

Research

How is ambulance patient care and response time data collected and reported in Malaysia and Indonesia?

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Abstract

Introduction

Ambulance service design is often reminiscent of the economic status of a country, with pre-hospital care in low to medium income countries relying on basic life support services and an historical 'swoop and scoop' Anglo-American emergency medical service model. The connection between pre-hospital intervention and patient outcome in low to medium income countries is unclear. This scoping study undertook an examination of the literature to establish the level and quality of patient care data collection, especially as it impacts ambulance case times in Malaysia and Indonesia.

Methods

A scoping review methodology with topic specific keywords including 'ambulance', 'emergency medical service', 'pre-hospital' (and their variants) using MEDLINE, CINAHL, Cochrane and EMCare databases was used.

Results

Of the 202 articles returned, 185 were screened, 85 full text articles were reviewed for relevance. Forty-three publications were included in the study with a number of other relevant from the grey literature.

Conclusion

The scoping study found there is no consistency in data collection methods in Indonesian or Malaysia, with some organisations collecting high quality data while others do not collect pre-hospital data. The study recommends deeper investigation into the status of standardisation of emergency medical services in the two countries and the manner in which the data is reported.

Keywords:

ambulances; Indonesia; Malaysia; data collection; emergency medical services

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Introduction

While much has changed in ambulance care since the 1970s and the emergence of pre-hospital advanced life support, little is known about the epidemiology and evolution of pre-hospital emergency medical services during that time (1). This is especially true in low to middle income countries (LMIC), such as Malaysia and Indonesia, which lack frameworks and performance indicators established by high income countries. While the socio-economic and medio-legal factors impacting Malaysia and Indonesia are varied, it remains that both countries are rapidly moving away from their historical LMIC status. This change in income levels, and introduction of universal health care in Indonesia, means that the expectation of healthcare services will increase, requiring increased transparency and increased clinical skill base.

The terms 'swoop and scoop' and 'stay and play' provide an insight into which clinical interventions are being applied to the patient in the pre-hospital setting. It can also suggest the length of time between the time an ambulance arrives and departs a location (2), with 'stay and play' allowing greater time for interventions on scene. The sub-text in these terms is that 'swoop and scoop' is aligned to the provision of basic life support (BLS), while 'stay and play' permits time to provide advanced life support (ALS) or intensive care life support (3). Ryyänen et al (4) suggest that 'the most remarkable limitation is that definition of ALS and BLS is changing in time and place', suggesting that different organisations may deem a clinical intervention at one skill level while another may determine the same skill is appropriate at a higher or lower level of clinical intervention.

This background of a changing ALS/BLS environment comes with increasing clinical evidence against the use of pre-hospital advanced life support interventions when in close proximity to a tertiary health care facility for both trauma patients (5) and medical patients (6-8). It is partly for this reason that it is recommended developing countries focus on providing BLS services (9).

The quality of case time data collection and tracking is dubious (10). In reference to the diverse Asian pre-hospital care systems, Rahman et al (10) observed that:

'Most patient care records are manual, and data collection is not standardized and non-uniform.

Interestingly, the obvious difference in the structure of EMS between the developed and developing countries in Asia lies with the EMS providers and their location.'

Durham et al (11) states that an emergency ambulance resource needs to have the ability to respond in a timely manner, which takes into account dispatch arrangements, vehicle reliability, road systems and patient access. All the factors presented by Durham et al, as well as issues such as dispatch time and response time, contribute to ambulance

case times (10). As one of the issues reported is the lack of reportable data (12) in many Asian jurisdictions, it suggests there may be no ability to monitor or track ambulance case times, vehicle location, dispatch processes or patient care records (10). Furthermore, the lack of documentation may mean there is no event record of the patient's presentation to ambulance, treatment on-scene/enroute (12) or anything other than anecdotal reports of providing a verbal patient handover at the emergency department (13). A confounding fact is that, while it appears there is no standardised data collection in many Southeast Asian countries, national response time data is provided to regional bodies, such as the Pan Asian Resuscitation Outcome Study (PAROS) Clinical Research Group (14) and its sister organisation, the Pan Asia Trauma Outcome Study (PATOS) Clinical Research Group (15).

This scoping study examines operational conditions impacting ambulance services in Asia, with a direct focus on Malaysia and Indonesia and currently known information about ambulance data collection. The review will present findings to unpack some of the issues faced by these two countries, while reflecting on experiences in other Asian countries.

Methods

This scoping study applied the Levac et al (16) adaption of Arksey and O'Malley's (16) framework. This approach was conducive to the topic, particularly given the option to include a consultative stage, should that be required. The five stages of framework used here are:

1. Identifying the research question
2. Identifying relevant studies
3. Study selection
4. Charting the data, and
5. Collating, summarising and reporting the results.

Identifying the research question

There is a lack of consistency and rigour around patient outcomes following ambulance transport in Malaysia and Indonesia. Inadequate data collection has a direct impact on the ability to measure key performance and quality indicators.

Identifying relevant studies

Identification of relevant studies through searching databases, the grey literature and the reference lists of literature reviews, and potentially relevant studies, proved challenging. The 'catch-all' search string of 'emergency medical service', 'ambulance' and 'pre-hospital' (along with variants) was developed. While combining the first and second search decreased the number of papers, the results remained quite abstract from the research question. The regional limiters of 'Southeast Asia', 'Malaysia' and 'Indonesia' (along with variants) were added to the search parameters. The addition of the term 'data collection' had the profound effect of decreasing the number of papers to an extremely low level, with one database returning two documents, both of which were not relevant to the study.

Study selection

Inclusion criteria (Table 1) revolved around the pre-hospital services in Malaysia and Indonesia, while exclusion criteria included papers that were not written in English (n=202). The type of clinician (eg. paramedic) was not relevant to this study in regard to search keywords. This was partly due to the title 'paramedic' not being an official role in some countries (17) and the type of clinicians who work in the pre-hospital setting can often include nurses (17).

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
English language	Non-English language
Described and/or evaluated data collection in the pre-hospital environment	Did not describe and/or evaluate data collection in the pre-hospital environment
Identified geographic location included Indonesia and/or Malaysia	Not Indonesia and/or Malaysia

The title and abstracts of studies were read to establish their relevance to the research question, with subsequent full texts of potentially relevant papers obtained and read. The inclusion criteria were applied through this review process with a majority of these studies originating from database searching with some coming from a reference list searching and others from the authors' previous knowledge of the topic.

Charting the data

Data was charted to summarise key information from identified studies. The chart level of summarisation often included commentary about the relevance or applicability of the study. Publication details were also added to the chart.

Collating summarising and reporting the results

Charting the data presented a challenge in drawing out information that addressed the question as most papers did not necessarily address the research question. What did become clear was that different papers presented different experiences

across the two countries, with some studies presenting evidence of data reporting and others highlighting lack of evidence and data within the same region.

Results

The search string results are listed in Table 2, which also includes a comparison of the results across four electronic databases: MEDLINE, CINAHL, EMCare and Cochrane.

The Prisma flow diagram (Figure 1) demonstrates the progressive steps of the search string result analysis, reflecting both the cull and selection of journal articles discussing the focus topic. It should be noted that search string eight was selected as it returned the largest manageable result (n=202) for analysis.

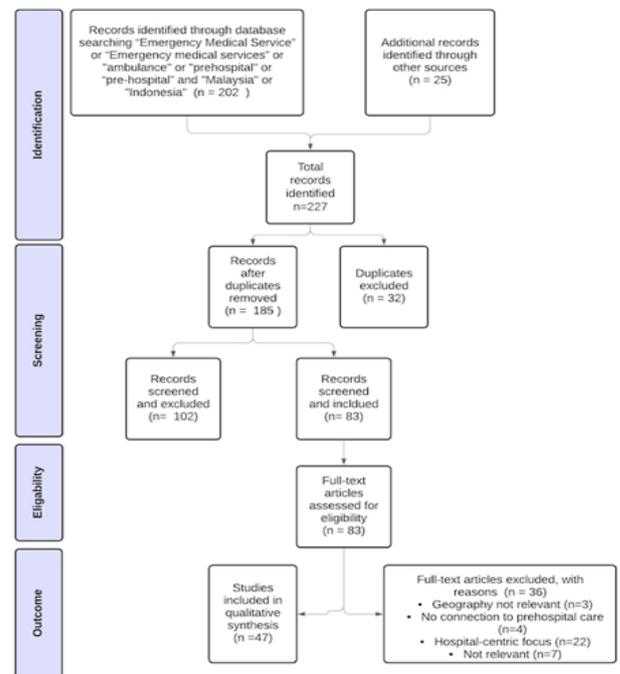


Figure 1. Prisma flow diagram

Table 2. Search strings against databases

	Words	MEDLINE	CINAHL	Cochrane	EmCare	Total
1	'Emergency medical service' or 'Emergency medical services'	43,675	27,166	1337	6674	78,852
2	Ambulance	11,422	7254	725	7072	26,473
3	Pre-hospital or prehospital	14,202	16,562	1441	9560	41,765
4	'Southeastern Asia' or 'Southeast Asia'	11,894	1011	364	2979	16,248
5	Malaysia* or Indonesia*	33,823	8046	3293	10,732	55,894
6	1 or 2 or 3	56,472	39,999	5478	18,392	120,341
7	4 or 5	43,559	8957	3648	13,355	69,518
8	5 and 6	94	49	12	47	202

Does system prodigy affect ambulance response behaviour?

Go et al (18) make the observation that ambulance services in some parts of Asia appear to be based on the Anglo-American emergency medical service (EMS) model of care. This model is based on a clinical framework with pre-hospital staff undertaking treatment and transport arrangements. Responders are trained in pre-hospital care training, ranging from basic first aid through to Bachelor of Paramedicine (depending on the system). In contrast, other parts of Asia demonstrate a more Franco-German EMS model (18), leveraging medical and nursing staff responding in an ambulance, usually with an operational concept of 'treat and not transport'.

Healthcare services need to be designed to deliver their service in a manner that meets the unique needs of the region and its community (19). Several authors (9,20) reflect on the futility of implementing a New York City-type EMS system into rural Asia, as this system has been developed to meet the specific and unique needs of a high-density urban environment.

Time of call

Another factor that impacts ambulance case times, and dispatch, can be the extended time between an incident occurring, such as the onset of chest pain, identification that an ambulance may be necessary and contacting an organisation to send an ambulance. While this issue is not limited to Asia, the time intervals can be exceptionally prolonged. At the micro-level, some cultures have a fatalism about healthcare services due to (real or perceived) barriers to access, including cost, clinical service quality and feelings of exclusion (19). Myers et al (21) present two related frameworks that illustrate possible reasons for a delay in care-seeking behaviour. Thaddeus and Maine's (22) 'three delays model' proposes that the delays are in the decision to seek care, in reaching care and in receiving adequate health care. In contrast, Penchants and Thomas's (23) 'five dimensions of access' present the issues of affordability, accessibility, accommodation, availability and

acceptability as reasons for delaying access to care.

What is a standard response time?

Ambulance services in most high-income countries have a performance indicator attached to the time of receiving an ambulance request to an ambulance arriving at the location of a patient. Examples of ambulance response times for a patient triaged as being life threatening include 7 minutes in London (24) and 10 minutes in urban Australia (25).

However, direct application of internationally standardised response times in Malaysia or Indonesia, as well as other countries, may be almost impossible (26) and possibly inappropriate (27).

Why are case times collected?

Case times provide an objective understanding of various time periods that occur through a case from time of dispatch through to arrival at hospital. There is a range of other variables that can impact patient outcomes. A number of authors (19,28) suggest a delay in initiating 'care-seeking behaviour', such as calling an ambulance, can contribute to increasing the time between the onset of a health event and seeking assistance. Figure 2 provides an overview of 11 case events; each an exemplar of what Ambulance refers to as a 'time stamp', that provides clarification around the internals used to calculate case time data.

Current status of pre-hospital data collection in Malaysia and Indonesia

The PAROS Clinical Research Group states that 'currently, research into pre-hospital emergency care in the Asia-Pacific region is largely inadequate and poorly coordinated owing to the marked variations in EMS systems and outcome reporting' (29). The lack of literature (17) makes this research more difficult. Furthermore, Numumal and Karim (30) highlight an increasing call for service 'betterment' from various parts of the Malaysian community.

Reflective of this concern is that both PAROS and PATOS

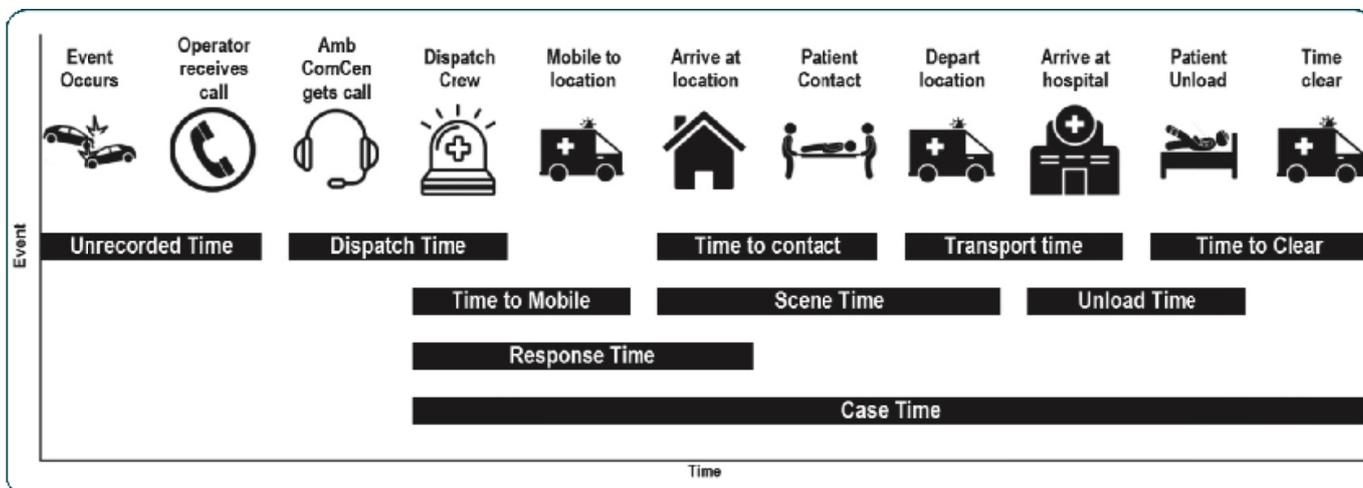


Figure 2. Typical segment of an ambulance response, from time of incident to departure from hospital. Reproduced with permission (31)

research groups have attempted to develop standardised data collection frameworks for use in the Pan-Asia region (31-34). However, with the current membership of only 11 countries participating in PAROS (Table 3) and 12 in PATOS (Table 4), these two organisations are limited in their ability to provide standardisation throughout the region. Data submitted to PATOS and PAROS from member countries is not necessarily national data as there are some state/provincial data missing from the records. Therefore, it appears there are gaps in the data collection from Asian countries who are not members of PATOS/PAROS, as well as gaps in data collection from some geographic regions within the member countries.

Table 3. PAROS participants and observers (31,32)

PAROS participants
China
India
Indonesia
Japan
Malaysia
Pakistan
Philippines
Singapore
Korea
Taiwan
Thailand
United Arab Emirates
Vietnam

Note: India is not included in the list of member countries but has two representatives on the executive committee (33).

Data collected by PAROS and PATOS tools are comprehensive, with an underlying framework based on the United States National Emergency Medical Services Information System. While the data dictionary is comprehensive, with over 400 definitions, the researchers state that 'additional data elements should be considered for use at the state and local levels depending on each state or local EMS system's need' (35). The importance of this definition is demonstrated by the suggestion that systems that are based purely on western EMS systems are 'not necessarily relevant' in LMIC (36), due to a lack of strict legislation, the scarcity of resources and limited number of trained personnel (36). Smullen (37) states that 'western institutional concepts... have limited applicability to the Asian context'. It is on this point that it is recommended that modelling assumptions should reflect EMS protocols of the area being studied, rather than apply non-contextualised performance indicators (38).

Perhaps an explanation for this perspective may be that financial and resource mismatch occurs when high-income systems are implemented into low to middle income areas

(39). Nonetheless, the conclusion seems that it is probably erroneous to base EMS pre-hospital case time assumptions in non-US countries on frameworks designed to be used in the US context (28). This perspective is strengthened when it is described as an 'unjustifiable exercise' to compare different ambulance systems as they 'operate in different contexts with different types of demands' (20), noting that 'even within a single country, different jurisdictions could have... unique EMS protocols' (28).

Table 4. PATOS participants and observers (33,34)

PATOS participants
Australia
Japan
China (Hangzhou and Hong Kong)
India
Japan
Laos
Malaysia
Singapore
Korea
Taiwan
Thailand
Philippines
Vietnam
United Arab Emirates
PATOS observers
Indonesia
Mongolia
Sri Lanka

Limitations to standardised pre-hospital data collection

Limitations to effective data collection are numerous. Rahman et al (10) suggest that the more uniform an EMS system is and how well data is collected the more developed the country. Difficulties include different data dictionaries and patient care records, meaning a consistent picture cannot be developed from the gathered data. Hisamuddin (39) lists a number of issues that were being faced by pre-hospital care systems in Malaysia, while Suryanto et al (40) provide insight into problems facing Indonesian pre-hospital care systems. Both suggest that (in the respective countries of their research) there is a demonstrable lack of uniform medical control, treatment (protocols), communications or systems management, training or education or quality assurance polices.

Ten years following Hisamuddin's (39) observations, trauma systems remain undeveloped and unorganised in 'most Asian countries', with the exception being high-income countries (41). This statement is reinforced by a description of Indonesian pre-

hospital services as having vehicles with only basic equipment (42) and staffed from Puskesmas (the term in Bahasa Indonesian for a community health clinic) with ambulance nurses lacking pre-hospital skills and knowledge (40).

Discussion

Baseline data provides a point of comparison to identify performance. How does an organisation know whether it is achieving its objectives, let alone key performance indicators, if it is not collecting data?

What does 'good' data collection look like?

There is no benchmark for 'good' data collection, although some data sets may provide indicators of what data should be collected. While the PAROS and PATOS research groups provide data sets for reporting from its constituent nations, these appear to be more strongly based on a North American model than one tailored for the unique situations and breadth of national income levels found within Asia. As asserted, a data set designed for the high-income country can probably not be applied to low-income communities or countries.

Culture, data and governance

Culture may play a part in the way data is collected and the perceived worth of collecting it. The belief system of some cultures may decrease the importance of collecting data (19).

Establishing an operational baseline

As countries move from historically LMIC status to higher income levels, there is an expectation from communities that issues will be addressed. The increasing number of complaints from communities within Indonesia following the introduction of universal health care is an indication of changing community expectations.

This scoping study presents more questions than it answers. From a review of the literature, it seems the quantity and quality of pre-hospital data collection in Malaysian and Indonesia is on a spectrum ranging from nothing collected through to excellent case documentation with no significant clarity around why the difference occurs. Furthermore, there seems to be a significant disconnect in the ability to track the outcome of a patient who was transported to hospital in these two countries. So, while data is being reported to regional bodies, such as PAROS and PATOS, different authors present differing status of data collection, its quality and, in some cases, its authenticity. The range of reports about data collection methods reported in the literature raises two significant questions: When data is reported up, where is the data coming from, organisationally and geographically? And, in regard to the collection itself, what is the quality of data that is being collected?

What is also evident from the literature is that it is medical-centric. Few articles are written from a nursing or paramedicine

perspective. It is not known whether the lack of nursing or paramedicine literature can be explained by the emerging status of paramedicine as a discipline in Malaysia and the heavy use of clinic nurses in pre-hospital care in Indonesia, along with a relatively deregulated (39) and decentralised system in both countries.

Limitations

This scoping study has identified that there is a significant gap in the literature between the two extremes that data is being collected and/or reported and that data is not being collected and/or reported. This disparity in the literature is, in itself, a significant limitation of this study.

Additionally, there are some (limited) journal articles written in Bahasa Indonesia and Bahasa Malay that may provide additional depth to this topic but these were not accessed for this study.

Conclusion

This scoping study is a foundation piece of work that has examined existing knowledge of pre-hospital care documentation in Malaysia and Indonesia. While acknowledging the limitations of the study, it is clear there is a lack of evidence of consistent data collection in the pre-hospital care environment in these two countries.

It is clear the literature on this topic has been found wanting. It is recommended that further research, including field consultations to gather qualitative data about pre-hospital data collection and quantitative research on operational response data is undertaken.

Conflict of interest

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

References

1. Pittet V, Burnand B, Yersin B, Carron P. Trends of pre-hospital emergency medical services activity over 10 years: a population-based registry analysis. *BMC Health Serv Res* 2014;14:380.
2. Smith RM, Conn AK. Pre-hospital care - scoop and run or stay and play? *Injury* 2009;(Suppl 4):S23-6.
3. Beuran M, Paun S, Gaspar B, et al. Pre-hospital trauma care: a clinical review. *Chirurgia (Bucur)* 2012;107:564-70.
4. Ryyänen O, Iirola T, Reitala J, Pälve H, Malmivaara A. Is advanced life support better than basic life support in pre-hospital care? A systematic review. *Scand J Trauma Resusc Emerg Med* 2010;18:62

References (continued)

5. Kondo Y, Fukuda T, Uchimido R, Hifumi T, Hayashida K. Effects of advanced life support versus basic life support on the mortality rates of patients with trauma in pre-hospital settings: a study protocol for a systematic review and meta-analysis. *BMJ Open* 2017;7:e016912.
6. Isenberg D, Bissell R. Does advanced life support provide benefits to patients? A literature review. *Prehosp Disaster Med* 2005;20:265-70.
7. Sanghavi P, Jena AB, Newhouse JP, Zaslavsky AM. Outcomes of basic versus advanced life support for out-of-hospital medical emergencies. *Ann Intern Med* 2015;163:681-90.
8. Callaham M. Evidence in support of a back-to-basics approach in out-of-hospital cardiopulmonary resuscitation vs 'advanced' treatment. *JAMA* 2015;175:205-6.
9. Hooper C. Time to respond - pre-hospital leadership and operational management. Chicago: Bookventure; 2016.
10. Rahman NH, Tanaka H, Shin SD, et al. Emergency medical services key performance measurement in Asian cities. *Int J Emerg Med* 2015;8:3.
11. Durham M, Faulkner M, Deakin C. Targeted response? An exploration of why ambulance services find government targets particularly challenging. *Br Med Bull* 2016;120:35-42.
12. Choi SJ, Oh MY, Kim NR, et al. Comparison of trauma care systems in Asian countries: a systematic literature review. *Emerg Med Australas* 2017;29:697-711.
13. Latif MA. Medical Planning for Mass Gathering Events. Workshop Presentation. University of Malaya: Kuala Lumpur. October 2017.
14. Singapore Clinical Research Institute. About PAROS. Singapore Clinical Research Institute. 2018. Available at: www.scri.edu.sg/crn/pan-asian-resuscitation-outcomes-study-paros-clinical-research-network-crn/about-paros/ [Accessed 11 November 2018].
15. Laboratory of Emergency Medical Service. Undated. About PATOS CRN. 2018. Available at: <http://lems.re.kr/eng/patos-about/> [Accessed 29 June 2018].
16. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5(69).
17. Yusvirazi L, Wijaya Ramlan AA, Hou PC. State of emergency medicine in Indonesia. *Emerg Med Australas* 2018;30:820-6.
18. Go TL, Lim CS, Danapalasingam KA, Tan MLP, Tan CW. A review on development and optimization of emergency medical services in Malaysia. *Jurnal Teknologi* 2014;70:93-6. Available at: <https://jurnalteknologi.utm.my/index.php/jurnalteknologi/article/view/3470> [Accessed 20 July 2019].
19. D'Ambruoso L, Byass P, Qomariyah SN. 'Maybe it was her fate and maybe she ran out of blood': Final caregivers' perspectives on access to care in obstetric emergencies in rural Indonesia. *J Biosoc Sci* 2010;42:213.
20. Al-Shaqsi S. Models of international emergency medical service (EMS) systems. *Oman Med J* 2010;25(4).
21. Myers BA, Fisher RP, Melson N, Belton S. Defining remoteness from healthcare: integrated research on accessing emergency material care in Indonesia. *AIMS Public Health* 2015;2(3).
22. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med* 1994;38:1091-110.
23. Levesque J, Harris MF, Russell G. Patient-centred access to health care: conceptualising access at the interface of health systems and populations. *Int J Equity Health* 2013;12:18.
24. NHS England. 2018 Statistical Note: Ambulance Quality Indicators (AQI) AQI Statistical Note, 8 November 2018. Available at: www.england.nhs.uk/statistics/wp-content/uploads/sites/2/2018/11/20181108-Ambulance-Quality-Indicators-Statistical-Note.pdf [Accessed 11 November 2018].
25. NSW Health. 2018-19 Service Agreement. An agreement between Secretary, NSW Health and NSW Ambulance for the period 1 July 2018 - 30 June 2019. Available at: www.ambulance.nsw.gov.au/media/docs/NSW%20Ambulance%202018%2019%20SA-e6fc7ca6-d253-4818-a6db-f23c6586dccb-0.pdf [Accessed 27 September 2019].
26. Perry P. Setting basic standards in a developing ambulance service: a qualitative description of the impact of the intermediate ambulance care course on pre-hospital care practice in Penang, Malaysia. 2016, University of Adelaide.
27. Patel AB, Waters NM, Blanchard IE, Doig CJ, Ghali WA. A validation of ground ambulance pre-hospital times modeled using geographic information systems. *Int J Health Geogr* 2012;11:42.
28. Li P, Yu D. Predictors of pre-hospital delay in Hong Kong Chinese patients with acute myocardial infarction. *Eur J Cardiovasc Nurs* 2018;17:75-84.
29. Singapore Clinical Research Institute. About PAROS. Singapore Clinical Research Institute 2018. Available at: www.scri.edu.sg/crn/pan-asian-resuscitation-outcomes-study-paros-clinical-research-network-crn/about-paros/ [Accessed 11 November 2018].
30. Nurumal MS, Karim SSA. Out of hospital cardiac arrest in Kuala Lumpur: Incident, adherence to protocol, and issues: a mixed method study. *Malaysian Journal of Public Health Medicine* 2015;15:94-103.
31. C. Hooper. 2016. Time to Respond- Pre-hospital Leadership and Operational Management. Bookventure: Chicago. p.15.
32. Laboratory of Emergency Medical Service. About PATOS CRN. 2018 Available at: <http://lems.re.kr/eng/patos-about/> [Accessed 29 June 2018].
33. Singapore Clinical Research Institute. Members of PAROS CRN. 2019. Available at: www.scri.edu.sg/crn/pan-asian-resuscitation-outcomes-study-paros-clinical-research-network-crn/members/ [Accessed 29 June 2018].

References (continued)

34. Kong, J. Programme Booklet of PATOS Introduction. Introduction to PATOS. Available at: http://lems.re.kr/eng/wp-content/uploads/sites/2/2018/02/Slides_1.pdf. Presented 2017.08: PATOS Research Workshop (Seoul, Korea)
35. NHTSA Office of EMS. NEMSIS: Uniform Pre-Hospital Emergency Medical Services (EMS) Dataset. US Department of Transportation National Highway Traffic Safety Administration. Version 2.2.1. 2006. Available at: <https://nemsis.org/technical-resources/version-2/version-2-dataset-dictionaries/> [Accessed 11 Nov 2018].
36. Brown HA, Douglass KA, Ejas S, Poovathumparambil V. Development and implementation of a novel pre-hospital care system in the State of Kerala, India. *Prehosp Dis Med* 2016;31:663-6.
37. Smullen A, Hong PK. Comparing the health care systems of high-performing Asian countries. *Asia Pac Policy Stud* 2015;2:347-55.
38. Callese TE; Richards CT, Shaw P, et al. Trauma system development in low- and middle- income countries: a review. *J Surg Res* 2015;193:300-7.
39. Hisamuddin NA, Hamzah MS, Holliman CJ. Pre-hospital emergency medical services in Malaysia. *J Emerg Med* 2007;32:415-21.
40. Suryanto, Plummer V, Boyle M. EMS systems in lower-middle income countries: a literature review. *Prehosp Dis Med* 2017;32:64-70.
41. Choi SJ, Oh MY, Kim NR, et al. Comparison of trauma care systems in Asian countries: A systematic literature review. *Emerg Med Australas* 2017;29(6).
42. Ismail S, Zia N, Samad K, et al. Pre-hospital airway management in emergency and trauma patients: a cross-sectional study of ambulance service providers and staff in a low- and medium- income country. *Prehosp Dis Med* 2015;30:606-12.