Chapter 14
International Perspectives: Australian Ambulance Services in 2020

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Introduction

Australia is huge, with a landmass similar to North America, but with only 27 million citizens, compared to over 350 million in the USA. Western Australia (WA) is the third largest subdivision of a country in the world; it is, at over 2.5 million square kilometres, larger than Alaska, the largest US state, and is only superseded by the northern region of Brazil and the Sakha Republic of Russia. Ambulance services in Australia are disparate in all dimensions, using varying combinations of personnel, including community first responders, volunteer ambulance crews, paramedics, extended care paramedic (ECP) services, air ambulance and rescue. Although Australian states and territories are responsible for the provision of ambulance services, WA and the Northern Territory contract non-government bodies such as St. John Ambulance to provide patient care and transport with all ancillary facilities. Australian ambulance services are funded largely by a combination of direct State or Territory revenue, subscription schemes and user charges. The total 2006/2007 revenue for ambulance services across Australia was $ 1.6 billion, with government providing 64.8 % of the total allocation (New South Wales Department of Health 2008).

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State of Australian Ambulance Services

Paramedics in Australia are not regulated at a state, territory or federal level, and the issue of registration incites impassioned arguments. Accreditation of paramedic continuing education and competence to practice is currently solely managed by individual ambulance services, albeit in association with voluntary continuing professional development (CPD) schemes run by representative bodies. A recent poll of paramedics by Paramedics Australasia attracted 4000 responses, with 86.7% supporting registration under a national scheme (Bange and van Biljon 2012).The implications of this lack of registration are that there are no validated and independent measures of knowledge or competence transferable between services, states or even countries, and there are no common curricula or definitions accepted by employers (Thom et al. 2014). Another significant handicap arising from the lack of registration is that the opportunity to self-regulate and maintain standards of practice, the hallmark of any professional group, is denied to paramedics as a group, and therefore, this remains a function of employers. Maintenance of standards and disciplining of poor performers usually then become an adversarial battle between employers, paramedics and union representatives.

Paramedics in Australia also perform much of their work according to either protocols or guidelines (Shaban et al. 2004). Being a specific set of step-by-step instructions to perform a defined task, protocols carry the implication that their content has to be adhered to with no room for choice and judgement, whereas guidelines suggest that there is room to interpret the instructions in the light of patient condition and available evidence. Clinical guidelines should be based on the best available evidence and provide recommendations for practice about specific clinical interventions for specific patient populations; however, it is uncertain whether either protocols or guidelines which drive paramedic practice are based on appropriate methodology or whether they solely reflect eminence-based opinion. Furthermore, and most importantly, paramedics are not taught to work within any diagnostic paradigm. There has been much contemplation regarding medical diagnosis, whether using exhaustive, hypothetico-deductive or pattern-recognition techniques; however, this has not translated in Australia to a similar discussion within paramedicine.

Paramedics in Australia largely concentrate on the traditional delivery of prehospital care. This means that prioritisation is carried out on 000 call receipt, in many jurisdictions using dedicated software, such as the ProQA®/Medical Priority Dispatch System (MPDS)®, using the chief complaint and a set of predetermined questions. On arrival at scene, Australian paramedics carry out patient assessment with variable degrees of systematic structure, not always orientated around the identification of threat to life or the potential for deterioration, and sometimes having more in common with the comprehensive secondary survey than the risk-identifying primary survey.

Coupled with a slow incremental increase in the perceived importance of identifying early abnormalities in physiology in order to risk-stratify patients, and a lack

of focus in targeted history taking, barriers to the effective identification of at-risk patients, and to the ability of paramedics and ambulance services to perform a valid secondary triage of patients on scene are significant. As a consequence, paramedics are not trained in the effective assessment of risk and the potential for deterioration, and thus inappropriate non-transport decisions may be made. Without the ability to recognise sentinel symptoms and signs and to place these in the context of the patient's physiological condition, errors occur in advice given to patients and in the weight placed on history and examination (Middleton and Malone 2010).

Issues have been identified with both maintenance and supervision of quality of care in the prehospital phase of emergency care. Callaham (1997) stated that '… because there is such a paucity of scientific support for EMS interventions and because monitoring of outcomes and adverse effects is so poor, a serious re-examination of EMS practice is indicated'. This is especially relevant in Australia, as there exist a number of highly technologically advanced ambulance services, allowing a large number of clinical interventions, but serving a vast area with a sparse population. This leads to infrequent performance of many interventions, with frequency often being in inverse proportion to the urgency of the situation.

Experimental projects in Australia have trialled extended care models of paramedicine, enabling ambulance services to elect not to transport patients to hospital, in instances where the chief complaint is one which can be managed with either extended role paramedic skills or through alternate referral patterns (Blacker et al. 2009). This appears to have been effective in many jurisdictions, based upon metrics such as a reduction in the number of patients transferred to emergency departments (ED); however, there has been little other measurement of effectiveness as evaluation has largely been confined to assessment of structure and process, rather than patient outcome. This satisfies the need for services to be seen to be working to reduce the emergency care burden but does not allow recognition of any true value to patients.

The final, and potentially the most important aspect of all, is that only in WA is data from the prehospital phase of care linked to date from in-hospital care, to allow investigation of outcomes in patients treated and transported by ambulance services. In all other jurisdictions, data generated within ambulance, comprising automated dispatch data and increasingly, electronically captured patient healthcare details, including patient history, examination findings, physiological variables and both pharmacological and physical interventions, are entirely separate from data gathered within the ED or hospital. Data transfer from ambulance to hospital is largely printed-paper-based even when a prehospital electronic healthcare record is used, negating many potential benefits of timely information sharing. There is also minimal return and sharing of hospital process and outcome data with ambulance services, leading to the situation where the majority of services and paramedics have no idea of patient outcome, beyond a very limited number of patients included in quality registries such as those with severe trauma. The lack of this knowledge means that there is no way to judge the effectiveness of the entire prehospital phase of care, whether on a system or individual patient level (Al-Harbi et al. 2012; Dean et al. 2001).

Australian Ambulance Services in 2020

This section highlights few key focus areas that would help to revolutionise the paramedicine and prehospital care in the next decades. Each of the areas is discussed in some detail.

Ambulance Services as the Prehospital Element of the Health Service

The first and most critical step is the philosophical conversion of Australian ambulance services from separate and disparate emergency services to fundamental elements of the health services, acknowledging that they provide the prehospital phase of emergency medical care. There is an almost irrefutable argument that, as the pathology which brings patients into the emergency care system is frequently undifferentiated and time-dependent, the processes of structured assessment, resuscitation, stabilisation and diagnosis should be taken to the patient to as great an extent as possible (Brun et al. 2014; Ebinger et al. 2014a, b).

The implementation of such a philosophical paradigm across Australia will be most effectively organised and driven by a central, federal agenda, which in itself will need to be driven by the processes and practices of the clinical quality movement. Australia has a federal agency responsible for clinical quality, The Australian Commission on Safety and Quality in Health Care (2014) created by Health Ministers in 2006 and funded by all governments on a cost-sharing basis, to lead and coordinate healthcare safety and quality improvements in Australia (Australian Commission on Safety and Quality in Health Care, Governance 2014). This is supported by organisations such as The Australian Institute for Health and Welfare, a national agency set up to provide information and statistics on Australia's health. Collaboration with the Council of Ambulance Authorities, the informal body formed to provide leadership for the provision of ambulance services in Australia, and having representatives from both ambulance executives and clinicians, is likely to be of significant importance.

Paramedic Registration

This description of ambulance services with an evolved place in the health system naturally lead to the next most important strategic step by 2020, which is national registration for paramedics. In their submission to the Australian Health Ministers' Advisory Council on options for regulation of paramedics, Paramedics Australasia identified a list of risks of paramedic practice in its current form, and seven areas that would benefit from registration (Table 14.1; Paramedics Australasia 2012).

Table 14.1 Risks and benefits in relation to paramedic registration. (Paramedics Australasia 2012)

Risks in paramedic practice	Benefits of registration
Invasive procedures	An independent complaints mechanism
Administration of scheduled drugs	Approved educational and practitioner standards to use the title 'paramedic'
Working away from supervision	Prevention of paramedics with 'issues' moving from job to job
Provision of complex and critical clinical assessments and care	Checks a condition of practice
Working in dangerous and uncontrolled settings	Compulsory and independent accreditation of training and education

Registration has a major impact in two specific areas—maintenance of education and practice quality, and self-regulation. As detailed in the Paramedics Australasia submission, compulsory, independent accreditation of both training and educational standards allows the development of a common curriculum for all paramedics, in both undergraduate and postgraduate settings. Registration can therefore clearly have benefits for paramedics, ambulance services and patients, ensuring high-quality education and practice, and would support moves toward integration within health services. Registration is potentially the single most important early step for ambulance services and government agencies to undertake for the future.

E-learning and the Education Revolution

The 'tyranny of distance' was mentioned earlier in the context of learning and continuing education in Australia. Currently, in 2014, there is a National Broadband Network being constructed across Australia, and although subject to infrastructural change driven by the prevailing political cycle, seems likely to deliver substantial capability in internet delivery. Australia's current internet download speed ranks 32nd in the world, at 5.8 Mbit/s, compared to the UK and the USA with almost twice this speed and is almost a quarter of the world leader, South Korea, with 22 Mbit/s (Australian Government Department of Communication 2012).

Notwithstanding this change, the ability of such a network to enable high-quality e-learning to distant sites, resulting in the implementation of asymmetric initiatives such as blended learning, combining online theory and face-to-face skills training; 'flipped classroom' models, with paramedics collaborating online then being guided through exercises in the classroom; and live discussion and guided learning through webinars, means that paramedic education is likely to be revolutionised. Implementing and utilising these technological innovations in the context of a national curriculum and supervised quality maintenance and CPD programs seem likely to exponentially increase these benefits.

Clinical Reasoning

Another radical but necessary evolution in Australian paramedicine, in order to deliver truly twenty-first century services integrated into the health system, is the development of a curriculum based on clinical reasoning. Linn defined this as 'the cognitive process that underlies diagnosis and management of a patient's presenting problem' and although potentially providing an educational challenge, is an absolute necessity to reduce risk for patients and allow paramedics to evolve into a discipline that is able to fit into the health service model as the initial element of emergency care (Linn et al. 2012).

Currently, as mentioned above, paramedics perform their function by following protocols, or at best less restrictive guidelines, in order to establish a presenting pattern of pathology that may be treated within a particular protocol. This methodology of practice carries with it, however, several inherent problems. Firstly, paramedics often contort presenting complaints into a 'diagnostic box', as they are told that they are unable to diagnose but may simply 'assess' a patient; they make the diagnosis fit the protocol. This clearly predisposes a patient to inappropriate or inadequate management, or both (Shaban et al. 2004; O'Hara et al. 2015).

Secondly, there is little structured risk assessment performed within the paramedic approach; therefore, delineation of the impact of pathology, degree of compensation, patient deterioration and prioritisation of interventions are limited to a substantial and worrying degree. Although many services and paramedic educators teach an advanced life support (ALS)/advanced trauma life support primary survey algorithm, the necessary theoretical underpinning is often absent to some extent, leading to a lack of appreciation not only of the value of measured physiological variables but also of the relative importance of abnormalities. Thus, for instance, a common error is the reliance on a normal oxygen saturation and systolic blood pressure to reassure paramedics that the patient is stable, whilst ignoring the presence of marked tachypnoea and tachycardia, which indicate deterioration but ongoing compensation and unlike the prior measures which, when abnormal, imply late loss of compensation (Cretikos et al. 2008).

Finally, rigid and linear assessment protocols, without the training and theoretical knowledge to estimate risk and consider underlying pathological processes, ensure that paramedics are seldom in a position to appreciate the potential for deterioration rather than actual deterioration which can be seen in front of them. The possibility of incipient airway obstruction, respiratory failure or decreasing perfusion and shock may take second place to obvious, but less serious, problems which may be stable such as limb injuries.

Clinical reasoning allows the presentation of more than one initial hypothesis, then the use of available information and structured questioning to reprioritise likely explanatory variables, using relative positive and negative findings to refine the likely diagnosis and prioritise interventions. A syllabus in clinical reasoning, even though not necessarily as comprehensive as that delivered within the context of a medical degree and postgraduate training, will still equip paramedics to consider the

relative impact of disease, as well as to examine patients in relation to the potential for life threat, assign levels of risk and intervene without diagnosis. A clear outcome of the informed clinical reasoning approach is that there may then be a decreasing reliance on rigid protocols to determine paramedic practice and an increasing ability to use interventions based in clinical risk. In this way, the response to an emergency call may, in reality, constitute a genuine first point of contact with emergency care rather than a service simply for the transport of patients.

Extended Care Paramedic Models

Many ambulance services have experimented with ECP models, which are based in the paradigm change from 'taking the patient to care' to 'taking care to the patient'(Blacker et al. 2009). ECP programs range in theoretical and philosophical underpinning from the performance of simple nonemergency interventions, such as the changing of urinary catheters, wound care and suturing and the administration of antibiotics for minor infections, to the performance of '…thorough medical examinations, risk assessment and development of patient management plans based on a predominantly medical model' (New South Wales Health: Ambulance Service of New South Wales 0000). Although this appears to represent an important development in the role of ambulance services and paramedics as part of the health system, there appears to be no attempt at analysing the impact of the ECP model on patient outcomes.

In keeping with most system innovation developed within the context of the bureaucratic health service model, measures of success are centred on metrics process such as the decrease in patient transports to hospital, and whether staff and patients 'like' the innovation. This approach to system analysis unfortunately sidesteps the question of whether it is actually good for patients, and does not recognise the intrinsic scientific problem that patients may simply be lost to follow up and therefore will not figure in any form of audit. Given that paramedics do not currently perform any structured history or examination based in the identification of risk or deterioration, documentation of less than optimal outcomes is currently very unlikely. Future ECP programs will need to be based on a predefined and scientifically designed plan to assess the programs not only in terms of the effect on the patient but also of the associated health economic effects.

Human Factors and Error

Clinical governance was discussed earlier with respect to the benefits of registration, however there are other vital areas for consideration, in particular relating to the prevention or minimisation of error and adverse events, and to maintenance of clinical quality. There is increasing recognition that there are patterns of related contributory components within adverse patient events, with an average of 10 con-

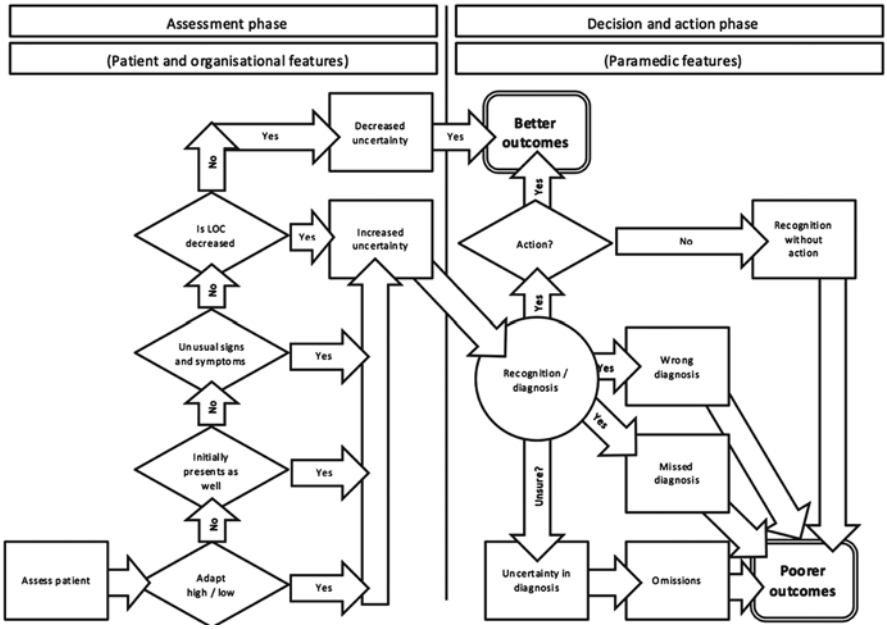

Fig. 14.1 Flow chart demonstrating possible relationships within some serious patient harm events (Price et al. 2013). *LOC* loss of consciousness

tributory factors per reported case (Price et al. 2013). This is particularly significant in prehospital care as resources, both human and technical, are extremely limited with little potential for escalation. Situations such as patient deterioration are magnified and exponentially worsened by coincident factors such as communication errors, case complexity, lack of room and adaptation from low to high acuity. Structured approaches may lend coherence and stratify risk and urgency in this situation, but the importance of recognising human factors within error is vital. Training in decision-making, largely based in realistic simulated scenarios, is likely to have a substantial impact on paramedics' ability to make good decisions in unfavourable and austere circumstances (Mundella et al. 2013; Fig. 14.1).

Cardiopulmonary Resuscitation Quality

The use of clinical governance in the maintenance of quality is similarly complex and far-reaching, but one area within which evidence is quickly accumulating to support change is in the measurement of interventional quality in emergency situations such as cardiac arrest. A worrying body of research has demonstrated that cardiopulmonary resuscitation (CPR) quality is highly variable in both prehospital and hospital-based environments and has shown wide variation in compression rates

and depths, frequent long pauses in CPR, and hyperventilation during resuscitation care (Aufderheide et al. 2005; Wik et al. 2005; Milander et al. 1995). Conversely, intense focus on measuring and improving the quality of CPR has shown that direct measurement of these variables and the addition of real-time feedback drastically improves performance and patient outcomes such as survival (Abella 2013).

In light of the clear relationship between the quality of interventions such as CPR and improvement in patient outcomes, it is difficult to justify training or practice in the prehospital arena which is not subject to careful and continuous quality measurement and maintenance. This therefore needs to be a mandatory component of paramedic education and CPD. International jurisdictions such as King County in the USA have increased the survival from a 'shockable' cardiac arrest from 27% in 2002 to 62% in 2014 (Public Health, Seattle and King County 2014) in contrast to an average rate of approximately 20% in Australia, and an overall survival rate of 10% (Cheung et al. 2013) largely by the intensive measurement and improvement of CPR and system quality. Australian ambulance systems should adopt this approach as rapidly as possible.

Simulation

Given the previous discussion regarding the difficulties in education across large distances with staff and educators highly separated by geography, the use of simulation becomes inescapable. Clinical education has to incorporate the learning of scientific principles but also demands objective measures of competence in the domains of knowledge, skills, and behaviours (Rosen 2008). Practice is a fundamental component of learning and maintenance of skills in many disciplines and in particular in interventional clinical domains. Studies have shown that performance on ALS scenarios improved significantly with repetitive practice using a medical simulator compared to clinical experience alone (Wayne et al. 2010). Use of a computer-enhanced mannequin in a structured educational program, with opportunities for deliberate practice, yielded large, consistent and sustained improvements in residents' skills with little decay over time.

A recent systematic review and meta-analysis suggested that simulation was of particular benefit in learning and perfecting skill-based processes, with potentially improved effectiveness from 'booster' practice or 'spaced education', the inclusion of team and group dynamics, distraction and integrated feedback (Mundella et al. 2013). Research in emergency medicine residents also found simulation to be effective at teaching metacognitive strategies, or knowledge about when and how to use particular strategies for problem solving, an area particularly useful when attempting to educate paramedics in the techniques of managing undifferentiated patients under conditions of stress and multiple distractions (Bond et al. 2004). Future progression towards models of ambulance services integrated with health services is dependent on carefully planned educational strategies based on necessary outcomes.

Data

It was described earlier that ambulance data, albeit comprehensive, are not linked with data from the rest of health, and despite comprehensive data on patient-level transactions, ambulance services have no knowledge of outcomes beyond the hospital door. Thus, there is currently little knowledge of any outcomes for these patients transported by ambulance, even from the level of ED; therefore, strategic questions concerning whether prehospital patient care is optimal, cost-effective or even clinically correct are unanswerable.

Conclusion

Fundamental to ambulance services in 2020 will be the ability to analyse and measure the quality of systems and processes in relation to patient outcomes. Adherence to targets for response times based on averages from other jurisdictions remote in geography, time and design needs to be replaced with carefully analysed linked data using sophisticated statistical techniques, including regression and survival analyses, as well as comprehensive health economic evaluations, in order to allow patient outcomes to be utilised to determine the effectiveness of ambulance practice.

Only when ambulance systems are formally part of health services, overtly providing the prehospital phase of a continuum emergency care, with paramedics assessing patients in a structured, risk-aware form based in clinical reasoning, and with processes, systems and interventions based on proven effectiveness, measured by clinical outcome at later stages in the patient journey, will Australian ambulance services truly have come into the twenty-first century.

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