

Knowledge of Acute Stroke Management Among Healthcare Professionals: Development and Validation of Acute Stroke Management Questionnaire (ASMaQ)

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Background: Around 15.0% of all strokes occurred in hospitalised patients and studies showed significant delay in the stroke recognition and lack of awareness on thrombolytic therapy for acute ischaemic stroke (AIS) which lead to higher mortality for in-hospital stroke. We aimed to develop and validate a new instrument known as acute stroke management questionnaire (ASMaQ) to evaluate the awareness of healthcare professionals in managing acute ischaemic stroke cases. **Methods:** This study consisted of 3 steps; the formulation of ASMaQ draft, content validation and construct validity. A total of 110 questions were drafted with 5-point Likert scale answers. From the list, 31 were selected and subsequently tested on 158 participants. The results were analysed and validated using exploratory factor analysis on SPSS. Components were extracted and questions with low factor loading were removed. The internal consistency was then measured with Cronbach's alpha. **Results:** Following analysis, 3 components were extracted and named as general stroke knowledge, hyperacute stroke care and advanced stroke management. Two items were deleted leaving 29 out of 31 questions for the final validated ASMaQ. Internal consistency showed high reliability with Cronbach's alpha of 0.82. Our respondents scored a total cumulative mean of 113.62 marks or 66.6%. A sub analysis by occupation showed that medical assistants scored the lowest in the group with a score of 57% whilst specialists including neurologists scored the highest at 79.4%. **Conclusion:** The ASMaQ is a newly developed and validated questionnaire consisting of 29 questions testing the respondents' acute stroke management knowledge.

Key Words: Validation—Acute stroke management—Stroke—In-hospital stroke
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Introduction

Stroke is the second most common cause of deaths and the second leading cause of disability adjusted life years lost worldwide.^{1,2} Stroke is a medical emergency and prompt treatment with reperfusion therapy may reverse the acute symptoms. However, the reperfusion therapy can only be utilised within a narrow window period.³ Studies have shown that delays in reperfusion treatment include failure to recognize symptoms, poor treatment awareness and lack of infrastructure especially in a developing country such as Malaysia.^{4,5}

Between 6.5 and 15.0% of all strokes occur in hospitalised patients, and support staff such as nurses, medical assistants and other allied health professionals tend to be the first to attend to the stroke patients.⁶ Previous literature have shown that stroke symptoms may not be recognised

List of abbreviations

IHS	In Hospital Stroke
AIS	Acute Ischaemic Stroke
ASMaQ	Acute Stroke Management Questionnaire
EFA	Exploratory Factor Analysis
GSK	General Stroke Knowledge
HSC	Hyperacute Stroke Care
ASM	Advance Stroke Management
UKMMC	Universiti Kebangsaan Malaysia Medical Centre
PCA	Principal Component Analysis
KMO	Kaiser-Meyer-Olkin
FAST	Face, Arm, Speech, Time
GCS	Glasgow Coma Scale
CT	Computed Tomography

in hospitalised patients causing delayed treatment.⁷ Alarmingly, Albert et al described that delayed referrals to the appropriate specialties account for the largest portion of delay, with less than 30% of patients assessed by stroke physicians within 90 min of stroke onset and over 25% not seen within 12 h of symptom recognition⁸.

Many hospitals include stroke education for all staff and have standardized Stroke Alert protocols for hospitalised patients who develop symptoms of stroke yet, the yield of in-hospital stroke (IHS) codes is less than for patients who are evaluated in the ED setting.⁹ In our centre, the neurology unit conducts yearly stroke education for all staff. There is no specific Stroke Alert protocol for hospitalised patients, once a stroke is recognised, the on-call neurology team will be consulted with subsequent steps following the ED stroke activation protocol. Needless to say, the successful treatment of IHS relies heavily on symptom recognition and treatment awareness by healthcare professionals.

Mortality for IHS is approximately double compared to community-occurring stroke.¹⁰ A study in Dublin, Ireland by Mellon et al on 96 hospital staffs found that less than half were aware of thrombolytic therapy for acute ischaemic stroke (AIS), and only 48% of the sample could identify the time window for thrombolysis administration.¹¹ This highlights the significant gap in knowledge of thrombolytic services for stroke among general hospital staff. There have been many studies looking at stroke awareness among the general population such as the Stroke Symptom Questionnaire, Stroke Action Test and Stroke Awareness Questionnaire.^{12–14} However, we found limited data on the determination of stroke awareness among healthcare providers especially in its acute management. To date, there is no such validated instrument to the best of our knowledge.

Therefore, as a first step we would need to create a questionnaire called ASMaQ as an instrument to evaluate

the respondents' awareness in managing AIS cases. This instrument would allow evaluation of knowledge as well as increase awareness on acute stroke management among healthcare workers and would be a valuable asset to the neurology fraternity, as it would enable us to identify factors for delayed reperfusion therapy. This would allow us to intervene specifically at a targeted population with steps such as regular tailored stroke education intervention training programme or creating protocols/guidelines to facilitate acute IHS management among others.

Methods

We used a methodological research design to develop, validate and psychometrically evaluate a new questionnaire called ASMaQ in this study. This study was approved by the Research Ethics Committee of the Universiti Kebangsaan Malaysia Medical Centre (Ethics Code: FF-2018-433) and consisted of three steps, namely:

- a. Formulation of ASMaQ draft
- b. Content validation
- c. Construct validity

A. Formulation of ASMaQ draft

From a review of stroke literature, existing stroke assessment scales, Malaysia clinical practice guidelines¹⁵ on management of AIS and guidelines for the early management of patients with AIS from American Heart Association/American Stroke Association,¹⁶ 30 prototype questions were formulated. The questions addressed various levels in the management of AIS ranging from symptom recognition to treatment administration. A total of 8 specialists and consultants in the neurology unit of Universiti Kebangsaan Malaysia Medical Centre (UKMMC) further contributed another 10 questions each to the draft bringing the total number of questions to 110. The questions are scored using a 5-point Likert scale.

B. Content validation

The questionnaire content was then evaluated thoroughly according to the recent guidelines. The neurology team and a public health physician of UKMMC were gathered as members of an expert panel to review the items for content, breadth and applicability, and rate each item on its validity and relevance. Questions were then vetted, dropped, added on and reworded based on the panel's consensus. Out of 110 questions, 79 were eliminated and 31 questions were selected as ASMaQ prototype. Eight questions or 25.8% of ASMaQ prototype were reverse marked with negative answers to avoid convenient answering by respondents. Prior to completing the questionnaire, the respondents were asked to fill in their sociodemographic information and state if they had any past personal experience with AIS.

C. Construct validity

Data collection

Psychometric testing of the ASMaQ prototype was done on 158 participants for validation. The sample size was calculated using the lower limit of 5 respondents per variable to be analysed.¹⁷ There were a total of 31 questions in ASMaQ. Therefore, the required sample size was 155 respondents. Participants were recruited via purposive sampling method by selecting various professions in UKMMC including nurses, medical assistants, pharmacists, house officers, medical officers and specialists. Exclusion criteria were those who were directly involved with the study. The method of administration was face-to-face survey using Google Forms on smartphone devices. The data was collected from March to May 2019.

Data analysis

The list of questions and their mean marks are represented on Table 2 in the results section. Results were analysed and validated using exploratory factor analysis¹⁸ via IBM SPSS statistical programme, version 23. The EFA was conducted for component extraction using principal component analysis (PCA) method. Firstly, Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity was calculated to determine if the data was suitable for PCA. Then, to determine how many components to keep we ran Total Variance Explained method with eigenvalues set above 1. This method is then complimented by Scree Plot and Parallel Analysis with Monte Carlo. The questions were then rotated with Direct Oblimin method and subjected to factor loading. Questions with low factor loading were dropped. Reliability analysis with Cronbach’s alpha was calculated before and after questions were removed.

Results

Respondents

A total of 158 respondents were recruited. Out of 158 responses, 1 was unreliable and thus removed. The age of the respondents ranged from 24 to 59 years old with a mean of 33 years and a standard deviation of 6.03 years. There were more female than male respondents at 68.2%. Respondents were mainly Malay (61.8%). Other demographics such as occupation, years of service and department of the respondents are depicted in Table 1 below. Another important characteristic of the respondents is their personal experience with AIS management which is considerably high at 76.4%.

Table 2 lists the 31 questions asked with mean marks and standard deviation of the responses obtained. The questions were scored in Likert scale ranging from 1 to 5 points. In questions with positive answers, the most

Table 1. Respondent’s demographic characteristics.

Characteristics	Respondents (n = 157)
Mean Age \pm SD (range)	33.13 \pm 6.03 (24–59)
Sex [n (%)]	
Male	50 (31.8)
Race [n (%)]	
Malay	97 (61.8)
Chinese	43 (27.4)
Indian	12 (7.6)
Others	5 (3.2)
Occupation [n (%)]	
House Officer	26 (16.6)
Medical Officer	62 (39.5)
Specialist	7 (4.5)
Pharmacist	4 (2.5)
Nurse	49 (31.2)
Medical Assistant	9 (5.7)
Years of Service [n (%)]	
<5 years	42 (26.8)
5–10 years	75 (47.8)
> 10 years	40 (25.5)
Department [n (%)]	
Medical	116 (73.9)
Neurology	5 (3.2)
Pharmacy	6 (3.8)
Radiology	1 (0.6)
Surgery	3 (1.9)
Anaesthesiology	4 (2.5)
Emergency	13 (8.3)
Family Medicine	1 (0.6)
Orthopaedics	3 (1.9)
Obstetrics and Gynaecology	2 (1.3)
Paediatric	3 (1.9)
Personal acute stroke experience [n (%)]	
Yes	120 (76.4)

desired response would be 5, 1 being the least desired response and vice versa for questions with negative answers namely questions 2, 12, 13, 20, 21, 22, 30 and 31.

Exploratory factor analysis

The KMO index was 0.86 whilst *p* value for Bartlett’s test was 0.000. Both values were very significant proving that the data was suitable for PCA. Then component extraction was performed using Total Variance Explained method (Table 3), Scree Plot (Fig. 1) and Parallel Analysis with Monte Carlo (Table 4). Total Variance Explained method with eigenvalues set above 1 extracted 8 components whilst Parallel Analysis suggested a 3 components solution. With supplementary Scree Plot we concluded that 3 components were adequate to represent most of the variables of 31 questions. All solutions are shown below. Thus, PCA was computed again with 3 components extraction.

Table 2. Questions and mean marks.

Question	Mean Mark	SD
1. How would you rate your knowledge on acute stroke management?	2.64	.71
2. Stroke is a medical emergency only within 4.5 h of stroke onset.*	2.72	1.20
3. Are you able to detect symptoms of acute stroke?	4.02	.57
4. Are you familiar with FAST (Face, Arm, Speech, Time)?	3.81	1.19
5. Acute confusion may be a sign of stroke.	4.09	.66
6. Hypoglycaemia can mimic acute stroke.	4.15	.85
7. Stroke can present with visual disturbances.	4.32	.72
8. Stroke patients can present with limb numbness.	4.39	.64
9. Unsteadiness of gait can be a sign of stroke.	4.40	.65
10. Acute stroke can present with reduced level of consciousness.	4.47	.62
11. The Glasgow Coma Scale (GCS) is a tool to assess level of consciousness.	4.52	.61
12. A full neurological examination must be performed immediately in patients presenting acutely with symptoms suggestive of stroke.*	1.63	.80
13. High blood pressure should be lowered to normal values in acute stroke.*	3.82	1.10
14. All acute stroke patients must undergo a brain CT immediately.	4.45	.71
15. All suspected stroke patients must be referred to the neurology team immediately.	4.05	.95
16. The earlier the treatment, the better the outcome of acute stroke.	4.61	.54
17. Thrombolysis therapy is given intravenously to break down clots.	4.41	.67
18. My hospital is equipped with thrombolysis treatment.	4.42	.84
19. A non-enhanced CT scan is adequate prior to thrombolysis.	3.68	.99
20. Coagulation profile must be screened before thrombolysis.*	2.03	.98
21. All acute stroke patients must have a 12 leads ECG before thrombolysis.*	2.10	.89
22. Patients aged 80 years and older are not eligible for thrombolysis.*	2.82	1.07
23. Intracranial haemorrhage is a contraindication for thrombolysis therapy.	4.43	.80
24. Are you aware of mechanical thrombectomy treatment for stroke?	3.66	1.10
25. Mechanical thrombectomy is administered for clot removal in acute stroke.	4.04	.73
26. My hospital is equipped with mechanical thrombectomy service.	3.75	.97
27. Acute stroke symptoms can be potentially reversed with administration of thrombolysis or with mechanical thrombectomy.	4.12	.75
28. Mechanical thrombectomy can be performed after thrombolysis therapy.	3.46	1.02
29. Thrombolysis and mechanical thrombectomy can only be administered within a therapeutic window.	3.97	.86
30. Wake up strokes are not eligible for thrombolysis nor mechanical thrombectomy.*	3.18	1.01
31. Acute stroke management education should be conducted regularly for healthcare professionals.*	1.46	.69
Total (Mean Mark) ^a	113.62 (3.67)	25.89

*Asterisk sign denotes negative answer as desired response, mark is converted to positive score in this table

^aTotal possible marks=155.

The data was then rotated for interpretation using an oblique solution via Direct Oblimin method as the data showed intercorrelations with each other. Factor loading of each question were determined and values of less than 0.3 were removed as shown on Table 5.

Based on this table, questions 19 and 22 both had low factor loadings of less than 0.3, thus both of these questions were removed leaving a total of 29 questions for ASMaQ. These questions were divided into 3 components or domains and we named them as such;

Component 1: General Stroke Knowledge

Component 2: Hyperacute Stroke Care

Component 3: Advanced Stroke Management

Finally, reliability analysis was computed which showed good reliability with Cronbach's alpha values of 0.806 for initial questionnaire of 31 items. The value further increased to 0.820 with removal of 2 questions after PCA.

Discussion

This study developed and validated an all new questionnaire called ASMaQ which can be used to determine healthcare workers' knowledge on AIS management. There is no known existing questionnaire for this purpose to our knowledge. Hence, EFA method was the choice for the validation of this questionnaire. EFA is a method used in the creation of a new questionnaire by extracting components and determine if the questionnaire is able to measure what it was designed to measure. By employing EFA, we were able to divide the questions into 3 components and remove questions with low factor loading score. The 3 components extracted named GSK, HSC and ASM were able to represent 43% of the variables in the study. Although question 23 loaded on component 1, we listed it under component 2 in the final validated ASMaQ for better flow and chronological order of the questionnaire.

Table 3. Total variance explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.617	27.796	27.796	8.617	27.796	27.796
2	2.582	8.330	36.127	2.582	8.330	36.127
3	2.092	6.749	42.876	2.092	6.749	42.876
4	1.570	5.065	47.941	1.570	5.065	47.941
5	1.313	4.236	52.176	1.313	4.236	52.176
6	1.221	3.940	56.116	1.221	3.940	56.116
7	1.141	3.680	59.797	1.141	3.680	59.797
8	1.080	3.483	63.280	1.080	3.483	63.280
9	.971	3.133	66.413			
10	.870	2.805	69.218			
11	.832	2.685	71.903			
12	.782	2.524	74.427			
13	.717	2.313	76.740			
14	.698	2.251	78.991			
15	.648	2.090	81.081			
16	.601	1.939	83.020			
17	.567	1.829	84.849			
18	.508	1.638	86.486			
19	.480	1.548	88.034			
20	.460	1.485	89.519			
21	.437	1.410	90.929			
22	.404	1.302	92.231			
23	.384	1.238	93.469			
24	.344	1.108	94.577			
25	.324	1.045	95.622			
26	.280	.902	96.525			
27	.264	.851	97.376			
28	.237	.763	98.139			
29	.214	.690	98.829			
30	.199	.643	99.472			
31	.164	.528	100.000			

Extraction Method: Principal Component Analysis.

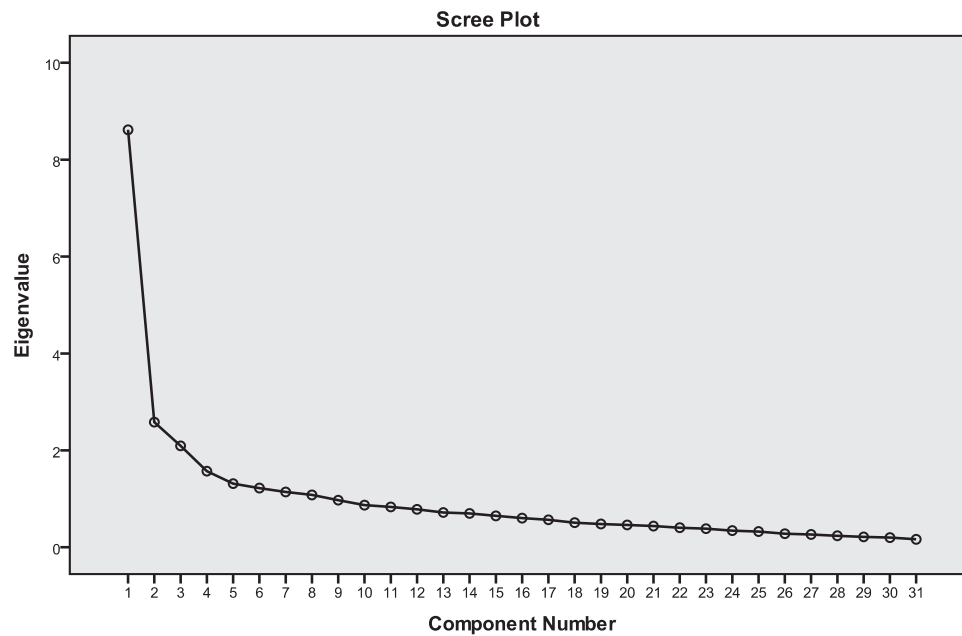


Fig. 1. Scree Plot.

Table 4. Monte Carlo PCA for parallel analysis.

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Number of variables: 31		
Number of subjects: 157		
Number of replications: 100		
Eigenvalue #	Random Eigenvalue	Standard Dev
1	1.9379	.0773
2	1.8138	.0633
3	1.7046	.0499
4	1.6167	.0385
5	1.5408	.0361
6	1.4655	.0351
7	1.4016	.0329
8	1.3410	.0344
9	1.2848	.0295
10	1.2296	.0259
11	1.1753	.0282
12	1.1208	.0257
13	1.0730	.0261
14	1.0242	.0280
15	0.9781	.0223
16	0.9383	.0210
17	0.8971	.0238
18	0.8547	.0201
19	0.8162	.0177
20	0.7759	.0197
21	0.7356	.0216
22	0.6976	.0209
23	0.6630	.0246
24	0.6203	.0230
25	0.5829	.0213
26	0.5509	.0216
27	0.5128	.0242
28	0.4721	.0268
29	0.4354	.0233
30	0.3943	.0233
31	0.3451	.0279

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Following PCA, we deleted 2 questions from the original list. The deleted items 19 and 22 were appropriate as in retrospect, we found some amount of overlap between question 14 and question 19 which also deals with CT scan before reperfusion therapy. Meanwhile the dissection of question 22 reveals that the answers were distributed unsatisfactorily with 73.3% undesired answer and only 26.8% desired response. The question was designed to have negative marking as age of 80 is not a contraindication to thrombolysis.¹⁹ We surmised that this question may be rather specific and requires a certain level of knowledge in neurology in order to answer it correctly and hence not suitable for our targeted population of non-neurologists. Crossloaded questions 11, 12, 16, 17, 18 and

29 were retained in this study as the information generated by these questions are indispensable.

The purpose of this study was to develop and validate a new instrument. It was not meant for an epidemiological study. The results could be extrapolated to future research incorporating this questionnaire. Nonetheless, a brief review of the results showed us that the cumulative mean score for our questionnaire ranges from 31 to 155. As we see from Table 2, our respondents scored a total cumulative mean of 113.62 marks. The closer the marks are to 155, the better their AIS management knowledge. This is further converted in percentage to an overall score of 66.6%. A sub analysis by occupation showed that medical assistants scored the lowest in the group with a score of 57% whilst specialists including neurologists predictably scored the highest at 79.4%. This proved that the questionnaire is able to correctly and reliably rank knowledge based on occupation.

Some questions such as question 1 and 31 ask the respondents for their opinion on adequacy of stroke knowledge instead of assessing stroke knowledge directly, thus, understandably some respondents regardless of occupation would grade stroke knowledge as inadequate. Hence our overall marks expectedly would not reach the extremes regardless of actual stroke knowledge. The questions with low mean scores, below 2, were Questions 12 and 31 denoting poor knowledge in that particular area tested. Question 12 was designed with a negative answer acknowledging that acute stroke is a medical emergency requiring rapid assessment and decision making hence, instead of a full neurological examination, a targeted approach such as NIHSS scoring is adequate prior to decision on reperfusion therapy. The score suggested that many respondents were unaware of what neurological examination precludes the decision to thrombolysis. Questions 31 asked the respondents if continuous education was required. The low scores implied their agreement that stroke knowledge generally was lacking and continuous education or updates would be beneficial.

An important limitation of ASMaQ is that we can only use general questions on AIS management. Highly specific questions to stroke management or treatment were omitted in order to keep the instrument relevant throughout time. Our purposive sampling method incorporated a wide range of professions in the medical department, thus their knowledge of stroke is widely distributed and not suitable for an epidemiological study. This sampling method was necessary for the purpose of this study in creating a new instrument. The questionnaire was developed and validated in a single hospital. Its validity when used in a different setting needs to be established. This questionnaire will have to be pilot tested and administered to specific targeted population of healthcare providers in the future. Another limitation is that the ASMaQ is a new and

Table 5. *Exploratory factor analysis: pattern matrix-components and factor loadings^a.*

	Component		
	1	2	3
10. Acute stroke can present with reduced level of consciousness.	.867		
9. Unsteadiness of gait can be a sign of stroke.	.796		
7. Stroke can present with visual disturbances.	.785		
8. Stroke patients can present with limb numbness.	.781		
5. Acute confusion may be a sign of stroke.	.682		
6. Hypoglycemia can mimic acute stroke.	.636		
31. Acute stroke management education should be conducted regularly for health care professionals.	.584		
13. High blood pressure should be lowered to normal values in acute stroke.	-.549		
11. The Glasgow Coma Scale (GCS) is a tool to assess level of consciousness.	.504	.331	
23. Intracranial haemorrhage is a contraindication for thrombolysis therapy.	.491		
12. A full neurological examination must be performed immediately in patients presenting acutely with symptoms suggestive of stroke.	.397	.395	
15. All suspected stroke patients must be referred to the neurology team immediately.		.579	
21. All acute stroke patients must have a 12 leads ECG before thrombolysis.		.507	
20. Coagulation profile must be screened before thrombolysis.		.505	
16. The earlier the treatment, the better the outcome of acute stroke.	.395	.490	
2. Stroke is a medical emergency only within 4.5 hours of stroke onset.		.475	
18. My hospital is equipped with thrombolysis treatment.		.464	.368
14. All acute stroke patients must undergo a brain CT immediately.		.430	
17. Thrombolysis therapy is given intravenously to break down clots.		.357	.302
22. Patients aged 80 years and older are not eligible for thrombolysis.			
26. My hospital is equipped with mechanical thrombectomy service.			.733
24. Are you aware of mechanical thrombectomy treatment for stroke?			.713
25. Mechanical thrombectomy is administered for clot removal in acute stroke.			.631
28. Mechanical thrombectomy can be performed after thrombolysis therapy.			.614
1. How would you rate your knowledge on acute stroke management?			.578
27. Acute stroke symptoms can be potentially reversed with administration of thrombolysis or with mechanical thrombectomy.			.557
4. Are you familiar with FAST (Face, Arm, Speech, Time)?			.489
3. Are you able to detect symptoms of acute stroke?			.464
29. Thrombolysis and mechanical thrombectomy can only be administered within a therapeutic window.	.380		.460
30. Wake up strokes are not eligible for thrombolysis nor mechanical thrombectomy.			-.344
19. A non-enhanced CT scan is adequate prior to thrombolysis.			

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.^a

a. Rotation converged in 16 iterations.

unique questionnaire. There is no similar questionnaire to compare with. Therefore, confirmatory factor analysis was not performed.

Conclusion

This study was instrumental in the development and validation of a new tool called ASMaQ, designed for the determination of healthcare professionals' awareness on AIS management. The questionnaire consists of 29 questions testing the respondent's AIS management knowledge on 3 components namely GSK, HSC and ASM. It has good internal consistency and is ready to be used in future research. This newly developed instrument not only tests

healthcare providers' knowledge on AIS management but is also vital to:

- i. Aid stroke clinicians in targeting educational programmes to a specific group of people;
- ii. Increase awareness among healthcare providers in the management of AIS, and;
- iii. Be utilised as an instrument to gauge understanding in pre and post stroke education for healthcare workers.

It is our hope that once the awareness of AIS management is increased among healthcare providers, it will translate to improved stroke knowledge among the general population as well.

Ethical approval

This study was approved by the Research Ethics Committee of the Universiti Kebangsaan Malaysia Medical Centre (Ethics Code: FF-2018-433).

Consent for publication

Not applicable.

Competing interests

The authors declare that there is no competing interests.

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Authors contributions

CYS, WAWZ and HJT researched literature and conceived the study. CYS was involved in protocol development, gaining ethical approval and patient recruitment. CYS and SAS analysed the data. CYS wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

Data for reference

All data analysed during this study are included in this published article. The raw datasets of forms and questionnaires are available from the corresponding author on reasonable request.

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APPENDIX A: Acute Stroke Management Questionnaire (ASMaQ)

General stroke knowledge

1. Acute confusion may be a sign of stroke.

Strongly agree Agree Neutral Disagree Strongly disagree

2. Hypoglycaemia can mimic acute stroke.

Strongly agree Agree Neutral Disagree Strongly disagree

3. Stroke can present with visual disturbances.

Strongly agree Agree Neutral Disagree Strongly disagree

4. Stroke patients can present with limb numbness.

Strongly agree Agree Neutral Disagree Strongly disagree

5. Unsteadiness of gait can be a sign of stroke.

Strongly agree Agree Neutral Disagree Strongly disagree

6. Acute stroke can present with reduced level of consciousness.

Strongly agree Agree Neutral Disagree Strongly disagree

7. The Glasgow Coma Scale (GCS) is a tool to assess level of consciousness.

Strongly agree Agree Neutral Disagree Strongly disagree

8. A full neurological examination must be performed immediately in patients presenting acutely with symptoms suggestive of stroke.

Strongly agree Agree Neutral Disagree Strongly disagree

9. High blood pressure must be lowered to normal values in acute stroke.

Strongly agree Agree Neutral Disagree Strongly disagree

10. Acute stroke management education should be conducted regularly for healthcare professionals.

Strongly agree Agree Neutral Disagree Strongly disagree

Hyperacute stroke management

1. Stroke is a medical emergency only within 4.5 hours of stroke onset.

Strongly agree Agree Neutral Disagree Strongly disagree

2. All acute stroke patients must undergo a brain CT immediately.

Strongly agree Agree Neutral Disagree Strongly disagree

3. All suspected stroke patients must be referred to the neurology team immediately.

Strongly agree Agree Neutral Disagree Strongly disagree

4. The earlier the treatment, the better the outcome of acute stroke.

Strongly agree Agree Neutral Disagree Strongly disagree

5. Thrombolysis therapy is given intravenously to break down clots.

Strongly agree Agree Neutral Disagree Strongly disagree

6. My hospital is equipped with thrombolysis treatment.

Strongly agree Agree Neutral Disagree Strongly disagree

7. Coagulation profile must be screened before thrombolysis.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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8. All acute stroke patients must have a 12 leads ECG before thrombolysis.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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9. Intracranial haemorrhage is a contraindication for thrombolysis therapy.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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Advanced stroke management

1. Are you able to detect symptoms of acute stroke?

Very likely	Likely	Neutral	Unlikely	Very unlikely
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2. Are you familiar with FAST (Face, Arm, Speech, Time)?

Very familiar	Familiar	Neutral	Not familiar	Never heard of it
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3. How would you rate your knowledge on acute stroke management?

Very good	Good	Neutral	Poor	Very poor
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4. Are you aware of mechanical thrombectomy treatment for stroke?

Well aware	Aware	Neutral	Not familiar	Never heard of it
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5. Mechanical thrombectomy is administered for clot removal in acute stroke.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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6. My hospital is equipped with mechanical thrombectomy service.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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7. Acute stroke symptoms can be potentially reversed with administration of thrombolysis or with mechanical thrombectomy.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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8. Mechanical thrombectomy can be performed after thrombolysis therapy.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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9. Thrombolysis and mechanical thrombectomy can only be administered within a therapeutic window.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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10 Wake up strokes are not eligible for thrombolysis nor mechanical thrombectomy.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
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