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Paramedic knowledge of infectious disease aetiology and transmission in an Australian Emergency Medical System

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CLINICAL PRACTICE

PARAMEDIC KNOWLEDGE OF INFECTIOUS DISEASE AETIOLOGY AND TRANSMISSION IN AN AUSTRALIAN EMERGENCY MEDICAL SYSTEM.

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Keywords

infectious disease aetiology; disease transmission; prehospital infection control

Abstract

Introduction

Paramedics and other emergency health workers are exposed to infectious disease particularly when undertaking exposure-prone procedures as a component of their everyday practice. This study examined paramedic knowledge of infectious disease aetiology and transmission in the pre-hospital care environment.

Methods

A mail survey of paramedics from an Australian ambulance service (n=2274) was conducted.

Results

With a response rate of 55.3% (1258/2274), the study demonstrated that paramedic knowledge of infectious disease aetiology and modes of transmission was poor. Of the 25 infectious diseases included in the survey, only three aetiological agents were correctly identified by at least 80% of respondents. The most accurate responses for aetiology of individual infectious diseases were for HIV/AIDS (91.4%), influenza (87.4%), and hepatitis B (85.7%). Poorest results were observed for pertussis, infectious mononucleosis, leprosy, dengue fever, Japanese B encephalitis and vancomycin resistant enterococcus (VRE), all with less than half the sample providing a correct response. Modes of transmission of significant infectious diseases were also assessed. Most accurate responses were found for HIV/AIDS (85.8%), salmonella (81.9%) and influenza (80.1%). Poorest results were observed for infectious mononucleosis, diphtheria, shigella, Japanese B encephalitis, vancomycin resistant enterococcus, meningococcal meningitis, rubella and infectious mononucleosis, with less than a third of the sample providing a correct response.

Conclusions

Results suggest that knowledge of aetiology and transmission of infectious disease is generally poor amongst paramedics. A comprehensive in-service education infection control programs for paramedics with emphasis on infectious disease aetiology and transmission is recommended.

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INTRODUCTION

Infection control is an essential part of health care. The changing epidemiology of disease, widening scope of practice of health care providers and increased occupational risks associated with provision of health care have precipitated a review of infection control in Australia. Evidence-based infection control practice across nursing, medicine and dentistry is evolving. However, there is limited infection control research in the pre-hospital care environment. Shaban [1] identified the need to review ambulance paramedic infection control guidelines as a result of changing patterns of health care in the pre-hospital environment, new disease epidemiology and a lack of sound, specific research into pre-hospital infection control.

This study aimed to establish baseline data on knowledge and reported practice in the pre-hospital context. In particular, this research examined levels of paramedic knowledge of infectious disease aetiology and modes of transmission in the pre-hospital environment.

A thorough literature search failed to locate any research that examined paramedic knowledge of the aetiology and transmission of infectious disease in ambulance care specific to the Australian setting. The literature review located a large body of research in the nursing, medical and dental disciplines.

Isolated studies have been conducted in the United States examining Emergency Medical Technicians' (EMTs) knowledge of infection control and infectious diseases. Mencl et al. [2] surveyed 425 EMTs on knowledge of transmission of four infectious diseases, human immunodeficiency virus (HIV), hepatitis, meningitis and tuberculosis. Questions about knowledge of universal precautions, transmission routes and postexposure actions, and items examining personal concerns about infectious diseases were surveyed. Mencl et al. [2] found poor knowledge of universal precautions, transmission routes and postexposure action and argued for further continuing EMT education in these areas focusing on routes of transmission, risk of exposure, appropriate use of postexposure prophylaxis and requirements for follow-up testing.

In another study in the US, Eutis [3] reported poor compliance with recommendations for universal precautions among prehospital providers. Inadequate knowledge and prevention of occupational exposure of HIV and AIDS among pre-hospital personnel was reported by Gellert et al. [4]. They recommended the introduction of additional education and training programs for pre-hospital emergency staff. Cydulka et al. [4] assessed the knowledge base of 420 paramedics on knowledge of AIDS and hepatitis B after conducting an education seminar in a large metropolitan US fire department and reported an improvement. No study has, however, examined knowledge of infectious disease aetiology and transmission, or indeed infection control practices in general, in the Australian pre-hospital context.

Infection control research to date has been discipline, context and location specific. This study sought to examine paramedics in an Australian setting in terms of regards to standards of infection control, specifically standard and additional precautions as

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defined by the National Health and Medical Research Council (NHMRC) [5] and paramedics' knowledge of infectious diseases.

METHODS

This study used survey methodology to examine paramedic knowledge of infectious disease
aetiology and transmission in an Australian EMS. All clinical staff personnel (n=2274) in one State-wide service were eligible to participate in the study.

An anonymous survey consisting of thirty-seven questions was constructed in consultation with an infection control and ambulance expert-working group (EWG). The content was in accordance with the NHMRC [6] infection control standards. The survey format was designed in three sections. Section one of the survey focused on the collection of demographic data. Questions used to assess knowledge of infection control were grouped in section two, and addressed a variety of infection control areas as determined by the EWG. Assessments of reported infection control practices were grouped in section three. The survey tool, information sheet and consent form were piloted. As a result of the pilot testing, minor editorial changes were made to questions in order to enhance clarity. Ethics approval was obtained from Griffith University Human Research Ethics Committee (HREC).

Surveys were sent to all eligible paramedic staff. The criterion for inclusion in this study was that the participant held a clinical or clinically related position, or a position that directly affected clinical outcomes of paramedic care.

RESULTS

A total of 1258 surveys were returned and collated centrally, yielding a response rate of 55.3%. The average age of participants was 38.1 years, with 78.1% (n=983) of participants being male and 20.7% (n=260) being female. In the sample, the average length of ambulance service was 10.1 years.

Paramedic knowledge of the aetiology of common epidemiologically significant infectious diseases was collected. Results for correct responses are listed in Table 1. Knowledge was deemed to be inadequate if a participant obtained less than 50% correct for the 25 diseases. More than 50% of participants could not correctly identify the aetiology for 8 of the 25 diseases. Interestingly, only three diseases were reported correctly by the majority of participants (that is, more than 80 percent), those being HIV/AIDS, hepatitis B and influenza. Poorest results were observed for pertussis, infectious mononucleosis, leprosy, dengue fever, Japanese B encephalitis and vancomycin resistant enterococcus (VRE), all with less than half correct.

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Table 1: Results - Aetiological agent of infectious diseases

Disease	Correct %, N	Incorrect %, N	Don't know %, N	Missing %, N	Total N
Acquired Immune Deficiency Syndrome (HIV/AIDS)	91.4 (1150)	2.6 (33)	3.8 (48)	2.2 (27)	1258
Influenza	87.4 (1099)	8.8 (111)	2.3 (29)	1.5 (19)	1258
Hepatitis B	85.7 (1078)	8.5 (108)	3.8 (48)	1.9(24)	1258
Hepatitis C	79.8 (1004)	13.4 (169)	4.7 (59)	2.1 (26)	1258
Salmonella	76.0 (956)	13.3 (168)	7.8 (98)	2.9 (36)	1258
Mumps	73.1 (919)	24.3 (306)	6.7 (84)	2.6 (33)	1258
Measles	73.0 (918)	17.3 (217)	6.8 (85)	(38) 3.0	1258
Hepatitis A	72.0 (906)	21.1 (265)	5.1 (64)	1.9 (23)	1258
Chickenpox	70.6 (888)	16.3 (205)	9.9 (125)	3.2 (40)	1258
Herpes Simplex	69.8 (878)	22.2 (279)	5.9 (74)	2.1 (27)	1258
Methicillin Resistant *Staphylococcus aureus* (MRSA)	68.7 (864)	15.8 (198)	13.8 (173)	1.8 (23)	1258
Rubella	65.5 (824)	16.1 (202)	15.4 (194)	3.0 (38)	1258
Tuberculosis	58.7 (738)	27.6 (347)	10.3 (129)	3.5 (44)	1258
Scabies	58.6 (737)	28.7 (361)	9.1 (115)	3.6 (45)	1258
Polio	54.5 (684)	20.8 (261)	20.7 (261)	4.1 (52)	1258
Meningococcal Meningitis	54.1 (681)	35.7 (449)	8.2 (103)	2.0 (25)	1258
Malaria	50.8 (639)	34.3 (431)	11.8 (149)	3.1 (39)	1258
Dengue Fever	39.7 (499)	37.5 (472)	18.2 (229)	4.6 (58)	1258
Diphtheria	39.6 (498)	33.3 (419)	23.9 (301)	3.2 (40)	1258
Japanese B Encephalitis	36.5 (459)	31.0 (390)	28.2 (355)	4.3 (54)	1258
Vancomycin Resistant Enterococcus (VRE)	35.6 (448)	14.2 (178)	48.1 (605)	2.1 (27)	1258
Leprosy	31.2 (392)	35.1 (442)	31.2 (392)	2.5 (32)	1258
Infectious Mononucleosis	27.7 (348)	26.2 (329)	42.1 (529)	4.1 (52)	1258
Pertussis	24.0 (302)	27.0 (340)	43.1 (542)	5.9 (74)	1258
Shigella	19.4 (244)	29.0 (364)	45.9 (578)	5.7 (72)	1258

Modes of transmission of common significant infectious diseases were also assessed. Within the sample, the distribution of correct responses was similar to that of the assessment of the aetiology of specific infectious diseases, and is outlined in Table 2.

Table 2: Results – Mode of transmission of infectious diseases

Disease	Correct %, (N)	Incorrect %, (N)	Don't know %, (N)	Missing %, (N)	Total N
Acquired Immune Deficiency Syndrome (HIV/AIDS)	85.8 (1080)	9.5 (119)	1.0 (13)	3.7 (46)	1258
Salmonella	81.9 (1031)	9.3 (117)	6.2 (78)	2.6 (32)	1258
Influenza	80.1 (1009)	11.1 (139)	7.1 (89)	1.7 (21)	1258
Herpes Simplex	78.3 (985)	10.1 (127)	9.4 (118)	2.2 (28)	1258
Chickenpox	77.8 (979)	8.9 (112)	9.4 (118)	3.9 (49)	1258
Scabies	75.4 (948)	14.2 (179)	8.2 (103)	2.2 (28)	1258
Hepatitis B	74.6 (938)	17.4 (219)	3.0 (38)	5.0 (63)	1258
Tuberculosis	74.0 (931)	16.1 (203)	6.9 (87)	2.9 (37)	1258
Hepatitis C	68.6 (862)	21.1 (266)	9.1 (115)	1.2 (15)	1258
Pertussis	62.7 (789)	16.8 (210)	18.2 (229)	2.4 (30)	1258
Leprosy	48.9 (615)	7.9 (99)	40.1 (504)	3.2 (40)	1258
Methicillin Resistant *Staphylococcus aureus* (MRSA)	47.5 (598)	30.2 (380)	20.1 (261)	1.5 (19)	1258
Malaria	47.1 (592)	42.7 (537)	7.7 (97)	2.5 (32)	1258
Dengue Fever	42.0 (528)	38.5 (485)	17.3 (218)	2.1 (27)	1258
Hepatitis A	35.7 (323)	61.9 (780)	9.5 (119)	2.9 (36)	1258
Mumps	34.5 (434)	51.9 (653)	9.2 (116)	4.4 (55)	1258
Polio	33.3 (419)	16.7 (209)	45.4 (571)	4.7 (59)	1258
Meningococcal Meningitis	31.9 (401)	40.6 (510)	311 (24.7)	36 (2.9)	1258
Measles	31.2 (393)	57.7 (726)	7.1 (89)	4.0 (50)	1258
Infectious Mononucleosis	21.9 (276)	22.5 (282)	51.3 (645)	4.4 (55)	1258
Rubella	21.5 (271)	47.1 (592)	26.0 (327)	5.4 (68)	1258
Diphtheria	21.3 (268)	43.4 (546)	32.4 (407)	2.9 (37)	1258
Vancomycin Resistant Enterococcus (VRE)	18.1 (228)	26.5 (332)	54.1 (680)	1.4 (18)	1258
Japanese B Encephalitis	18.0 (227)	31.2 (392)	47.3 (595)	3.5 (44)	1258
Shigella	12.1 (152)	29.1 (367)	56.7 (713)	2.1 (26)	1258

Knowledge was deemed to be inadequate if a participant obtained less than 50% correct for the 25 diseases. More than 50% of participants could not correctly identify

the mode of transmission for 15 of the 25 diseases. Only four three of the disease types were correctly identified by more than 80% of the sample, those being HIV/AIDS, salmonella and influenza. Poorest results were observed for polio, infectious mononucleosis, diphtheria, shigella, Japanese B encephalitis, vancomycin resistant enterococcus and meningococcal meningitis, all with less than 50% of respondents achieving a correct response.

(46.2%, n=581) of participants identified the correct response to components of the 'Chain of Infection' [7]. The Chain of Infection outlines the essential factors required for the spread of infectious disease, namely: causative agent, reservoir, susceptible host, transfer mode, entry point and exit point. Around twenty percent of the sample (19.4%, n=244) reported they did not know the answer.

DISCUSSION

Knowledge and understanding of microbiology underpins infection control patient care practices of paramedics, as with all health care workers. The management of infectious diseases and limiting of the spread of these diseases requires knowledge of disease aetiology and epidemiology. Recognition of the early signs of infection informs timely provisional identification of the type of infectious disease, its aetiological cause and the type of precautions needed to prevent transmission to others [7]. This study suggests poor overall knowledge of infectious disease aetiology and epidemiology among paramedics.

Paramedic knowledge of the aetiology of twenty-five (25) epidemiologically significant infectious diseases as determined by the NHMRC [6] was found to be generally poor in this survey. The average proportion of respondents correctly identifying the aetiological cause for a disease was 59.3%. Interestingly, the most correctly identified cause of disease was that of HIV/AIDS, with almost all participants identifying correct aetiology. The poorest result was achieved for shigella. Only three disease types were noted to have correct percentage rates above 80, those being HIV/AIDS, hepatitis B, and influenza. More than 50% of participants could not correctly identify the aetiology for 8 of the 25 diseases. These results may reflect the visible public profile of specific diseases such as HIV/AIDS. Regardless, the results reflect poor overall knowledge.

Paramedic knowledge of the modes of transmission of infectious diseases was also assessed. The majority of the sample correctly identified the transmission modes of HIV/AIDS (85.9%), with the poorest result found for polio (6.4%). For 15 of the 25 infectious diseases, over 50% of respondents could not identify correct modes of transmission. Only modes of transmission for three diseases were noted as having correct percentage rates higher than 80, those being for HIV/AIDS, salmonella and influenza. Disturbingly, a proportion of participants either did not know or incorrectly identified modes of transmission for hepatitis B (20.4%) and C (30.2%). These diseases are widely regarded and documented as high-risk occupational hazards for health care workers performing exposure prone procedures [6].

The results suggest paramedics in this study had poor knowledge of how infectious diseases are transmitted. Paramedics with poor knowledge of agents causing disease and poor knowledge of how disease is transmitted are hampered in their

ability to prevent cross-infection [7]. Patients who present with diagnosed infectious diseases require specific care. Over half the participants incorrectly identified the aetiology for 8 diseases, some of which require the application of specific additional infection control precautions [1].

The understanding of disease aetiology and modes of transmission are vital components in understanding disease epidemiology and form two components of the concept widely recognised in infection control as the 'Chain of Infection [7]. This concept illustrates the manner in which infectious diseases remain endemic in populations, and from time to time lead to epidemics and pandemics. Further, it underpins the rationale for the use of precautions taken for particular infections [7]. In the present study, participants were asked to identify, using a true/false format, the correct components of the 'Chain of Infection'. Only 46.2% of participants correctly identified the six components of the 'Chain of Infection', with 19.4% reporting that they did not know. This result illustrates poor overall knowledge of the basic mechanism of cross infection. McCulloch [7] suggests that it is vital for health care personnel to understand the process of infection, so that they know how they can prevent the transmission of infection.

McCulloch [7] suggests that in order to improve infection control practice, all staff require education and involvement in the implementation of infection control policies. To precipitate improvement in knowledge and practice, comprehensive education programs are required. Vital cornerstones of such programs for paramedics should include the management of staff health, occupational exposure, and immunisation. Staff are required to possess a good understanding of the transmission of infection, understand prevention, and analyse their practice to obtain improvement. Importantly, McCulloch [7] suggests infection control skills should be observed and minimum standards maintained, as with any basic clinical procedure, and not merely taught and practised.

While the present study is the first of its kind in Australia and provides important baseline data, there are a number of limitations. Surveys were sent to all paramedics but only 55.3% were returned. The participants may not be representative of the larger group. It could be that those staff with poor knowledge did not respond. Although the range of responses provides some confidence in the results, the low levels of knowledge among those who did respond is still of concern. Moreover, the study focused on one particular state-based ambulance service and it is not possible to extrapolate across other jurisdictions.

CONCLUSION

The risk of exposure to infectious disease for paramedics is high, particularly given the unique environments in which paramedics are required to work. Despite the high-risk environment in which paramedics work, this study found generally poor knowledge of aetiology and transmission of infectious disease and principles of infection among paramedics.

The results suggest poor overall knowledge of infectious disease aetiology and transmission by paramedics in this Australian setting and warrant review of infection control practices and education programs in the pre-hospital paramedic setting. Ambulance services and authorities need to address specific and ever-increasing

challenges in infection control, by establishing evidence-based practices that value-add to patient care. The study demonstrates a need for further investigation into ambulance infection control knowledge and practices nationally. Importantly, infection control management programs ultimately protect staff and clients from infectious diseases and improve the clinical care and patient care outcomes of the sick and injured.

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