

RESEARCH

Clinical presentations, physician consultations and patient transport options for Australian remote and industrial paramedics

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Abstract

Introduction: The aim of this study was to provide a snapshot of Australian remote and industrial paramedics' patient clinical presentations, experience with physician consultations and options for patient transport to tertiary care.

Methods: This exploratory, cross-sectional descriptive study employed a purpose-built online survey. Participants were 78 paramedics working in Australian rural and remote industrial settings recruited in 2015 using web-based, respondent-driven sampling. In addition to a series of closed ended questions, respondents were asked to recall the number of times they encountered specific clinical presentations during the past year. Data were analysed using descriptive statistics and modes were calculated for ordinal data associated with clinical presentations.

Results: The traumatic presentations that participants recalled encountering at least 10 times the preceding year included back pain (39.7%), minor lacerations (38.5%), joint (36.4%) and hand (30.8%) injuries. Respondents selected headache (64.1%), nausea, vomiting or diarrhoea (52.6%), respiratory infections (50%), ear, nose or throat problems (43.6%) and localised infections or rash (39.7%) as the most common medical presentations. Of the respondents, 38.4% managed patients with mental health presentations a minimum of six times in the preceding year, and 45.3% treated at least one patient in cardiac arrest. While 94.8% of participants said topside support was available, over half described consulting physicians infrequently and if they did, it was typically by telephone. Most respondents (61%) indicated that their worksite was located over 100 km from a hospital.

Conclusion: Survey findings indicate that paramedic participants recall encountering a wide range of clinical presentations and managing low acuity illnesses more commonly than traumatic injuries. Most respondents were located at least 100 km from the nearest hospital and although almost all had access to topside support, over half stated they consulted physicians infrequently.

Keywords

paramedic; industrial; remote; workforce; pre-hospital

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INTRODUCTION

Exceeding 7.6 million km² in size, Australia is a vast country rich in natural resources.(1) With over 140,000 people working in the mining sector alone, there are thousands of staff at any given time employed in remote settings across the country.(2,3) Work in the resource sector is typically performed in isolated and austere environments by rotational shift workers who have varied scheduled and unscheduled healthcare needs. These range from preventative care (4) and maintenance of chronic conditions (5,6) through to emergency

response for serious illness or injuries.(7) Although the risk of trauma is ever present,(8) there is evidence of a change in pattern with medical illness overtaking injury as the predominant reason for evacuations from remote worksites.(9–11) Recent literature has also highlighted an increased prevalence of well-being and mental health concerns in the remote workforce.(5,6,12)

To meet the legislated health and safety needs of their workers, resource companies provide medical assistance using a number of different models depending upon their size and location.(10) While physicians and occupational nurses historically provided the majority of

healthcare to industrial employees globally, chronic health workforce shortages have left a gap.(13) Over time paramedics have been recruited to these positions with the 'industrial paramedic' viewed as an emerging speciality role.(14,15) In Australia, for example, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) reported that 23 out of 71 manned offshore facilities were staffed by paramedics in 2017 while a further 10 facilities had either paramedics or registered nursing personnel.(16)

In many instances, remote healthcare workers, especially those offshore, work independently and may need to manage a patient for hours before they can be safely evacuated. Advice and support are available as needed via remote access to physicians. Colloquially referred to as 'topside support',(10) this clinical advice and decision making support is useful in emergency situations as well as to reduce or defer unnecessary medical transports for stable patients.(9) Various forms of telehealth are available to facilitate these consultations, ranging from simple telephone calls to transmitting ultrasound images real time via satellite.(4,17,18)

Striving for a global approach in the provision of remote healthcare, the Institute of Remote Healthcare (IRHC) in the United Kingdom consulted industry experts to develop a core competency and training guide. The resulting document outlines four key areas of responsibility for remote healthcare workers including emergency management, primary healthcare, occupational medicine and clinical governance and health administration.(19) Historically, paramedics have been well suited to perform competencies in the emergency response domain which continues to dominate paramedic education.(20,21) Driven by a need to improve health outcomes in rural and remote communities, paramedic practice is evolving to include primary and preventative healthcare.(20,22) Accordingly, Australian undergraduate and postgraduate paramedic curricula are gradually changing to better prepare paramedics to meet the needs of the broader healthcare system in the remote and industrial setting.(21,23)

As paramedics continue to establish themselves as more holistic practitioners, more research is needed to understand the specialty role of the industrial paramedic including the types of patients they encounter, when and how they access topside support, and what transport options are available for their patients. The aim of this study was to provide a snapshot of Australian remote and industrial paramedics' patient clinical presentations, experience with physician consultations and options for patient transport to tertiary care. The findings from this study can be used to inform future research on industrial paramedic practice and to support changes to existing paramedic curricula.

METHOD

Study design

This exploratory, cross-sectional descriptive study employed a purpose-built online survey instrument titled 'Remote and Industrial Paramedicine'. The survey was administered to Australian remote and industrial paramedics in 2015.

Participants and eligibility

Paramedics who self-identified as having work experience in rural and remote industrial settings in Australia were eligible to participate in this workforce survey.

Recruitment

The participants were recruited using web-based respondent-driven sampling (WebRDS), a strategy known for its usefulness when targeting a relatively small and specialised group.(24) The researchers invited participation via the social media platforms Twitter™ and LinkedIn™. The hashtags #remoteparamedicine and #industrialparamedic were used on Twitter™. Groups on LinkedIn™ included those with a focus on remote paramedicine and natural resources. An invitation to participate and link to the survey were also sent to specific organisations in the resource sector who employed remote paramedics. These included companies such as Aspen Medical, International SOS, SiteMed, St John Ambulance and ER24. Using a network-based, snowball type sampling method, the researchers also sent the survey link to specific individuals known to them and encouraged the link to be forwarded to others in the sector. Lastly, Paramedics Australasia, a former peak professional body representing paramedics in Australasia, assisted by posting information about the survey in their trade magazine *Response*.

Instrumentation

A purpose-built questionnaire was developed to gain a broader understanding of remote industrial paramedicine in Australia. The survey design was informed by two previous Australian surveys including one on the rural allied health workforce and another on patient procedures and conditions that medical students encountered in rural settings.(25,26) The primary researcher drafted the initial instrument and piloted it with six experienced industrial paramedics and two academics who have expertise in industrial paramedicine. Their feedback was incorporated into the final version that was presented electronically using SurveyMonkey™.

Part one of the questionnaire explored participant demographics and clinical practice profile while part two presented respondents' lists of traumatic and medical presentations. In part two, actively working participants were asked to estimate the number of patients with these presentations they had encountered in the past 12 months. The lists were informed by literature that described common clinical presentations found in remote and industrial settings.(11,18,27) Respondents were asked whether they consulted with physicians about their patients, an estimation of how frequently this occurred, and what method was used. Finally, they were

asked if patients were transported from their remote site directly to a tertiary hospital, what the transport options were, and the distance to tertiary care. The survey questions are presented in Supplementary Materials.

Data collection

The online survey was open in SurveyMonkey™ for approximately three months to allow for as many fly-in, fly-out workers as possible to participate. Initially, 111 participants completed part one of the questionnaire.(28) A subset of 78 respondents who indicated that they were actively working in remote and industrial settings at the time of the survey subsequently completed part two of the survey.

Data analysis

The Statistical Package for the Social Sciences (SPSS) version 26.0 was used to analyse the data. Descriptive statistics were calculated using the frequencies dialog. Modes were calculated for the ordinal data associated with clinical presentations. The mode was selected as the most appropriate measure of central tendency for ordinal data.(29)

Ethics approval

Charles Sturt University Human Research Ethics Committee approved ethics for this research study (protocol number 400/2015/25).

RESULTS

Demographics

A total of 78 respondents completed the survey. Characteristics of the study participants are presented in Table 1. Most respondents were male (n = 69, 88.5%) and between 35 and 44 years of age (n = 31, 39.7%).

Most participants (n = 27, 34.5%) identified Western Australia as their employment location and half (n = 39, 50%) stated that they had between one and five years of

Table 1. Respondent demographics (N = 78)

Demographic item	N (%)
Gender	
Male	69 (88.5)
Female	9 (11.5)
Age (years)	
25–34	16 (20.5)
35–44	31 (39.7)
45–54	22 (28.2)
55–64	8 (10.3)
65–74	1 (1.3)
Citizenship	
Australian	69 (88.5)
Other	9 (11.5)
Aboriginal or Torres Strait Islander	
Yes	3 (3.8)
No	75 (96.2)

Table 2. Respondent employment location and experience (N = 78)

Employment location and experience	N (%)
Location of employment	
Western Australia	27 (34.6)
South Australia	16 (20.5)
Queensland	10 (12.8)
New South Wales	8 (10.3)
Victoria	2 (2.6)
Tasmania	1 (1.3)
Australian Capital Territory	1 (1.3)
Northern Territory	0 (0)
Offshore platform or vessel	5 (6.4)
Outside of Australia	8 (10.3)
Remote or industrial work experience (years)	
1–5	39 (50)
6–10	25 (32.1)
11–15	10 (12.8)
16–20	2 (2.6)
21–25	0 (0.0)
> 25	2 (2.6)

remote or industrial work experience. Respondent employment locations and work experience are presented in Table 2.

Patient clinical presentations

Survey participants were asked to reflect on the previous 12 months and estimate how often they encountered patients with various traumatic injuries and types of medical conditions. From the list provided, the most common traumatic injuries that respondents reported attending to included back pain, minor lacerations, hand and joint injuries. For each of these clinical presentations, the mode or most frequently selected response was greater than 10 times in the last year.

In contrast, the three least encountered traumatic presentations were reported to be major trauma, spinal injuries and abdominal or thoracic injuries. The mode response for each of these was 0. Despite ranking relatively low on the list, 25.5% (n = 20) of participants had treated major trauma patients at least three times in the preceding 12 months. A detailed list of traumatic injury clinical presentations and estimated number of encounters with the mode response is presented in Table 3.

The participants were asked to report on the estimated number of patients they encountered with specific medical conditions in the previous year. The top two conditions, with a mode response of greater than 10 times, were headache and nausea, vomiting and/or diarrhoea. The next three most reported clinical presentations, also with a mode response of greater than 10 times, were respiratory infections, ear, nose or throat (ENT) problems and localised infections or rash.

Participants selected 0 as the most common response for eight conditions including: alcohol and drug related

Table 3. Number of encounters involving patients with traumatic injuries in the past 12 months

Clinical presentation	Frequency in last 12 months N (%)					Mode
	0	1–2x	3–5x	6–10x	> 10x	
1. Back pain	7 (9.0)	3 (3.8)	20 (25.6)	17 (21/8)	31 (39.7)	> 10x
2. Minor laceration	3 (3.8)	12 (15.4)	19 (24.4)	14 (17.9)	30 (38.5)	> 10x
3. Joint injury	12 (15.4)	8 (10.3)	16 (20.5)	15 (19.2)	27 (34.6)	> 10x
4. Hand injury	4 (5.1)	12 (15.4)	20 (25.6)	18 (23.1)	24 (30.8)	> 10x
5. Fracture	11 (14.1)	25 (32.1)	19 (24.4)	11 (14.1)	12 (15.4)	1–2x
6. Eye injury	11 (14.1)	20 (25.6)	18 (23.1)	13 (16.7)	16 (20.5)	1–2x
7. Major laceration	14 (17.9)	23 (29.5)	23 (29.5)	13 (16.7)	5 (6.4)	1–2x
8. Burn	10 (12.8)	29 (37.2)	23 (29.5)	13 (16.7)	3 (3.8)	1–2x
9. Head trauma	14 (17.9)	31 (39.7)	12 (15.4)	17 (21.8)	4 (5.1)	1–2x
10. Dental problems	22 (28.2)	22 (28.2)	13 (16.7)	6 (7.7)	15 (19.2)	1–2x
11. Major trauma	35 (44.9)	23 (39.5)	12 (15.4)	6 (7.7)	2 (2.6)	0
12. Spinal injury	33 (42.3)	23 (29.5)	13 (16.7)	6 (7.7)	3 (3.8)	0
13. Thoracic or abdominal trauma	42 (53.8)	25 (32.1)	5 (6.4)	6 (7.7)	0 (0)	0

x: number of encounters

issues, seizures and diabetic emergencies, sexually transmitted infections, cardiac arrest, stroke and acute pulmonary oedema, indicating that these were the least encountered medical presentations. There were 45.3% (n = 34) of paramedics who reported that they had managed at least one patient in cardiac arrest in the last year. Additionally, 32% (n = 25) recalled treating patients with cardiac chest pain, while 38.4% (n = 30) of respondents reported dealing with mental health related problems a minimum of six times over the previous 12 months. The complete list and frequency of clinical medical presentations encountered are presented in Table 4.

To summarise, the top 10 traumatic and medical presentations that participants identified as having encountered in the preceding 12 months are presented in Figure 1.

Consultation with physicians

When participants were asked about performing consultations, 74 of 78 paramedics (94.8%) indicated 'yes', that they had consulted physicians as part of their remote practice. Approximately 80% (n = 62) of these 74 respondents indicated that they did not have physicians directly available at their work site and relied on remote medical topside support. Of the 74 who completed this section, 84.6% (n = 66) said 'yes', that they had consulted a physician using the telephone in the preceding 12 months. This was reported as an infrequent activity, however, with 59% (n = 39) stating that phone consultation had occurred either a few times per month or rarely. Approximately 15% (n = 12) of participants indicated that they used video chat (FaceTime™ or Skype™) or telemedicine technology to contact physicians from their workplace and 5.1% (n = 4) said patients had used this technology to speak to physicians directly in the preceding 12 months.

Transportation to hospital

Survey respondents were asked if they transported patients directly to a tertiary centre. Of the 78 participants, 59 (75.6%) indicated 'yes', that patients

were transported from their site direct to a tertiary level hospital and answered the subsequent questions about mode of transport and distances. Most (n = 48, 81.3%) of the 59 stated that patients were transported by ground ambulance to a receiving centre while 54.2% (n = 32) also reported using helicopters to convey patients. There were three participants (3.8%) who described using marine vessels for transport. When asked the distance to the closest hospital of any type, respondents reported a wide variation ranging from 20 km to 1400 km. Most respondents (n = 36, 61%) indicated that their worksite was located greater than 100 km from a hospital and 13.5% (n = 8) stated it was greater than 200 km away.

DISCUSSION

The results of this survey offer some insight into the clinical presentations that Australian paramedics encountered while working in remote and industrial settings, their experience consulting with physicians, and how their patients were transported to tertiary care. The findings build upon an earlier study on the demographics and clinical profile of the Australian remote and industrial paramedic workforce.(28) In broad terms, our data suggest that paramedics working remotely manage patients presenting with a wide range of traumatic and medical conditions and acuity levels.

Traumatic presentations

Participants in this survey revealed exposure to a variety of traumatic presentations. Back pain was the most common, with 39.7% of survey respondents (n = 31) selecting it as a clinical presentation they recalled seeing more than 10 times in the past year. Additionally, participants selected greater than 10 times per year as the most common response for minor lacerations (n = 30, 38.5%), joint (n = 27, 34.6%) and hand (n = 24, 30.8%) injuries. These data align with the Health and Safety Executive (2020) who documented minor sprains and strains, lacerations and contusions as the most frequent cause of non-lost time traumatic incidents on

Table 4. Number of encounters involving patients with medical conditions in the past 12 months

Clinical presentation	Frequency in last 12 months N (%)					Mode
	0	1–2x	3–5x	6–10x	> 10x	
1. Headache	3 (3.8)	3 (3.8)	11 (14.1)	11 (14.1)	50 (64.1)	> 10x
2. Nausea, vomiting and/or diarrhoea	1 (1.3)	12 (15.4)	13 (16.7)	11 (14.1)	41 (52.6)	> 10x
3. Respiratory infection	8 (10.3)	5 (6.4)	13 (16.7)	13 (16.7)	39 (50.0)	> 10x
4. Ear, nose, throat problem	4 (5.1)	14 (17.9)	11 (14.1)	15 (19.2)	34 (43.6)	> 10x
5. Local infection, rash	7 (9.0)	12 (15.4)	14 (17.9)	14 (17.9)	31 (39.7)	> 10x
6. Abdominal pain	13 (16.7)	15 (19.2)	13 (16.7)	15 (19.2)	22 (28.2)	> 10x
7. Mental health problem	15 (19.2)	18 (23.1)	15 (19.2)	10 (12.8)	20 (25.6)	> 10x
8. Cardiac chest pain	9 (11.5)	21 (26.9)	23 (29.5)	11 (14.1)	14 (17.9)	3–5x
9. Non-cardiac chest pain	10 (12.8)	23 (29.5)	14 (17.9)	9 (11.5)	22 (28.2)	1–2x
10. Shortness of breath	3 (3.8)	21 (26.9)	18 (23.1)	18 (23.1)	18 (23.1)	1–2x
11. General infection	20 (14.1)	25 (32.1)	12 (17.9)	7 (9.0)	14 (17.9)	1–2x
12. Kidney problems	21 (26.9)	26 (33.3)	10 (12.8)	10 (12.8)	11 (14.1)	1–2x
13. Alcohol intoxication	27 (34.6)	16 (20.5)	9 (11.5)	6 (7.7)	20 (25.6)	0
14. Drug abuse or overdose	36 (46.2)	11 (14.1)	8 (10.3)	8 (10.3)	15 (19.2)	0
15. Seizures or fitting	37 (47.4)	24 (30.8)	5 (6.4)	7 (9.0)	5 (6.4)	0
16. Diabetic emergency	28 (35.9)	27 (34.6)	10 (12.8)	9 (11.5)	4 (5.1)	0
17. Sexually transmitted infection	48 (64.0)	14 (17.9)	6 (7.7)	5 (6.4)	5 (6.4)	0
18. Cardiac arrest	44 (56.4)	17 (21.8)	12 (15.4)	3 (3.8)	2 (2.6)	0
19. Stroke with deficits	49 (62.8)	17 (21.8)	5 (6.4)	5 (6.4)	2 (2.6)	0
20. Acute pulmonary oedema	59 (75.6)	10 (12.8)	4 (5.1)	4 (5.1)	1 (1.3)	0

x: number of encounters

offshore oil and gas locations in the United Kingdom.(30) Similarly, researchers identified back, hand and limb injuries as most prevalent among mining workers globally, followed by fractures, lacerations and contusions.(7,8)

A high incidence of minor trauma is a trend that extends beyond the remote setting. For example, in a recent study of 79,897 trauma patients transported by paramedics in a Western Australian ambulance service, less than three per cent were classified as seriously injured.(31) The study authors argue that there is a disparity between paramedic education focused on high acuity trauma care and the realities of paramedic practice. Likewise, the findings of this study highlight the requirement for remote and industrial paramedics to be suitably trained to assess and treat low acuity injuries, capabilities that are included in the IRHC competency consensus document for all remote healthcare workers.(19)

While the data from this survey suggest that serious traumatic injuries are relatively uncommon, there were some participants who recalled attending to patients with spinal injuries (n = 9, 11.5%), major trauma (n = 8, 10.3%) and thoracic or abdominal trauma (n = 6, 7.7%) a minimum of six times in the last year. This finding is an important reminder that remote industrial work carries the risk of significant injury and death.(7,10) Despite being infrequent, initial emergency management of the above injuries would require an advanced clinical skillset to manage airway, breathing and circulation. Fittingly, 42.7% of Australian industrial paramedics surveyed reported having endotracheal intubation (n = 25) in their scope of practice, while 71.9% could perform chest needle decompression (n = 59) and 59.8% could gain intraosseous access (n =

49).(28) Skills associated with high acuity, low occurrence procedures and presentations are difficult to maintain (32) with paramedics subject to skill decay.(10) This can be partially mitigated with continuing professional development, including participating in simulation based medical education.(33) The IRHC also suggests that remote healthcare practitioners can reduce skill degradation and maintain currency through certification courses such as International Trauma Life Support and Prehospital Trauma Life Support or equivalent.(19)

Medical presentations

When participants were asked to estimate their recollection of medical presentations, over half selected headache (n = 50, 64.1%), nausea and vomiting and/or diarrhoea (n = 41, 52.6%) and respiratory infections (n = 39, 50%) as conditions they had encountered at least 10 times in the preceding year. These findings align with previous literature on medical illnesses reported in the resource sector workforce. Subjective symptoms such as headaches and gastrointestinal complaints have been reported as prevalent among shift workers on offshore oil and gas rigs (34) while digestive conditions and dental problems were identified as the most common illnesses requiring medevacs from offshore workplaces.(35) Similarly, in a telehealth pilot project for American offshore oil and gas installations, physicians most frequently treated workers with respiratory infections.(4) These survey findings complement a growing body of literature highlighting a shift away from paramedicine as a profession focused on 'emergency' response. Contemporary research describes an increased need for paramedics with the education and extended competencies to provide low acuity and primary healthcare in remote settings.(20–22)

The apparent prevalence of low acuity presentations in this survey supports the concept of the ‘healthy worker effect’ expected in a relatively young workforce whose employees are subject to regular medical examinations.(36) One 1998 UK study highlighted this, with authors noting that less than one per cent of returning offshore workers had failed their medical exam.(37) In contrast, more recent studies have challenged this assumption, reporting an epidemiological trend in increasing obesity and chronic health conditions among the remote workforce.(5,6) In this survey there were 46% of respondents who recalled patients presenting with shortness of breath (n = 36), 32% with cardiac chest pain (n = 25) and 27% with kidney problems (n = 21) at least six times in the preceding 12 months; findings which could be indicative of a remote workforce with chronic health problems.

Mental health presentations

The survey results also provide some insight into the prevalence of mental health presentations in the remote and industrial setting. In this study, 80.7% of participants (n = 63) indicated that they encountered mental health presentations to some extent with 25.5% (n = 20) managing some type of mental health concern a minimum of 10 times in the past year. Remote worker mental health and well-being is a known area of concern, with recent research focusing on the impact of fly-in fly-out scheduling and social isolation.(3,5,12) Worker psychological stress has also been specifically attributed to the remote work location and the type of work involved.(38,39) Recognising the prevalence of mental health presentations, the IRHC includes the ability to assess and treat ‘acute depression, anxiety psychosis, mania, suicidal ideations, and violent behaviours’ as a core competency for remote healthcare practitioners including paramedics.(19) A recent study found that paramedic mental health education in Australian universities was not well integrated into the curriculum and lacked consistency.(40) Further to this, there is

evidence of concern across the wider profession over a perceived lack of knowledge and ability for paramedics to effectively treat mental health presentations.(41) This suggests that managing mental health patients could be especially challenging for industrial paramedics working in remote settings.

Consultation with physicians

Remote healthcare settings are characterised by their distance to tertiary care coupled with limited direct access to healthcare resources.(12,42) Telemedicine provides a way to bridge these gaps by connecting remote paramedics with physicians and other specialists. Companies in the natural resource sector are increasingly relying on telemedicine to support early interventions for critical patients and to reduce the number of costly and potentially dangerous evacuations for less serious conditions.(4,9,43) Almost all (n = 74, 94.8%) paramedic respondents in this survey reported having access to physician support through some means of telehealth. The telephone was listed as the most likely method of contact, which is expected as it is a reliable tool that enables an immediate response. The participants reported accessing physician topside support infrequently with 59% (n = 39) saying they did this either rarely or a maximum of three times per month. Although this study did not explore the reasons participants did or did not use telehealth, others have identified potential barriers including: unfamiliarity with equipment and processes, concerns about patient privacy, and bandwidth restrictions.(9) One author also cited cost as a barrier for offshore companies to implement telehealth solutions.(43)

Access and transport to tertiary hospital

Almost one quarter of respondents (n = 19, 24.4%) selected ‘no’ when asked if patients were transferred to tertiary care from their site, suggesting that these paramedics either work in a larger centre or were unsure how to interpret the question. Findings from the

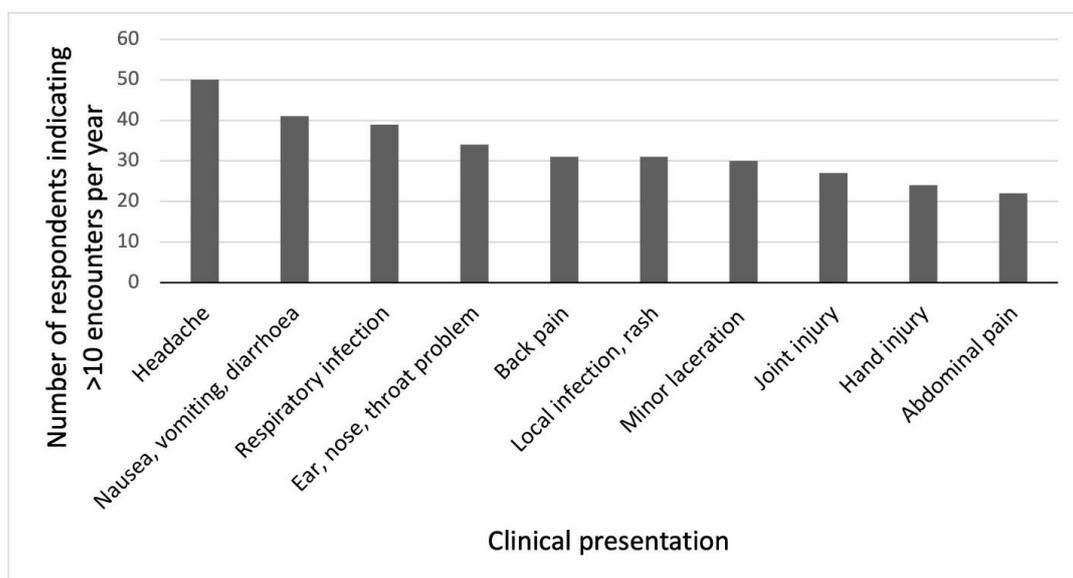


Figure 1. Top 10 clinical presentations encountered in the preceding 12 months

remaining 59 participants identified that the majority (n = 48, 81.3%) of them rely on ground ambulance for secondary conveyance and over half (n = 32, 54.2%) can transfer patients to tertiary care by helicopter. The data highlight the need for industrial paramedics to be adept at preparing patients for transport, a core skill in paramedicine.⁽⁴⁴⁾ Most of these participants (n = 36) work at least 100 km from the closest tertiary hospital with eight stating this distance was more than 200 km. These stated distances are a reminder of how far away some of these paramedics practise and do not account for transport delays caused by logistical challenges including inclement weather and poor road conditions.⁽¹⁹⁾

Limitations

This study has important limitations to consider. The findings are specific to the recollections of a small number of paramedics who self-identified as working in the Australian remote and industrial setting in 2015. Paramedic-focused research in industrial paramedicine is limited. While the data from this workforce survey are dated, they provide a valuable snapshot given the paucity of available literature in this specialised practice area. Notably, the survey was performed before Australian paramedics attained professional registration under the Australian Health Practitioner Regulation Agency. Although registration requirements and title protection could impact participant characteristics in future workforce surveys, these data describing the clinical presentations, physician consultations and patient transport options remain relevant.

Current statistics on the number of industrial paramedics in Australia are unavailable, limiting the researchers' ability to determine how representative this sample is of the target population. While small, this study does present the best participant sample in the published literature to date. The participant selection and survey design are also subject to bias and any conclusions drawn from the survey results may not be generalisable to the larger population. Thus, the results of this study must be viewed as hypothesis generating at best.

An additional limitation of the findings is that the study did not investigate whether the respondents worked independently or as part of an interprofessional team. Furthermore, the survey did not inquire whether respondents felt adequately prepared to attend to the patients they encountered, whether they experienced skill decay, and what their experience was when using topside support.

Future research

While this study offers some additional insight into paramedicine in Australian remote and industrial work settings, an updated workforce survey is warranted especially considering the potential impact of the COVID-19 pandemic and global changes to the natural resources sector. Additionally, it would be useful to be able to quantify and describe the population of remote and industrial paramedics working in Australia using

updated sources and statistics. Future qualitative research should be considered to explore perceptions that remote and industrial paramedics have regarding the core competencies needed to perform their roles and their initial and continuing education requirements. Finally, future studies could explore the reasons why paramedics seek physician support and how telehealth can best facilitate this process.

CONCLUSION

Findings from an Australian remote and industrial workforce survey indicate that paramedics encounter a variety of clinical presentations with the most common being headache, nausea and vomiting and/or diarrhoea, respiratory infections, ENT problems and back pain. Consistent with recent trends in the literature, participants recalled managing low acuity illnesses more commonly than traumatic injuries. Most respondents also had exposure to mental health presentations in the last year, a growing area of concern among remote rotation workers. Although almost all paramedics had access to topside support through telehealth, the majority stated they consulted physicians infrequently and when they did seek clinical advice, it was primarily done by telephone. Most respondents were located at least 100 km from the nearest hospital and primarily rely on ground ambulances for secondary transfers.

COMPETING INTERESTS

The authors declare no competing interests. Each author of this paper has completed the ICMJE conflict of interest statement.

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SUPPLEMENTARY MATERIALS**Remote and industrial paramedicine workforce survey****Patient presentations**

1. Please estimate the number of encounters you have had with the following patient presentations in the last 12 months:

Trauma presentations:

	0	1–2	3–5	6–10	> 10
Hand injury					
Minor lacerations requiring basic skin closure					
Major laceration requiring advanced skin closure					
Burn					
Fracture					
Joint injury (dislocation, strain or sprain)					
Head trauma					
Major trauma (multisystem)					
Suspected or confirmed spinal injury					
Blunt or penetrating thoracic or abdominal trauma					
Non-traumatic back pain					
Dental problems					
Eye injury					

2. Please estimate the number of encounters you have had with the following patient presentations in the last 12 months:

Medical presentations:

	0	1–2	3–5	6–10	> 10
Ear, nose or throat problem					
Headache					
Respiratory infection					
Local rash or infection					
General infection (sepsis)					
Sexually transmitted disease					
Mental health problem (suicidal, depression, psychosis, anxiety)					
Shortness of breath (asthma, anaphylaxis or similar)					
Seizures or fitting					
Nausea and/or vomiting and/or diarrhoea					
Abdominal pain (including GI bleed)					
Kidney problems (renal colic, urination problems, UTI)					
Diabetic emergency					
Alcohol intoxication					
Drug abuse or overdose					

Cardiac arrest	
Cardiac chest pain	
Non-cardiac chest pain	
Acute pulmonary oedema	
Stroke with deficits	

Consultation and referral pathways

1. Do you communicate with a doctor or specialist about the care of your patients? Y/N
2. Do you consult with a doctor on site directly (ie, face-to-face)?
 - a. Please rate the frequency of face-to-face communication with a doctor for referral or advice:
 - Frequently (3 or more times per week)
 - Sometimes (1–2 times per week)
 - Occasionally (a few times per month)
 - Rarely (less than once per month)
3. Do you consult with a doctor by telephone? Y/N
 - a. Please rate the frequency of telephone communication with a doctor for referral or advice:
4. Do you consult with a doctor by video chat (eg, Skype™ or FaceTime™)? Y/N
 - a. Please rate the frequency of video chat communication with a doctor for referral or advice:
5. Do you consult with a doctor using telemedicine technology? Y/N
 - a. Please rate the frequency of communication with a doctor using telemedicine technology for referral or advice:
6. Do patients at your site use telemedicine technology to communicate with doctors or specialists about their medical issues? Y/N
 - a. Please rate the frequency of patient communication with a doctor using telemedicine technology for referral or advice:

Patient transportation options

1. Are patients transported from your site to a tertiary hospital? Y/N
2. Are patients transported from your site by ground ambulances? Y/N
 - a. Regarding ground ambulance transportation from your site to a tertiary hospital, how far is it one-way (km)?
3. Are any other methods of transport used to transfer patients from your site to a tertiary hospital? Y/N
4. Are patients transported from your site by helicopter? Y/N
 - a. Regarding helicopter transportation from your site to a tertiary hospital, how far is it one-way (km)?
5. Are patients transported from your site by fixed wing? Y/N
 - a. Regarding fixed wing transportation from your site to a tertiary hospital, how far is it one-way (km)?
6. Are patients transported from your site by marine vessel? Y/N
 - a. Regarding marine vessel transportation from your site to a tertiary hospital, how far is it one-way (km)?