher infection rates [18] and in 2011 we put in place teaching programs targeting practices such as hand-hygiene compliance [19] and full sterile barrier precaution during catheter insertions [20,21]. The incidence of CLABSI fell from 2.75 to 1.9 per 1000 central line days and that of VAP from 3.55 to 1.2 per 1000 ventilator days. This highlights progress that has been made in recent years regarding patient safety. Also noteworthy is that in 1992 the rate of accidental extubation on our PICU was 1.26 per 100 ventilator days [22], which was comparable to other PICU reports [23,24]. The rate of accidental extubation over the period of this study was 0.46 per 100 ventilator days.

The occurrence of an adverse event does not necessarily imply medical negligence [25,26]. Brennan and colleagues [27] showed that the occurrence of adverse events does not correlate with the quality of medical care and

that patients in certain specialties, such as intensive care, are at increased risk.

A strength of this study is that the data was collected prospectively from a large PICU over a relatively long period. The study has important implications for safety improvement in the critical care setting. The type and frequency of adverse events sustained can help guide policy making decisions at a local level, as well as for those intensive care units with similar patient mix. Examples of this include targeted interventions based on the assessment of preventable adverse events, and the development of protocols and guidelines to reduce preventable adverse events such as infection, procedure related incidents and pressure sores. Preventable adverse events are often associated with systems-related deficiencies which can be corrected using ICU or hospital-wide changes in practice. This has been shown to be the case in previous studies not restricted to critical care [28,29]. Data on our key performance indices may be useful to other units for comparative purposes.

The study has several limitations. Firstly, we report findings from a single centre. Although the period of study is quite long, our patient mix consisting of general paediatric and cardiac ICU patients, practices and protocols will differ from other institutions making comparison difficult. In addition, our results may not be directly comparable to other institutions due to differing definitions of what constitutes an adverse event. We included complications associated with underlying disease, such as hyperkalemia in a patient with rhabdomyolysis. Whereas some will argue that these are frequently unavoidable, we felt that they still put the patient at risk and should be recorded to aid target intervention. We did not collect data on medication errors which is a weakness of the study. Accurate measurement of medication errors requires the examination of every patient's drug chart each day. Whilst we monitor medication errors in our PICU with regular audits, resources would not allow us to perform this daily.

Future research should concentrate on methods to create a culture in the critical care setting where discussing patient safety and reporting adverse events is encouraged at a unit and hospital level to reduce the incidence of adverse events on PICU and improve outcome.

CONCLUSIONS

Whilst admission to PICU provides life-saving care for patients, adverse events are common and may be associated with significant morbidity and mortality in our PICU. Adverse events decreased in frequency and severity over the study period. Monitoring of adverse events as part of quality improvement enables targeted intervention to improve patient safety.

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Table 1: Adverse events by year

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Total admissions	1213	1273	1352	1360	1392	1682	1721	1758	1738	1719	15208
Total days of care	5388	5182	5888	6243	6347	7195	7862	7436	7799	7593	66933
All adverse events	4215	4502	4323	4051	4100	4166	4474	4492	5195	5520	45038
Major adverse events	539	506	611	528	509	497	567	576	583	616	5532
All adverse events per 100 days of care	78	87	73	65	65	58	57	60	67	73	67
Major adverse events per 100 days of care	10	10	10	8	8	7	7	8	7	8	8
All adverse events per admission	3.5	3.5	3.2	3.0	2.9	2.5	2.6	2.6	3.0	3.2	3.0
Major adverse events per admission	0.4	0.4	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4

Table 2: Adverse events by category

Category	Major	Minor	Total
Abdominal	419	1905	2324
Cardiac arrest	386	0	386
Cardiovascular	610	6057	6667
Central Nervous System	528	147	675
Fluid and electrolyte	1	16628	16629
Haematological	529	7893	8422
Infection	961	1439	2400
Pressure area	286	0	286
Procedure related	229	1653	1882
Respiratory	1596	3784	5380
Surgery related	373	0	373
Total	5918	39506	45038

Table 3: Patient demographics and frequency of adverse events 2008 to 2017

All admissions (n)		No adverse event (per 100 ICU days)	Adverse event (per 100 ICU days)
Admission	Elective (n1903)	12	205
	Emergency (n6105)	49	399
PIM2	< 1 (n1649)	37	112
	1 to 5 (n7409)	20	306
	5 – 15 (n1541)	3	121
	>15 (n698)	0.08	66
RACHS	RACHS 1 (n518)	0.7	10
	RACHS 2 (n1622)	3	48
	RACHS 3 (n1903)	2	89
	RACHS 4 (n655)	0.4	62
	RACHS 5 (n11)	0	2
	RACHS 6 (n163)	0	35
Pre-existing function on admission	Normal (n2918)	16	87
	Functionally normal (n3815)	14	96
	Mild disability (n3669)	11	138
	Moderate disability (n1853)	9	86
	Severe disability (n1006)	7	44
	< 1 month age (n1947)	4	153
Age	< 1 month (n1947)	26	153
	1-12 months (n4442)	24	175
	1-5 years (n3981)	19	114
	>5 years (n4838)	16	162
ICU LOS category	< 7 days (n12926)	57	217
	7-21 days (n1804)	4	200
	>21 days (n478)	0	187
Invasive Ventilation (n10028)		23	537

PIM: Paediatric Index of Mortality (predicted % risk of death); RACHS: Risk Adjustment in Congenital Heart Surgery; ICU: Intensive Care Unit; LOS: Length of Stay

Table 4: Comparison of duration of mechanical ventilation, mean ICU and hospital length of stay and mortality for patients who encountered an adverse event compared with those who did not

	All admissions (n15208)			Major (n6918)			Minor (n12419)		
	Adverse event (n11,066)	No adverse event (n4,142)	P-value	Major (n2776)	None (n4142)	P-value	Minor (n8277)	None (n4142)	P-value
Mean Invasive Ventilation	79	7	<0.001	212	7	<0.001	35	7	<0.001
Mean ICU LOS	131	35	<0.001	300	35	<0.001	75	35	<0.001
Mean Hospital LOS	484	206	<0.001	921	212	<0.001	851	212	<0.001
Patients died	459	16	<0.001	306	16	<0.001	153	16	<0.001

ICU: Intensive Care Unit
LOS: Length of Stay

Asia-Pacific Journal of Health Management ACHSM

Managers of Health Services in Australia 2006-2016

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ABSTRACT

Purpose: Activity in health services is expanding faster than population growth and that of the production of all goods and services in Australia. This paper is concerned with the number and characteristics of its managers in relation to the number of people employed and resources used. It also assesses different trends in hospitals and other medical and health services.

Methodology/Design: Design of the analyses follows specifications set by the authors for tabulations prepared by the Australian Bureau of Statistics (ABS) from the censuses of population conducted by ABS in 2006 and 2016.

Analysis: Assesses changes in the number and variations in the characteristics of managers of hospitals and medical and other health services, in relation to the number of people employed, contrasted with changes in all industries.

Findings: There are different trends in hospitals and medical and other health services, with a decline in the number of employees per manager in medical and other health services and a slight rise in hospitals. The older average age of health service managers continued to rise, similarly to that for all industries. The proportion of female managers in health services, below the average for all employees, increased somewhat during the decade. The distribution among the various fields of study remained about the same; but level of education, higher than the average for all industries continued to rise. The growth in average income of managers during the decade was somewhat lower than in all industries, due to a lower increase rate in medical and other health services. The proportion of managers of indigenous status rose substantially – almost double the proportion in all industries.

***Implications*:** The findings are of relevance to those concerned with the management of health services and training of the growing number of managers of health services in Australia.

Keywords: health service; health management; Australia

1. Managers of a growing industry

Health service managers in Australia have the task of organising a large array of people with diverse skills and responsibilities into a whole that provides effective and efficient health services to the community. They manage a complex system with evolving technologies, diverse human resources and growing at a faster pace than the Australian population, labour force and the economy. In the decade 2006-2016, the Australian population grew at an annual average of 1.6% and the labour force at about the same rate, but the number of people employed in health services increased at an average rate of 3.3% per year [1] [2]. Health services expenditure grew at an average of 4.7% per year in real terms, well above the rate of growth of Gross Domestic Product (GDP), to rise from 8.7% of GDP in 2005-06 to 10.3% in 2015-16 [3]. These aggregate rates of growth mask varied and important systemic changes that took place during that time [4] that have placed additional demands on health service managers to deal with the process of change.

The authors have provided the first comprehensive assessment of the number and characteristics of health services managers in Australia for 2006 and 2011based on the 2006 and 2011 population censuses with a related literature review [5] [6]. The purpose of this paper is to analyse the changes that have taken place in the number and characteristics of health service managers in the decade 2006-2016. These findings are of relevance to those concerned with changes that are taking place in health services and training of its managers.

2. Data specifications

The specifications for the data sourced from the 2016 population census of Australia are the same as those that the authors used for the 2006 census. This ensures compatibility between the two data sets. A detailed description of the Australian occupation and industry classifications used by the Australian Bureau of Statistics (ABS) was given by the authors in their first paper [5]. The data were collected by ABS in the 2006 and 2016 Censuses of Population and Housing. They rely on answers to census questions but ABS carries out post-enumeration surveys to ensure the reliability of the information provided. The data used in the authors' analyses were supplied by ABS in accordance with the authors' specifications. The occupation and industry classifications mentioned were used to identify the place of work (industry) and occupation. The data cover hospital and medical and other services in both the public and private sectors. Following the Australian classification of occupations, managers are in four categories: Managers not further defined (Mnfd), Chief Executive Officers (CEO) together with General Managers (GM), Specialist Managers, and Service Managers. The scope of services covered does not include pharmacies in the private sector because of the difficulty in separating functions related to the provision of pharmaceutical drugs and those concerned with the retailing of cosmetics, toiletries and other products. Other variables were specified in accordance with ABS coding of age, sex, marital status, field and level of education, indigenous status, country of birth, hours worked and income. Other data used in the analyses are from sources as indicated and references provided. For comparison purposes the authors also requested similar data for all industries, excluding farmers and farm managers because of the nature of their work. In the compilation of the basic tabulations, ABS changed figures in some cells to prevent the identification of individuals in the censuses. This led to some minor differences in some figures but does not materially affect the

results of the analyses carried out by the authors.

As mentioned, the basic data used by the authors were from tabulations prepared by ABS. However, it is relevant to state that most of the information in the tables and figures are the result of the analyses carried out by the authors. In other words, although the sources of the components of analyses are given in the tables, the information is the outcome of the authors' analyses.

3. Management of the growing labour force and resources

A feature of population growth in Australia is the importance of immigration to keep the labour force growth at a similar pace as that of the population, in spite of fertility being below replacement level and the increasing proportion of older people. Health services are labour-intensive and, as stated, the number of people employed in health services grew at a faster rate than the labour force for all industries. The number of people employed grew from about 574,000 in 2006 to 801,000 in 2016. Accordingly, its share of the labour force rose from 6.3% in 2006 census to 7.5% in 2016. Another feature of health services is that the proportion of females employed (76% in 2016) is substantially higher than the average proportion employed in all industries (48% in 2016) [2] [7]. In this context, the number of health service managers in hospitals and medical and other health services increased from 19,400 in 2006 to 29,400 in 2016. The increment in the number of managers was considerably higher in medical and other health services (+6,200) than in hospitals (+3,800) during that decade, from respectively 8,500 and 10,900 in 2006 to about 14,700 in both cases in 2016 [5] [7].

The labour-intensive nature of health services led to a ratio of considerably more employees per manager in health services (27.3/manager) than in all industries (8.6/manager) in 2016. The average number of employees per manager declined in health services and stayed about the same in all industries during the decade 2006-2016. However, while the number of employees per manager in hospitals increased (+0.6/manager) the number of employees per manager in medical and other health services actually declined substantially (-5.7/manager). This led to a reversal of the average ratios: in 2006 there were more employees per manager in medical and other health services (31.7/manager) against a lower ratio in hospitals (27.9/manager), hospitals in 2016 employed more people per manager (28.6/manager) than medical and other health services (26.0/manager) (Table 1).

Excluding private pharmacies, the average health expenditure (at 2015-16 constant prices) per health manager increased from $626,200 in 2005-06 to $633,900 in 2015-16 [1] [3] [7].

4. Manager categories

The diversity of skills and functions in health services and its organisation along skill specialisation are reflected in the larger proportion of specialist (who include administration as well as clinical) managers in health services (69.2%) compared with the proportion in all industries (54.6%) in 2016. The inverse applies to the proportion of managers in supporting services (including food and cleaning) that was considerably lower in health services (14.5%) than in all industries (33.4%). The proportion of Chief Executive Officers/General Managers (CEOs/GMs) and Managers not further defined (Mnfd) in health services (16.3%) was higher than in all industries (12.0%) (Table 2). This is only partly

due to the higher proportion of these managers in medical and other health services (19.2%) compared with that in hospitals (13.6%) in 2016 [7].

In 2016, the management structure of health services was more concentrated with a lower ratio of specialist and service managers per each CEO/GM & M(nfd). This is mostly due to the lower number of managers concerned with ancillary service activities (Fig. 1).

During the decade 2006-2016, the proportion of managers of ancillary services in health declined with about an equal proportional increment in specialist managers, while the proportion of CEO/GM & M(nfd) remained about the same. This is similar to the trend in all industries (Table 2).

5. Age of managers

The average age of health managers in Australia rose by about one year from 46.0 years in 2006 to 47.2 in 2016. This is in line with the trend in all industries. However, the average age of managers in all industries was bout 2.5 years younger than the average for managers in health services. Managers in hospitals were also older by about two and half years than those in medical and other health services both in 2016 and 2006 (Table 3).

The age distribution of health service managers followed a hump-shaped curve with a peak at 45-54 years of age. There was a tendency for the proportion of older managers to get larger, as the average and the median ages shows, between 2006 and 2016 (Fig. 2).

As might be expected, on average, chief executive officers and general managers were older (49.8 years in 2016) than other managers in health services. Service managers were the youngest (average 45.7 years in 2016) followed by specialist managers (average 47.0 years in 2016). A feature of the age distribution is that although service managers were younger, on average, the age distribution is more widely spread as indicated by the considerably larger coefficient of variation. Similar patterns prevailed in all industries. As noted earlier, managers in health services tended to be older in all categories than those in the same categories in all industries. The trend was also for health service managers and those in all industries to be older in 2016 than 2006, in all categories, by about one year on average (Table 4).

6. Female and male managers

Health services in Australia have been characterised by a predominance of females in its labour force. In this regard, it is substantially different from the labour force in general. In 2016, females constituted 76.0% of people employed in health services in contrast with the average for all industries of 47.5%. The predominance of females employed was greater in hospitals (78.0%) than in medical and other health services (73.9%). In all industries, the proportion of females employed increased slightly from 46.1% to 47.5% and in medical and other health services by about one percent. However, the proportion of males employed in hospitals rose from 20.9% to 22.0% during the same period. This meant that the relative difference index using all industries as the standard declined from 30.3 in 2006 to 28.6 in 2016 (Table 5). The authors have followed ABS and other definitions of sex and gender. Sex is defined as the biological characteristics of females and males. Gender refers to psychological and social characteristics that are culturally determined from belief systems as of what masculine and feminine behaviour is or ought to be.

Following the labour force distribution, females constituted the larger proportion of health service managers in 2016 (62.1%) compared with that in all industries of 38.0%. The substantial gap in the proportion of female managers to the proportion of female employees in health services, that was greater in health services than in all industries, fell from 15.8% in 2006 to the still high proportion of 13.9% in 2016. The gap diminished most in hospital services with the highest gap of 17.6% and 14.5% respectively in 2006 and 2016 compared with the gap in all industries of 10.9% and 9.5% in the same years. The changes meant that the proportion of female managers continued to be lower than the proportion of female employees in health services, and especially in hospitals, in spite of the narrowing of the gap in 2006-2016 (Table 6).

The proportions of female and male managers varied considerably by category in 2016 and also in 2006. The proportion of female managers was lowest among CEO/GM (53.4% in 2016)) and service managers (58.5% in 2016) and highest among specialist managers (64.5% in 2016) and managers (not further defined) (62.6% in 2016). As mentioned earlier, there was an average rise of 1.7% in the proportion of female managers during the decade 2006-2016, with the highest in the specialist and CEO/GM categories (1.9% and 1.8% respectively) and lowest among service managers (1.1%) (Table 7).

On average, female health service managers were younger than male managers by about one year (1.2 years) in 2016. This was about the same difference as in 2006. In 2016, the difference in average age was greater among service managers (2.3 years) that had a lower average age but wider spread of ages. This was followed by a difference of one year in the CEO/GM category, a slight smaller difference among specialist (0.8 years) and managers not further defined (0.6). The 2006-2016 trend was for an increase of the average age of both male and female managers in all categories, but especially so in the case of those in the CEO/GM category (2.0 years) (Table 8).

7. Field of study

The field of study of 29.3% of managers in health services was management and commerce, followed closely by health (28.4%) in 2016. The other two major fields of study were social and related fields (10.7%) and natural and physical sciences (5.2%). There were some compensatory differences between hospitals and medical and other health services. Hospitals had a larger proportion of managers with health as the field of study (+6.8%) and medical and other health services a greater proportion of managers in natural and physical sciences (+4.3%) and social and related fields (+2.6%). As would be expected, the distribution in health services was in some cases considerably different from the average from all industries, such as in the case of health, engineering, architecture and building fields of study. There was also considerably lower proportion of managers in health services without a field of study, partly reflecting the greater proportion of managers with tertiary education (Tables 9 and 11).

The analysis of the sex distribution of the field of study of managers in health services in 2016 followed what could be considered gendered specialisation of females and males, as reflected in the average for all industries. Thus, health managers in engineering, architecture and building, information technology fields of study tended to be mostly male, while those in health, education, social and related fields of study, food, hospitality and personal care were mostly female. Nevertheless, female health service managers also constituted more than

half in management and commerce, natural and physical sciences fields of study (Table 10).

In the period 2006-2016, there was a fall in the proportion of health service managers who had no specific field of study (without certificate/diploma/tertiary education) (-4.0%) and those from social and related fields (-1.2%). This was compensated by increments in the proportions of those in the management and commerce field of study (+3.1%) and information technology (+1.1%). These were accompanied by small proportional decreases in other fields of study (Table 10 and [8]).

8. Education level

The level of education of health service managers at graduate and post graduate was considerably higher (61.2%) than the average for all industries (39.6%) in 2016. Some of the difference arose from the larger proportion of managers in health services with postgraduate education (29.4%) compared with the average for all industries (14.2%). In the balance, the proportion of managers in all industries at the diploma/certificate level was higher (33.2%) than in health services (24.6%). There were also divergences between hospitals and medical and other health services, especially at postgraduate level. Hospital managers had a considerably higher proportion at post graduate level (34.5%) than managers in medical and other health services (24.3%), while the proportion at diploma/certificate levels were higher in medical and other health services (26.7%) than in hospitals (22.5%) (Table 11).

In the decade 2006-2016, the proportion of managers in health services with graduate and post graduate qualifications rose from 55.8% in 2006 to 61.2% in 2016, while those at diploma/certificate level remained at about the same proportion (24.1% and 24.6% respectively), but those without or not stated such qualifications dropped from 20.0% to 14.2% during that period. The educational qualification level in health services remained well above that of all industries, nevertheless the gap was reduced by a substantial increase in the average proportion of managers in all industries with graduate and post graduate education (Table 11).

The analysis of the level of education by manager category showed that hospital managers tended to have more postgraduate education (34.5%) than those in medical and other health services (24.3%) in 2016, with the exception of managers of ancillary services. In both health activities, the proportion of CEOs/GMs with postgraduate level of education (44.2% in hospitals and (33.2% in medical and other health services) was higher than those in other categories. In hospitals, M(nfd) (36.8%) and specialist managers (37.4%) followed, with service managers with the lowest proportion at postgraduate level (8.1%). Similar order of proportions prevailed in medical and other health services but specialist managers in this case had a higher proportion at both postgraduate and bachelor levels of education than M(nfd) (Table 12).

Female and male managers in health services had, on average, about the same level of graduate and postgraduate level of education (61.0% and 61.6% respectively) in 2016. Small differences were observed, with a lower proportion of female managers at diploma/certificate levels and a larger proportion with other lower and not stated qualifications. However, the analysis of the level of education of health service managers by category revealed some divergences as well as some commonalities. Specialist managers – the largest group – had similar levels of education at graduate and post graduate level:

females 66.8% and males 67.0%. Their proportions at diploma/certificate levels were also about the same, and that was also the case of those with lower or not stated levels of education. In the case of managers of ancillary services, males had higher proportions at diploma/certificate levels and smaller lower difference at graduate level. In the small group of managers (not further defined), male managers with a smaller proportion at postgraduate level (26.7%) than females (29.6%) had a larger proportion at bachelor level (33.9%) than females (25.4%), with a smaller difference at diploma/certificate levels (males 26.2% and females (24.7%). The largest difference was in the proportion of females with lower or not stated level of education (20.3%) and that of males (13.2%). Male CEOs/GMs had a considerable higher proportion at postgraduate level (41.8%) than females (34.5%), with a lower difference at bachelor level: 33.8% and 32.4% respectively. This was only partly compensated by the proportion of females at diploma/certificate levels (19.9%) compared with males (15.6%) (Table 13).

9. Income of managers

Empirical evidence points to a gradual rise in average income as people age to reach a peak about the age 40-50 years of age. It also shows that the average income of females tends to be lower than that of males [9]. In view of the average older age of health service managers, higher levels of education, number of people employed per manager, and larger proportion in high position in health services, it could be hypothesised that the average income of health service managers would be higher than the average for all industries.

The average weekly income of health service managers was $2,089 at the time of the 2016 census. At that rate, the annual income would be about $109,300. In line with their higher than average level of education, hospital managers earned about $114,400 per year that was more than $104,100 earned by those in medical and other health services. This compared with the average annual income of $99,100 in all industries. The order of magnitude of the differences was similar to that at the time of the 2006 Census. However, during the decade, while the average income of managers in hospitals kept pace with the proportional rise of the average of managers in all industries, those in medical and other health services lagged somewhat (Table 14).

As might be expected, CEOs/GMs earned much higher incomes than the average in health services (+28.9%) and in all industries (+38.8%) in 2016. The proportional difference in the income of CEOs/GMs was much higher in all industries than in medical and other services (+32.0%) and especially in hospitals (+27.0%). Specialist managers in health services were about average (+1.9%), but not in all industries (+14.2%), while service managers with lower average level of education earned considerably less than the average, by about a third both in health (-34.1%) and all industries (-34.2%) (Table 15).

The analysis of health managers' income by sex and age showed that on average females earned less than males at all ages in 2016. While the female pattern of earnings follows the hypothesised hump-shaped distribution by age, that of males departs from this pattern to rise in early ages and, on average, actually increased after the age of 64 years (Fig. 3).

10. Hours worked by managers

On average, managers in health services worked 42.6 hours during the week before the 2016 census. Managers in hospitals worked somewhat longer hours (43.2 hours) than

those in medical and other health services (42.0 hours). These averages are lower than the average for all industries (46.0 hours) (Table 16).

CEOs/GMs worked longer hours (+4.8 hours) than the average in health services (42.6 hours) in 2016. This was also the practice in all industries (5.3 hours more than the average of 46.0). Managers in ancillary services worked shorter hours (-3.5) than the average in health services and also on average in all industries (-2.2 hours). Specialist managers in health services hours of work (42.5 hours) followed the average in health services, but those in hospitals (43.4 hours) worked longer hours than those in medical and other health services (41.4 hours) (Table 17).

On average, in 2016, male managers worked longer hours (+3.9 hours) than females in hospitals and even more so in medical and other health services (+7.2 hours). It is apparent that the rate of dispersion is greater among female than male managers in both cases (Table 18).

A major reason for the difference in the average number of hours worked between female and male managers was the substantial disproportion of female managers working part-time defined as those working less than 35 hours per week. Accordingly, in 2016, about a quarter of female managers in health services (26.3%) worked part-time compared with about one tenth (11.0%) in the case of males. The proportion was higher in medical and other services (29.5%) than in hospitals (23.3%). Similar pattern prevailed in all industries (Table 19).

The deviation in 2016 was considerably reduced when managers working 35 hours or more was considered. The difference in the average hours worked between males and females was only 0.5 hours in hospitals and 3.4 in medical and other health services compared with 4.4 hours in all industries (Table 20).

The tendency in 2016 for male managers to work longer hours than females became even more obvious when the proportion of male and female managers working longer than 48 and less than 16 hours was examined. More than a quarter of males in health services (27.4%) worked 49 hours or more per week while less than a fifth applied to females (18.4%). At the other end of the distribution, 15.1% of female managers in health services worked 15 hours or less per week but only 7.3% of males. These patterns were similar to the average in all industries (Table 21).

Some changes took place in the 10-year period 2006-2016. The average hours worked by managers in medical and other health services remained about the same (+0.1%), but those of managers in hospitals rose somewhat (+1.3%) and those in all industries decreased slightly from their still higher level (-0.9%) (Table 16). Further, the proportion of managers working part-time (less than 35 hours per week) in all industries was about the same in two censuses, but increased further in health services, especially in the case of female managers (Table 19).

11. Marital status of managers

The marital status of health service managers was different than the average for all industries in 2016. The major disparity was in the proportion of never married but also in those who were divorced/separated or widowed. About a quarter of managers in all industries (24.0%) were in the never married status but the same groups in health services made up about a fifth (19.1%). The proportion of divorced/separated/widowed was also larger in health services (15.0%) than the

average for all industries (12.1%) (Table 22). However, marital status is to some extent a function of age. In other words, marriage follows single status, and divorced/separated/widowed follows marriage. As health service mangers were on average older than those in all industries, some of these differences could be attributed to the age distribution. However, age and sex standardisation of the marital status of health service managers using all industries as the standard indicated that in 2016, health service managers had a lower proportion of never married than would be expected given the standard for all industries and also a lower proportion of widowed, divorced/separated, and a balancing higher proportion of married. The deviation from the all industry standard was higher in medical and other health services than in hospitals.

12. Country of birth of managers

At the time of the 2016 census, 66.7% of the population had been born in Australia (ABS 2017a) and the proportion of managers in all industries born in Australia was 68.7%. The proportion of health service managers born in Australia was slightly higher at 69.7%. However, there was a major difference between those in hospitals (72.1%) and medical and other health services (67.3%). Health service managers born in New Zealand and Oceania (3.7%) and the United Kingdom and Ireland (9.7%) made up a substantial proportion of the distribution (Table 23).

There were changes in the period 2006-2016 some of which reflect changes in the composition of the Australian population, the relative importance of migration and country of origin of migrants. Accordingly, the proportion of health service managers born in Australia declined from 74.3% in 2006 to 69.7% in 2016. The major changes in country of origin of health service managers born Overseas was the decline in the proportion of those born in Europe, other than the United Kingdom and Ireland, from 8.4% in 2006 to 3.8% in 2016, and the rise in the proportion of those born elsewhere, mostly Asia, from 3.6% in 2006 to 14.0% in 2016. These changes were greater in medical and other health services than in hospitals during that period. There was also a small fall in the proportion born in the United Kingdom and Ireland and an increase in those born in New Zealand and Oceania (Table 23).

13. Indigenous status

The proportion of health service managers with Indigenous status (1.7%) was almost double that in all industries (0.9%) as per the 2016 census. The percentage was much higher in medical and other health services (2.2%) than in hospitals (1.3%). The proportion of female managers in health services (1.9%) was larger than that of males (1.5%). This was especially so in the case of hospitals (1.5% versus 1.0%) (Table 24).

The proportions in 2006 were lower than in 2016, in both health services (-0.5%) and all industries (-0.3%). With the largest increment in the proportion of female managers in medical and other health services (Table 24).

14. Managers of growth and change

In an activity that is human resource intensive, the substantial growth in health services resulted in a rise in the number of people employed in health services by 39.5% during the decade 2006-2016. This was associated with a much greater increase of 51.5% in the number of managers that amounted to 29,400 in 2016. However, the number of managers in hospitals rose by only 34.9 % but the increment in medical and other health services was 72.9%. This meant that while the ratio of employees per manager in hospitals increased slightly from 27.9 in 2006 to 28.6 in 2016, the

ratio declined considerably in medical and other health services from 31.7 in 2006 to 26.0 in 2016.

The increase in activity in health services was accompanied with a rise in the proportion of specialist managers but a decline in the proportion of managers of ancillary services such as food and cleaning services. The latter might be attributed to the outsourcing of these services. The proportion of senior managers (CEO/GM/M(nfd)) remained about the same during the decade under review. Nevertheless, the proportion of these senior managers in medical and other health services was greater (21.1% in 2006 and 19.2% in 2016) than in hospitals (13.2% in 2006 and 13.5% in 2016) [7] [10]. This might reflect differences in the scale of operation in the two settings.

Health service managers were older (47.2 and 46.0 years in 2016 and 2006 respectively) than the average for all industries (44.6 and 43.5 years in 2016 and 2006 respectively). This could be the result of the longer period of time spent in education and training by managers in health services. Senior managers (CEO/GM/M(nfd)) were older on average than specialist managers or the much younger managers of ancillary services. This was also the pattern among the average younger managers in all industries. The trend was for managers in all categories to be about one year older in 2016 than 2006. This might be attributed to managers staying-on longer at work and retiring at an older age. Female managers tended to be about one year younger than males.

Although females constituted the majority of health service managers in all categories both in 2006 (60.4%) and 2016 (62.1%), the proportion of female managers was lower than the proportion of female employees in health services. The gap was narrowed during the decade from -15.8% to -13.9%. However, the gap in health services remained higher than the average in all industries (-10.9% in 2006 and -9.5% in 2016). The gap was particularly large in the CEO/GM category in both years.

As would be expected, a larger proportion of health service managers came from the health field of study than in all industries, but considerably less from engineering, architecture and building. Specialisation of the field of study by sex in health services followed that of the average for all industries with a greater proportion of female managers coming from health, social and related fields and education, and a higher proportion of males from engineering, architecture and building and information technology. This pattern prevailed both in 2006 and 2016.

Although the relative difference between the level of education of managers in health services and the average for all industries fell in the decade 2006-2016, mostly due to the rising average proportion of managers with graduate or postgraduate degrees in all industries, the level of education of health service managers continued to be substantially higher in 2016. While in 2016 the average proportion of health service managers with graduate or post graduate education was 61.2% that of the average for all industries was only 39.6%. The proportion at this level in hospitals (64.4%) was also greater than in medical and other health services (58.0%). The percentage of hospital CEOs/GMs with graduate and post-graduate was particularly high at 75.5% compared with 67.5% in medical and other health services. Service managers, with the lowest proportion of managers with graduate or post graduate degrees (20.6% in hospitals and 30.9% in medical and other health services), had the largest proportion at

diploma/certificate or lower levels. On average, female and male managers of health services had about the same percentage at graduate and post graduate level: 61.0% and 61.6% respectively. The major difference was in the CEO/GM category where the proportion of male managers at that level was 75.6% and females 66.9%.

In line with their higher level of education, on average, health service managers earned 10% more than those in all industries in 2016, and hospital managers about 10% more than those in medical and other health services. The health services average weekly income ($2,089) in 2016 represented an average annual rate of increase of 3.3% during the decade 2006-2016 that was slightly lower than the average of 3.5% for all industries. This difference was due to the lower pace of increase in medical and other health services, while managers in hospital kept at about the same rate of increase as the average for all industries. CEOs/GMs in health services earned 28.9% more than the average in 2016. This was a lower difference than the average for all industries of 38.8%, especially in the case of hospital managers (+27.0%). Those in medical and other health services (+32.0%) were closer but still below the average for all industries. As might be expected from their lower level of education, managers of ancillary services earned less than average (-34.1%) in health services, as in the average for all industries (-34.2%). In general, earnings tend to follow a hump-shaped pattern with lower earning early and late in the working life. Female managers in health services tended to follow this pattern in 2016. On average, they also earn less than males at all ages. This was partly a result of the higher proportion of female managers working part-time and the lower proportion of them in the higher paid CEO/GM category in health services. The pattern for male managers was somewhat different. Male average earnings also rose with age but they kept on rising after the age of 65 years. This was due to the higher proportion of CEOs/GMs who stayed at work and became a larger proportion of all managers at older ages lifting the average earnings, as specialist and service managers with lower earnings retired earlier.

On average, at the time of the 2016 census, health service managers worked slightly longer hours (42.6 hours) per week than at the time of the 2006 census (41.9 hours). This was the result of the rise of hours worked by hospital managers (+1.3 hours) as the hours worked by managers in medical and other health services remained about the same during that time. This is in contrast with the slight decline (-0.9 hours) in the higher average for all industries (46.0 hours in 2016). In all industries CEOs/GMs worked longer hours per week (+5.3 hours) than the average for all categories. In health services, they also worked longer hours than the average per week (+4.8 hours) while ancillary service managers worked 3.5 hours less than the average, with specialist managers who constituted the majority working about the same as the average for all managers (42.5 hours). In all industries in 2016, the proportion of female managers who worked part-time (25.4%) was much greater than that of males (10.5%). This was about the pattern in health services (26.3% and 11.0% respectively). This explained much of the difference in the average hours worked by female and male managers in health services: 40.6 and 46.0 hours respectively [7]. When full-time managers were considered, the difference was relatively small in hospitals (0.5 hours) but larger in medical and other services (3.4 hours). The contrast between female and male working hours became more accentuated when the proportions of managers working longer and

shorter hours in 2016 were examined: a lower proportion of female health service managers worked 49 hours or more per week (18.4%) than males (27.4%), and a higher proportion worked 15 hours or less (15.1%) than males (7.3%).

Marital status is associated with age. As health managers were older than the average for all industries, it would be expected that their marital status to be somewhat different as found. The age and sex standardised marital status using the all industries pattern as a standard showed that health service managers in 2016 were more likely to be married than expected for their age and sex distribution, and less likely to be never married, divorced/separated or widowed.

The proportion of health service managers born in Australia at the time of the 2016 census was somewhat larger (69.7%) than the average for all industries (68.7%) or for the whole population (66.7%). The proportion of Australian-born was a decline since the 2006 census when it amounted to 74.3%. In addition to the larger proportion of health service managers born Overseas, the country of origin also changed. Accordingly, the proportion of health service managers born in the United Kingdom and Ireland fell (from 10.7% in 2006 to 9.7% in 2016) and those born in New Zealand increased (3.0% to 3.7%) slightly. The major changes affected the proportion of health service managers born in other Europe (than the United Kingdom and Ireland) that fell from 8.4% in 2006 to 2.9% in 2016, while those born elsewhere (mostly in Asia) rose from 3.6% to 14.0%. These changes were similar to those experienced on the average for all industries during the period and changes in the country of origin of Australian immigrants in general.

During the decade 2006-2016, the proportion of health service managers of Indigenous status rose from 1.2% to 1.7%. These percentages were about double the average for all industries in both years. Although the proportions were higher for both females and males, they were greater in the case of females (1.9% versus males 1.5% in 2016). The proportions of Indigenous health service managers were only slightly above the all industries' average in the case of hospitals but substantially above in medical and other health services.

15. Major features and research agenda

This research shows growth in the number of health service managers and also change in their characteristics. A feature of the growth in numbers was the disparity between the rate of increase of managers in medical and other health services and that in hospital services, to the point where their numbers were close to each other. Another aspect is the narrowing but continuing large gap between the percentage of females in health service labour force and the proportion of female managers. This gap was particularly noticeable in the proportion of females in the CEO/GM category. The higher average income of health service managers was closely associated with their higher level of education at graduate and but especially at post graduate levels. Most of the difference between the higher average income of male managers could be attributed to greater proportion of females who work part-time and their lower hours of work. However, part of it could have risen from their lower proportion in the CEO/GM category. Still another change was the country of birth of managers in health services born Overseas that reflected shift in the flow of migrants to Australia from Europe to Asia. An important feature was the progression made in the rise of

the proportion of health service managers who were indigenous people.

The informative and important nature of the findings has some limitations that form an agenda for further research using other sources and methods. Among those are the reasons for the gap between the proportion of females in the labour force and that of female managers. This gap is larger in health services than the average for all industries. A related issue is the relatively low proportion of females in the CEO/GM category. Another question is the relevance of the content of education and training to the management of human-resource activity and of multidisciplinary silos that need to work for a common end. The human dimension of the training received by health service managers seems to be basic to personal fulfilment as well as achievement in effective and efficient health care.

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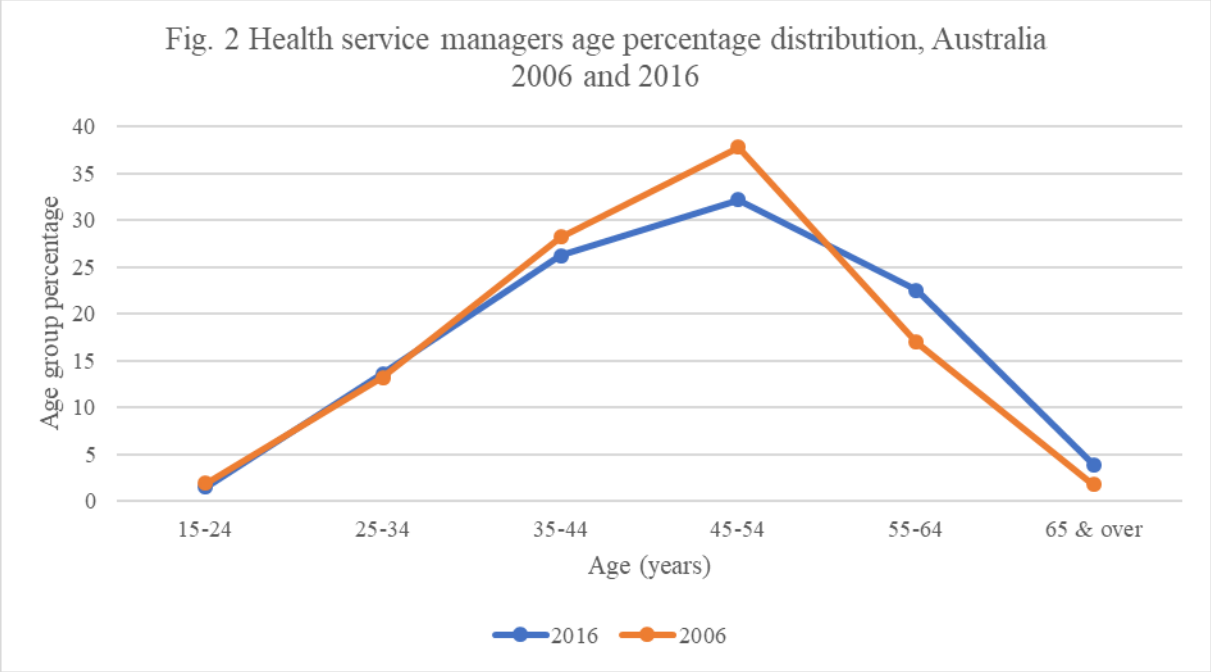
Fig. 1: Specialist and service managers per general manager, health services and all industries, 2016

CEO/GM/M(nfd) (1)

Health services: Specialist managers 4.2 + Service managers 0.9 = 5.1

All industries: Specialist managers 4.6 + Service managers 2.8 = 7.4



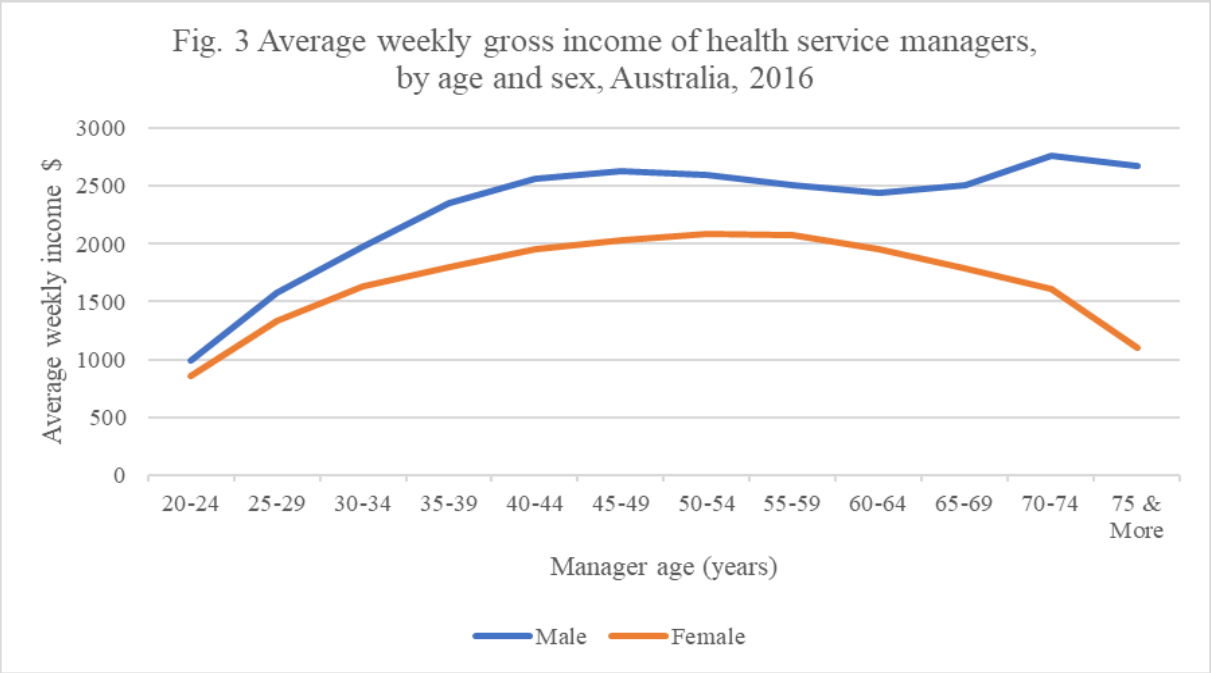


Table 1: Number of people employed per manager, health services and all industries, Australia, 2006 and 2016

Activity	Employees per manager		Change 2016-2006
	2016	2006	
Hospitals	28.6	27.9	0.6
Medical & other	26.0	31.7	-5.7
Health services	27.3	29.6	-2.3
All industries	8.6	8.9	-0.3

Sources: ABS (2007, 2012, 2017a and 2017b).

Table 2: Health and all industry managers by category, Australia, 2006 and 2016

Industry	Category percentage distribution			
	CEO/GM & M(nfd)	Specialist	Service	All
Health services				
2016	16.3	69.2	14.5	100.0
2006	16.6	66.6	16.8	100.0
Difference 2016-2006	-0.3	+2.6	-2.3	
All Industries				
2016	12.0	54.6	33.4	100.0
2006	13.2	50.3	36.5	100.0
Difference 2016-2006	-1.2	+4.3	-3.1	

Note: (CEO/GM & M(nfd)) is the sum of the chief executive officer/general manager category with managers not further defined. Health services is the sum of hospital and medical and other health services.
Sources: ABS (2017a and 2017b); Martins & Isouard (2012a).

Table 3: Age of managers in health services and all industries, Australia, 2006 and 2016

Age	Hospitals	Medical & other health	All health	All industries
2016				
Average age (years)	48.5	45.9	47.2	44.6
Median age (years)	49.2	46.1	47.6	44.5
Standard deviation (years)	10.4	11.3	10.9	12.0
Coefficient of variation	0.21	0.25	0.23	0.27
2006				
Average age (years)	47.0	44.7	46.0	43.5
Median age (years)	47.6	45.2	46.6	43.5
Standard deviation (years)	9.4	10.6	10.0	11.6
Coefficient of variation	0.20	0.24	0.22	0.27

Sources: ABS (2017a and 2017b); Martins & Isouard (2012b).

Asia Pacific Journal of Health Management 2018; 13(3): i26 doi:10.24083/apjhm.2018.12.0026

Table 4: Age of managers by category, health services and all industries, Australia, 2006 and 2016

Manager category	All health age (years)				All industries age (years)			
	Average	Median	SD	CV	Average	Median	SD	CV
2016								
CEO/GM	49.8	50.2	10.7	0.21	49.1	48.9	11.2	0.23
M(nfd)	48.0	48.3	10.8	0.23	47.3	47.1	11.9	0.25
Specialist	47.0	47.4	10.7	0.23	44.8	44.5	11.2	0.25
Service	45.7	46.0	12.1	0.27	42.9	42.4	13.2	0.31
All 2016	47.2	47.6	10.9	0.23	44.6	44.5	12.0	0.27
2006								
CEO/GM	47.8	48.1	9.3	0.19	47.4	47.2	10.6	0.22
M(nfd)	47.4	47.4	10.3	0.22	47.2	47.1	11.7	0.25
Specialist	45.7	46.3	9.7	0.21	43.5	43.4	10.8	0.25
Service	45.4	46.6	11.0	0.24	41.9	41.9	12.5	0.30
All 2006	46.0	46.6	10.0	0.22	43.5	43.5	11.6	0.27

Note: (Health services) are the aggregate of hospitals and medical and other health services. (CEO/GM) are chief executive officers and general managers. ((M(nfd)) are managers not further defined. (SD) is the standard deviation in years. (CV) is the coefficient of variance (proportion).
Sources: ABS (2017b); Martins & Isouard (2012b).

Table 5: Sex distribution of people employed in health services and all industries, Australia, 2006 and 2016

Sex	Percentage			
	Hospitals	Medical & other health	All health	All industries
2016				
Females	78.0	73.9	76.0	47.5
Males	22.0	26.1	24.0	52.5
2016 Relative Difference Index	30.5	26.4	28.6	Standard
2006				
Females	79.1	72.8	76.2	46.1
Males	20.9	27.2	23.8	53.9
2006 Relative Difference Index	33.3	26.9	30.3	Standard

Note: The relative difference index = $[\sum|\{(a_i/b_i)*100\}-100|] / (2*n)$; (a_i) is the proportion of employees of sex (i) in given health service; (b_i) is the proportion of employees of sex (i) in all industries; (n) is the number of sex groups.
Sources: ABS (2017b); Martins & Isouard (2012b).

Table 6: Sex distribution of managers in health services and all industries, Australia, 2006 and 2016

Sex	Percentage			
	Hospitals	Medical & other health	All health	All industries
2016				
Females	63.5	60.8	62.1	38.0
Males	36.5	39.2	37.9	62.0
2016 Female managers to employees % gap	-14.5	-13.1	-13.9	-9.5
2006				
Females	61.5	58.8	60.4	35.2
Males	38.5	41.2	39.6	64.8
2006 Female managers to employees % gap	-17.6	-14.0	-15.8	-10.9

Note: The female to employee % gap is the difference between the proportion of female employees and the proportion of managers in the given activity.
Sources: ABS (2017a and 2017b); Table 5; Martins & Isouard (2012b).

Table 7: Health service managers by category and sex, Australia, 2006 and 2016

Sex	Percentage				
	CEO/GM	M(nfd)	Specialist	Service	All
2016					
Females	53.4	62.6	64.5	58.5	62.1
Males	46.6	37.4	35.5	41.5	37.9
2006					
Females	51.6	61.0	62.6	57.4	60.4
Males	48.4	39.0	37.4	42.6	39.6
Female % change 2006-2016	+ 1.8	+1.6	+1.9	+1.1	+ 1.7

Note: (CEO/GM) are chief executive officers and general managers. ((M(nfd)) are managers not further defined.
Sources: ABS (2017a and 2017b); Martins & Isouard (2012b).

Asia Pacific Journal of Health Management 2018; 13(3): i26 doi:10.24083/apjhm.2018.12.0026

Table 8: Health service managers average age by category and sex, Australia, 2006 and 2016

Sex	Average years of age				
	CEO/GM	M(nfd)	Specialist	Service	All
2016					
Females	49.3	47.7	46.8	44.7	46.8
Males	50.3	48.3	47.6	47.0	48.0
Persons 2016	49.8	48.0	47.0	45.7	47.2
2006					
Females	47.6	46.7	45.2	45.1	45.5
Males	48.1	48.3	46.5	45.8	46.7
Persons 20016	47.8	47.4	45.7	45.6	46.0
2006-2016 Persons' age years difference	+ 2.0	+0.6	+1.3	+0.3	+ 1.2

Note: (CEO/GM) are chief executive officers and general managers. ((M(nfd)) are managers not further defined.
Sources: ABS (2017b); Martins & Isouard (2012b).

Table 9: Field of study of managers in health services and all industries, Australia, 2016

Field of study	Percentage of total			
	Hospitals	Medical & other health	All health	All industries
Management & commerce	30.0	28.5	29.3	26.8
Health	31.8	25.0	28.4	3.2
Social & related fields	9.4	12.0	10.7	10.5
Natural & physical sciences	3.0	7.3	5.2	2.7
Engineering & related fields	4.1	3.4	3.7	11.5
Information technology	2. 9	2.4	2.7	3.5
Education	1.9	2.8	2.4	4.1
Food, hospit. & personal care	2.2	1.2	1.7	3.3
Architecture & building	1.1	0.7	0.9	5.7
Other	13.5	16.7	15.1	28.7
All fields of study	100.0	100.0	100.0	100.0

Note: Other includes a very small proportion of managers in agriculture and environment field of study, inadequately defined and not stated and those without tertiary/diploma/certificate completed education.
Source: ABS (2017b).

Asia Pacific Journal of Health Management 2018; 13(3): i26 doi:10.24083/apjhm.2018.12.0026

Table 10: Field of study of managers in health services and all industries, by sex, Australia, 2016

Field of study	Sex percentage			
	All health		All industries	
	Females	Males	Females	Males
Management & commerce	59.9	40.1	43.6	56.4
Health	70.9	29.1	64.7	35.3
Social & related fields	71.8	28.2	56.9	43.1
Natural & physical sciences	55.6	44.4	38.9	61.1
Engineering & related fields	12.0	88.0	5.9	94.1
Information technology	21.1	78.9	17.6	82.4
Education	77.5	22.5	64.5	35.5
Food, hospit. & personal care	60.2	39.8	51.9	48.1
Architecture & building	17.4	82.6	5.9	94.1
Other	65.9	34.1	39.7	60.2
All fields of study	62.1	37.9	38.0	62.0

Note: Other includes a very small proportion of managers in agriculture and environment field of study, inadequately defined and not stated and those without tertiary/diploma/certificate completed education.
Source: ABS (2017b).

Asia Pacific Journal of Health Management 2018; 13(3): i26 doi:10.24083/apjhm.2018.12.0026

Table 11: Level of education of health and all industries managers, Australia, 2006 and 2016

Level of education	Percentage of all levels			
	Hospitals	Medical & other health	All health	All industries
2016				
Postgraduate	34.5	24.3	29.4	14.2
Bachelor	29.9	33.7	31.8	25.4
	64.4	58.0	61.2	39.6
Diploma/certificate	22.5	26.7	24.6	33.2
Other & not stated	13.1	15.3	14.2	27.1
All	100.0	100.0	100.0	100.0
Relative difference index	30.6	20.9	25.7	Standard
2006				
Postgraduate	29.9	20.7	25.8	9.6
Bachelor	29.1	31.2	30.0	19.9
	59.0	51.9	55.8	29.5
Diploma/certificate	22.1	26.8	24.1	31.5
Other & not stated	19.0	21.3	20.0	39.0
All	100.0	100.0	100.0	100.0
Relative difference index	42.4	29.1	36.5	Standard

Note: The relative difference index = $[\sum|\{(a_i/b_i)*100\}-100|] / (2*n)$; ($a_i$) is the proportion of employees of level of education (i) in given health service; (b_i) is the proportion of employees of level of education (i) in all industries; (n) is the number of level of education groups.
Source: ABS (2017b).

Table 12: Level of education of hospital and medical and other health service managers by category, Australia, 2016

Level of education	Percentage of all level of education				
	CEO/GM	M(nfd)	Specialist	Service	All
Hospitals					
Postgraduate	44.2	36.8	37.4	8.1	34.5
Bachelor	31.3	25.8	32.7	12.5	29.9
	75.5	62.6	70.1	20.6	64.4
Diploma/certificate	15.1	19.1	19.5	47.2	22.5
Other & not stated	9.5	18.3	10.3	32.2	13.1
All	100.0	100.0	100.0	100.0	100.0
Medical & other health services					
Postgraduate	33.2	23.9	26.3	8.8	24.3
Bachelor	34.3	30.0	36.8	22.1	33.7
	67.5	53.9	63.1	30.9	58.0
Diploma/certificate	20.0	28.6	24.2	41.8	26.7
Other & not stated	12.4	17.5	12.8	27.4	15.3
All	100.0	100.0	100.0	100.0	100.0

Note: CEO/GM are chief executive officers and general managers. M(nfd) are managers not further defined. Percentages may not add due to rounding.
Source: ABS (2017b).

Asia Pacific Journal of Health Management 2018; 13(3): i26 doi:10.24083/apjhm.2018.12.0026

Table 13: Level of education of health services managers, by sex and category, Australia, 2016

Level of education	Female and male percentage in level by category				
	CEO/GM	M(nfd)	Specialist	Service	All
Females					
Postgraduate	34.5	29.6	32.4	7.7	29.2
Bachelor	32.4	25.4	34.4	19.1	31.8
	66.9	55.0	66.8	26.8	61.0
Diploma/Certificate	19.9	24.7	21.8	37.2	23.8
Other & not stated	13.2	20.3	11.4	36.1	15.3
Males					
Postgraduate	41.8	26.7	32.0	9.6	29.8
Bachelor	33.8	33.9	35.0	16.3	31.8
	75.6	60.6	67.0	25.9	61.6
Diploma/Certificate	15.6	26.2	21.5	54.0	25.9
Other & not stated	8.8	13.2	11.5	20.2	12.5

Note: (CEO/GM) are chief executive officers and general managers. ((M(nfd)) are managers not further defined. Percentages may not add up due to rounding.
Source: ABS (2017b).

Table 14: Average weekly gross income of managers in health services and all industries, Australia, 2006 and 2016

Weekly income	Weekly income ($)			
	Hospitals	Medical & other health	All health	All industries
2016				
Average	2,188	1,991	2,089	1,894
Median	1,985	1,721	1,865	1,589
Standard deviation	1,010	1,132	1,077	1,185
Coefficient of variation	0.46	0.57	0.52	0.63
2006				
Average	1,548	1,436	1,499	1,341
Median	1,411	1,261	1,362	1,108
Standard deviation	769	827	799	882
Coefficient of variation	0.50	0.58	0.53	0.66
2016-2006				
% change of average	+41.3	+38.6	+39.4	+41.2

Sources: ABS (2017b); Martins & Isouard (2012c).

Asia Pacific Journal of Health Management 2018; 13(3): i26 doi:10.24083/apjhm.2018.12.0026

Table 15: Average weekly gross income of managers in health services and all industries, by category, Australia, 2016

Category	Percentage above (+) or below (-) average weekly income			
	Hospitals	Medical & other health	All health	All industries
CEO/GM	+27.0	+32.0	+28.9	+38.8
M(nfd)	+1.9	-5.2	-3.7	+2.9
Specialist	+1.9	+1.9	+1.9	+14.2
Service	-35.6	-32.0	-34.1	-34.2
All managers average weekly income ($)	2,188	1,991	2,089	1,894

Source: ABS (2017b).

Table 16: Average hours worked the week before the census by managers in health services and all industries, Australia, 2006 and 2016

Weekly work hours	Average hours worked			
	Hospitals	Medical & other health	All health	All industries
2016				
Average	43.2	42.0	42.6	46.0
Median	40.4	40.3	40.4	40.8
Standard deviation	16.6	17.5	17.1	17.8
Coefficient of variation	0.38	0.42	0.40	0.41
2006				
Average	41.9	41.9	41.9	46.9
Median	39.7	39.8	39.7	43.6
Standard deviation	17.2	18.5	17.8	19.6
Coefficient of variation	0.41	0.44	0.42	0.42
2016-2006				
% change of average	+1.3	+0.1	+0.7	-0.9

The figures exclude managers who did not state the number of hours worked: 0.5% in health services, and 0.9% in all industries in 2016; and 1.1% in health services and 1.7% in all industries in 2006.
Sources: ABS (2017b); Martins & Isouard (2012d).

Asia Pacific Journal of Health Management 2018; 13(3): i26 doi:10.24083/apjhm.2018.12.0026

Table 17: Average hours worked the week before the census by managers in health services and all industries, by category, Australia, 2016

Category	Average hours worked per week			
	Hospitals	Medical & other health	All health	All industries
CEO/GM	46.6	48.0	47.4	51.3
M(nfd)	44.3	40.7	42.0	45.8
Specialist	43.4	41.4	42.5	46.5
Service	38.8	39.4	39.1	43.8
All	43.2	42.0	42.6	46.0

Note: The figures exclude managers who did not state the number of hours worked: 0.5% in hospitals, medical and other health services, and 0.9% in all industries.
Source: ABS (2017b).

Table 18: Average hours worked the week before the census by managers in hospitals and medical and other health services by sex, Australia, 2016

Weekly work hours	Hours worked per week			
	Hospitals		Medical & other services	
	Females	Males	Females	Males
Average	41.8	45.7	39.2	46.4
Median	40.3	40.6	39.9	40.8
Standard deviation	16.8	15.9	17.0	17.4
Coefficient of variation	0.40	0.35	0.43	0.38

Note: The figures exclude managers who did not state the number of hours worked: 0.5% in hospitals, medical and other health services, and 0.9% in all industries.
Source: ABS (2017b).

Table 19: Managers working less than 35 hours per week before the census in health services and all industries by sex, Australia, 2006 and 2016

Sex	Percentage of managers working less than 35 hours per week			
	Hospital	Medical & other health	All health	All industries
2016				
Females	23.3	29.5	26.3	25.4
Males	9.2	12.7	11.0	10.5
2016 all	18.2	22.9	20.5	15.3
2006				
Females	21.3	28.5	24.4	24.8
Males	9.0	12.0	10.3	9.7
2006 All	16.5	21.7	18.9	15.0

The figures exclude managers who did not state the number of hours worked: 0.5% in health services, and 0.9% in all industries in 2016; and 1.1% in health services and 1.7% in all industries in 2006.
Sources: ABS (2017b); Martins & Isouard (2012d).

Asia Pacific Journal of Health Management 2018; 13(3): i26 doi:10.24083/apjhm.2018.12.0026

Table 20: Average hours worked the week before the census by full-time managers in health services and all industries, by sex, Australia, 2016

Sex	Average hours worked per week			
	Hospitals	Medical & other health	All health	All industries
Female	48.0	47.1	47.6	48.8
Male	48.5	50.5	49.5	53.2
All	48.2	48.6	48.4	51.7

Note: Full-time managers are defined as those working 35 hours or more per week. The figures exclude managers who did not state the number of hours worked: 0.5% in health services, and 0.9% in all industries.
Source: ABS (2017b).

Table 21: Managers who worked more than 48 and less than 16 hours the week before the census in health services and all industries, by sex, Australia, 2016

Sex	Hospitals	Medical & other health	All health	All industries
	Percentage of managers working 49 hours or more per week			
Female	20.1	16.6	18.4	21.4
Male	25.1	29.5	27.4	37.9
All	21.9	21.6	21.8	29.8
	Percentage of managers working 15 hours or less per week			
Female	12.8	17.4	15.1	15.3
Male	6.0	8.5	7.3	6.9
All	10.3	13.9	12.1	9.5

The figures exclude managers who did not state the number of hours worked: 0.5% in health services, and 0.9% in all industries.
Source: ABS (2017b).

Table 22: Marital status of health service managers and all industries, Australia, 2006 and 2016

Marital status	Percentage			
	Hospitals	Medical & other health	All health	All industries
2016				
Never married	17.6	20.6	19.1	24.0
Married	66.5	65.0	65.9	63.9
Divorced/separated	14.6	13.4	13.9	11.2
Widowed	1.3	1.0	1.1	0.9
All 2016	100.0	100.0	100.0	100.0
2006				
Never married	16.9	19.3	17.9	21.9
Married	66.0	66.2	66.1	65.9
Divorced/separated	15.4	13.4	14.5	11.3
Widowed	1.6	1.2	1.4	0.9
All 2006	100.0	100.0	100.0	100.0

Note: Figures may not add up due to rounding. (Married) includes those in a partnership.
Sources: ABS (2017b); Martins & Isouard (2012d).

Table 23: Country of birth of health service managers and all industries, Australia, 2006 and 2016

Country of birth	Percentage			
	Hospitals	Medical & other health	All health	All industries
2016				
Australia	72.1	67.3	69.7	68.7
New Zealand & Oceania	3.8	3.5	3.7	3.8
United Kingdom & Ireland	10.1	9.3	9.7	7.7
Other Europe	2.9	2.9	2.9	3.8
Other	11.1	17.0	14.0	16.0
All 2016	100.0	100.0	100.0	100.0
2006				
Australia	75.6	72.5	74.3	73.2
New Zealand & Oceania	2.8	3.2	3.0	3.5
United Kingdom & Ireland	11.1	10.1	10.7	8.4
Other Europe	7.5	9.7	8.4	10.9
Other	3.0	4.5	3.6	4.1
All 2006	100.0	100.0	100.0	100.0

Note: Health service managers who did not state their country of birth constituted 1.5% of the total in 2006 and 1.0% in 2016. Figures may not add up due to rounding.
Sources: ABS (2017b); Martins & Isouard (2012d).

Table 24: Indigenous status of health service managers and all industries, Australia, 2006 and 2016

Sex	Indigenous percentage			
	Hospitals	Medical & other health	All health	All industries
2016				
Females	1.5	2.3	1.9	1.2
Males	1.0	2.0	1.5	0.8
All 2016	1.3	2.2	1.7	0.9
2006				
Females	1.0	1.5	1.3	0.8
Males	0.8	1.5	1.1	0.5
All 2006	1.0	1.5	1.2	0.6

Note: Managers who did not state their indigenous/non-indigenous status constituted 0.6% in all industries and 0.5% in health services in 2006 and 0.4% in both cases in 2016.
Sources: ABS (2017b); Martins & Isouard (2012d).

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A Study on Management of Health Care Infrastructure Development in Rural India: Critical analysis of current status and future challenges

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Abstract

The study has focused on the role of rural health infrastructure development in India. Currently the health infrastructure development of India is poor and it needs fundamental reforms to deal with new emerging challenges. The role of private providers is increasing but simultaneously healthcare facilities are becoming costly. The study surveys the present position of rural health care infrastructure growth, the development of infrastructure, health care facilities, position of human resource, and quality of service delivery.

The paper suggests future challenges of Indian healthcare infrastructure development in rural area, as the burden of disease, financial deficiency in a large section of the population, vaccination policy and poor access to health care. Longevity, literacy and per capita income are further considerations.

Keywords: infrastructure, services, longevity, rural healthcare, delivery and facilities

INTRODUCTION

The research investigates the rural health infrastructure development in India, one of the largest population's country in the world. Delivery of healthcare facilities to each everyone is a very difficult task. The Indian ministry of healthcare is required to formulate a centralised organisation which would be healthcare centres based, across the 29 states of India, connecting with local self-governance organisations or Panchayats. The public healthcare centres and hospitals have been unsuccessful in developing a proper integrated approach model which can stop the spread of epidemics and disease. About 70 percent of India's population lives in rural communities but only 20 percent of healthcare centres beds are in rural areas. The paper explores the majorly healthcare infrastructure prerequisite in fast-tracking the jump of healthcare infrastructure both financial and social elements. The healthcare infrastructure development is that which openly simplifies the intervention process. Considerations include transport facility from village to health centres, communication and technology, energy, irrigation, banking and the services facilities comprising of economic development and healthcare infrastructure. [1]

NEED AND SIGNIFICANCE OF THE STUDY

The literature review identified the issues in rural healthcare infrastructure service delivery in India. The use of the private sector has increased significantly and, includes increased use by the rural poor suggesting inadequacies and poor access to public healthcare facilities. The bed facilities in the rural healthcare centres have increased from about 36000 to 38000 in the period from 2000 to 2014, beds in private hospital increased from 49000 to 67500. [2] This represents approximately a 40% increase in the private hospital bed facilities in a period of 10 years in comparison to approximately 5.5% increase in the government hospital facilities beds.

About 5000 physicians work in the government healthcare facilities whereas comparatively double the number work in the private sector. The private sector surpassed the government healthcare services facilities in the delivery of refined modalities of diagnosis and therapy, such as CT scan, MRI scan units. Simultaneously, government health services are at risk to internal privatization, having to acquire diagnostic services from the private sector. Emerging nations have been concentrating on pertinent infrastructure improvement in rural healthcare centres, technology development, prevent the disease spread, and healthcare results in terms of deaths and disability-accustomed life years, fundamentally overlooking the service quality improvement characteristic from the patients' perspective.

Research objectives were to examine the policies and practices of government of India for healthcare infrastructure development in rural areas, to investigate the effective competence of the health services facilities and delivery of the infrastructure services to the rural area people of India. To suggest factors which influence the effective management of rural health care infrastructure services hypothesis were constructed to test the data analysis and statistical analysis. These were:

Hypothesis-1: Beneficiaries are satisfied with healthcare infrastructure services provided by the healthcare centres in India.

Hypothesis-2: Beneficiaries are highly dependent on availability of healthcare infrastructure facilities of healthcare centres in India.

Hypothesis-3: There is a substantial deterioration in the rural healthcare centres for the providing operational efficiency of health care system in India.

LITERATURE REVIEW

Narayana [3] has explained the important objective is to develop the economic feasibility and excellence of health care in government hospital in the states of Andhra Pradesh and Telangana, these two states have introduced a succession of improvements. However, because of an absence of human resource, there has been inactivity and deterioration in the improvement of healthcare centres. Abhijit Banerjee [4] (2004) described health care centres services distribution in the state of Rural Rajasthan. His study reported on a review in Udaipur to measure the delivery of services from healthcare centres to rural people in Rajasthan and the influence it has on the health outcome of the mostly deprived people of the region. He found that the public service is extremely low and that private providers provide the majority of health care provision.

Chungkham Holendro Singh [5] has explained the PPP model disparity of delivering the infrastructure facilities in health care centres and healthcare budgets in India: The examination discovered that more than 58 percent of the patients have been treated in private healthcare in India. The average cost of treatment in private hospitals is Rs. 5,019 to Rs. 1,307 for government hospitals. The mean accustomed cost of treatment of heart diseases is Rs. 5,981, surveyed by Rs. 5,402, Rs. 4,616, Rs. 2,478 and Rs. 891 for urological diseases, gynaecological disorders, tuberculosis and diarrheal diseases. Shankar Prinja, [6] in 2012 undertook a study to determine inequities in healthcare facilities, service consumption and Out-Of-Pocket (OOP) health expenditures in two States in north India namely, Haryana and Punjab, and Union Territory of Chandigarh. Anitha and Navitha Thimmaih [7] 2013 study focused on the 'Satisfaction from Primary Health Care Services: A Comparative Study of Two Taluks (administrative districts) in Mysore District'. The utilization of any collective services with health care facilities have never been justifiably evaluated. Beside with maximum services facilities provided to the people, it is also significant to be able to relate to admittance to community services particularly health care services and its relationship with other variables. It would be stimulating to study the association between services used and satisfaction.

The World Health Organization [8] report views the access to health workers in isolated and rural health areas as a huge problem of providing connecting points to villages to healthcare centres and the delivery more so than a lack of human resource. The activities of health workers in general, such as income rates, non-attendance, redundancy or twin employment has an association between the causes manipulating the choices and pronouncements of health workers to practice in remote and rural areas and the detractors that could answer to those factors.

Kaveri Gill [9] study concluded that the healthcare National Rural Health Mission (NHRM) is on the right track for the addressing rural health care through the healthcare centres variations inside the healthcare policies. But there are difficulties in execution of the healthcare model, so that provision is variable with respect to healthcare centres infrastructure facilities services, treatments and finance. Whereas with respect to Duggal [10] his study on the availability of health care facilities in India, revealed that India has a plurality of health care systems as well as different systems of medicine. The government and local administrations provide public health care in hospitals and clinics. The rural health centres are underutilized because they cannot make available services their customers anticipated in quantity of consideration and medication and services. Hanan AL-Ahmadi et al [11] found that the factors that are determining the high-quality care are management & administrative aspects, execution of suggestion-constructed practices, specialized expansion, use of recommendations to subordinate care and structural values. The other factors that are required in order to improve quality are the knowledge and skills of staff.

The rural health care system in India has been established as a three tier Model with Sub Centre, Primary Health Centre (PHC) and Community Health Centre (CHC) being the important three pillars for rural healthcare development. The Sub Centre is the

furthermost marginal and main connecting point between PHCs and CHCs, however the PHC is the first connecting centre to the village and the medical centres in the rural area, and CHC is the centre for four PHCs, and provides facilities for the beneficiaries. The development of these health infrastructure facilities, especially growth of the Sub Centres is a precondition for the whole progress of the complete system. Accessibility of manpower and quality of health care services are other significant components of health care infrastructure.

The founding of these rural centres is constructed on definite population norms which is different for Plain areas and Hilly areas according to the NRHM [12]. "The population norm in Plain areas is 5000 per Sub Centre, 30000 per PHC and 120000 per CHC; whereas that for Hilly/Tribal/Desert areas is 3000 per Sub Centres, 20000 per PHC and 80000 per CHC. Further, there will be six Sub Centres per PHC and four PHCs per CHC. The population norm for a female health worker at Sub Centre & PHC and a male health worker at Sub Centre are fixed at 5000 for Plain areas and 3000 for Hilly/Tribal/Desert areas". [12]

METHODOLOGY

The research study has collected the information from primary data and secondary data. The first-hand data has been collected from the beneficiaries and provider in the rural healthcare centres by administering structured questionnaire. The questionnaire has been a blend of open ended and close-ended questions. An appropriate scaling technique has been used to measure the response and all secondary data pertinent document and published reports have been referred and the researcher has visited the field to collect the information. Semi structured interviews were conducted with provider of rural healthcare services such as medical officer, store assistant and ASHA (Accredited social health activists) workers in selected healthcare centres.

The research paper followed mixed methods and analytic tools have been used to assess the healthcare infrastructure facilities from the rural Healthcare centres in the form of both structured and semi-structured questions from the different stakeholders and providers as well as attention groups discussion planned to highpoint the foremost extents of disappointment of both facilities providers (health workers) and their clients. The main determination is to understand the variety in the plaintiff's responses [13] The total sample size is 450 based on random sampling methods. The data has been collected from the rural healthcare centres from the providers, beneficiaries and NGOs.

DATA ANALYSIS

The data analysis involved a multiple regression model used for analysing variables (total 10 variables). The detailed of the data analysis has been made available but not been included because of Journal word limit requirements.

RESULTS AND DISCUSSION

The results indicate infrastructure facilities improvement of the rural healthcare centres in India were found to be insignificant and that the PHCs infrastructure facilities are in very poor condition and, it needs to improve the facilities in the PHCs of the tribal area region. Most of the beneficiaries and providers tend toward strongly agreeing with the concept that the rural healthcare infrastructure has not significantly affected healthcare delivery services in the state of the Andhra Pradesh, Telangana, Madhya Pradesh, CG, UP and Orissa. The research study has concluded that

the rural health care infrastructure facilities have not significantly affected healthcare delivery services in India. A comparison of common factors clearly shows that infrastructure delivery services at PHCs and availability of critical manpower at PHCs emerge as key factors for the effective delivery of services in the rural area of India showing the improvement and evaluation of the performance of the rural area health centres.

The study has taken into consideration three ways of services connected to rural healthcare delivery facilities, one is infrastructure improvement at PHCs, the availability of critical manpower at PHCs and coordination with community by Accredited social health activists (ASHA) at PHCs.

CONCLUSION

Healthcare infrastructure improvement is a vital aspect in the rural areas of India. The research paper analysed various factors that contribute to the performance of rural healthcare infrastructures. It can be concluded that reliability in healthcare centres delivery, can be improved by providing infrastructure facilities, involvement of and coordination with the community as influencing the performance of healthcare services. The study also identified the factors influencing healthcare services delivery and development with infrastructure facilities and concluded that lack of effective delivery services in rural services centres.

The majority of the respondents have expressed their view in respect of poor facilities in rural healthcare centres, those shortages in energetic human resource facilities in healthcare centres and very poor management in managing the levels of supporting staff essential. This has been the main antagonistic effect on the rural healthcare centres services and the insignificant impact on the health-care infrastructure delivery services.

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