

ABCD Approach At The #7119 Center, Telephone Triage System in Tokyo, Japan; A Retrospective Cohort Study

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Abstract

Background

The algorithm and protocol of the #7119 telephone triage in Tokyo, Japan, had been originally established and consists of three steps. In this study, we investigated the outcome of patients treated with physiological abnormality (ABCD approach: A, airway; B, breathing; C, circulation, and D, dysfunction of central nervous system) in step 2 during the #7119 telephone triage and clarified the meaning of evaluation of this approach.

Methods

We retrospectively reviewed data from the Tokyo Fire Department from January 2016 to December 2017. Almost all the patients triaged using the ABCD approach were transferred to the hospital by ambulance and assigned severity by a physician. We divided patients into groups with combinations of 15 patterns including A, B, C, D, AB, AC, AD, BC, BD, CD, ABC, ABD, ACD, BCD, and ABCD. We compared the proportion of severe cases in each group using a Fisher's exact test, followed by residual analysis..

Results

We analyzed 13,793 cases triaged using the ABCD approach. In this analysis, 31% of total cases were assessed as severe cases. Groupwise analysis showed that the proportion of severe cases was significantly higher in the AD, BC, CD, ABD, and ABCD groups, while it was significantly less in the C and AB groups than in the total cases.

Conclusion

At the #7119 telephone triage, we can pick up the severe cases by the ABCD approach. This may contribute to the prompt transportation of severe patients to hospitals by dispatching ambulance cars using the #7119 telephone triage methods.

Introduction

Telephone triage services have been established in several countries [1–4] and play an important role in the management of ambulance use and adjustment of primary care workload[5, 6]. The Tokyo metropolitan government has also established a telephone consultation center (the #7119 center), which has been providing a 24-hours a day and 7-days a week service since 2007 [6, 7]. It operates a nurse-run telephone advice line that aims to refer callers to the most appropriate services or to provide them with advice about how to care for their condition. These services are expected to contribute to efficient, clinically appropriate health care, and to avoid delays in the provision of emergency care in life-

threatening cases. With this point of view, we established the new original algorithm and protocol for telephone triaging at the #7119 center [6, 7], referring to the Manchester Triage System (MTS) [8] and the telephone triage protocol for nurses at Portland, Oregon [9]. The #7119 protocol is also computerized and uses a symptom-based triage support system, making it a kind of computer decision support systems.

The flow chart of the triage algorithm in #7119 has been originally established by us and consists of three steps. In Step 1, a call handler (nurse) receives a patient's call and collects information about the patient's identification and reason for calling. If certain key words occur—especially cardiac arrest, no respiration, no pulse, submersion, or cold body—the call handler immediately connects the call to the emergency center to dispatch an ambulance. At a next phase of consultation with Step 2, we established the system of telephone triage using the ABCD approach: airway (A), breathing (B), circulation (C), and dysfunction of the central nervous system (D). In Step 2, the telephone consultation nurse asks the patient questions regarding the presence or absence of severe, abnormal physiological signs; this is similar to the ABCDE approach of Advanced Trauma Life Support (ATLS) [10] or first order (vital sign) modifiers in Canadian Emergency Department Triage and Acuity Scale (CTAS) [11]. The formulation of the mnemonic ABC has its roots in cardiopulmonary resuscitation established by Safar and Kouwenhoven in the 1950s [12, 13]. The ABCDE approach has subsequently been developed for application in all clinical emergencies for immediate assessment and treatment [14]. Olgers et al. reported the effectiveness of the ABCDE approach in the emergency department in potentially medically ill patients [15]. In the MTS factor, A, B, C, and D were picked up as discriminators of life threatening factors [8]. In Step 3, there are 98 symptom-specific protocols for injuries or disease, including 18 for pediatric cases [7].

Several validated emergency scales dedicated to triage patients at emergency department (ED) admission exist like CTAS, Emergency Severity Index (ESI), [16] and MTS [8]. Many validation studies have been performed in the ED in the past [17–20]. However, validation studies on telephone triage protocol for physiological sign evaluation like the ABCDE survey have not been reported to date. Fortunately, we had access to the entire data of ambulance cases in Tokyo as almost all ambulance dispatches transfer patients to hospitals. Furthermore, we could estimate the outcome of almost all cases triaged using Step 2 because these cases are allocated to emergent category, and public ambulances then transport these patients to hospitals and record their outcome. Accordingly, the aim of this study was to investigate the outcome of cases triaged using ABCD approach, and to clarify the meanings of evaluation of physiological abnormality at a telephone triage.

Methods

This is a retrospective cohort study. We retrospectively reviewed the data of the Tokyo Fire Department (FD) from January 1, 2016 to December 31, 2017.

Severity of patients at hospitals

In this study, the severity of a patient’s condition on emergency admission at a hospital was classified into one of five categories—dead, lethal, severe, moderate, and mild. In Japan, almost all patients who are transferred to hospital by ambulance car are assigned a severity grade by a physician upon arrival at the hospital, and these are recorded and aggregated publicly by the ambulance staff. This system was established by the Fire and Disaster Management Agency in Japan in 2006, and the definition of each severity category is shown in Table 1 [21]. This administrative guideline enabled us to acquire data on patients’ outcome of severity for all patients transferred to the hospital by ambulance. Cases with severity was defined as moderate, severe, lethal, and dead, and these patients were hospitalized.

Table 1
Definition of the severity categories of ambulance delivery cases in Japan

Severity	Definition
Mild	Not admitted
Moderate	Admitted without a life-threatening condition
Severe	Admitted with possibility of a life-threatening condition*
Lethal	Admitted with a life-threatening condition**
Dead	Confirmed death
* Possibility of a life-threatening condition means patients with a life-threatening condition, but not lethal or dead.	
** Life-threatening condition means the following: a) patients with a risk of cardiac or respiratory arrest; b) patients who have undergone cardiopulmonary resuscitation.	

Method with ABCD approach by triage nurses

Triage nurses asked questions based on the ABCD approach regarding severe, abnormal physiological signs related to A, B, C, and D. In this regard, a nurse may use the following questions over the telephone to enquire about abnormal physiological signs: A) “Can you speak normally?”, B) “Do you have short of breath?”, C) “How about your complexion. Is it pale? Do you have cold sweating?”, D) “Do you respond normally?” or “Does he or she respond normally?” If the consultation nurse feels there is a severe physiological abnormality, as reflected from the answers, he or she must assign the category red of triage level (most emergent level) and must connect to the 119 center to activate the emergency ambulance system .

Data with ABCD approach (Step 2)

Data collected in ABCD approach were age; gender; questions regarding severe abnormal physiological signs relating to airway (A), breathing (B), circulation (C), and dysfunction of the central nervous system (D), and whether they led to the transportation of the patient to the hospital and outcome of patients’ severity at the hospital. As abnormal physiological signs in one case can exist from only 1 to 4, combinations of these signs yielded 15 patterns including A, B, C, D, AB, AC, AD, BC, BD, CD, ABC, ABD,

ACD, BCD, and ABCD. The proportion of cases with severity was calculated using the formula: (number of moderate, severe, lethal, and dead cases) / (total number of cases).

Statistical analyses

Based on severity grouping, we compared the outcomes of each group. Fisher's exact test, followed by residual analysis, was conducted to examine the possibility of differences in outcomes among the 15 classified groups. If a specific factor was found by residual analysis, a binary logistic regression analysis was conducted for cases with or without severity as the objective variable and age, sex, and presence of that specific factor as independent variables. A P-value of <0.05 was considered statistically significant.

Ethics

This study was approved by the #7119 handling committee of the Tokyo Medical Association. All data are anonymized, no patient identifiable data were recorded at any time, hence there was no need for informed consent from participants.

Results

During this study's period, 324,696 cases were triaged by nurses. Our study included 14,920 (5%) cases triaged using ABCD approach. In ABCD approach, there were 609 cases with missing data and 5 cases with unreasonable cases, in which all physiological signs of A, B, C, and D were not checked and 513 cases were not transported because the patient refused to be transported to the hospital, and the outcome was unknown. We excluded these cases and consequently, analyzed data for 13,793 cases.

The results of the analysis of ABCD approach triaging are shown in **Tables 2-1, 2-2, and 2-3**. The outcome in 31% of total cases was cases with severity; either moderate, severe, lethal, or dead. There was no case in the BD group. Age and gender were not deviated at each group. The proportion of cases with severity was significantly higher in the AD (53%), BC (34%), CD (35%), ABD (58%), and ABCD (52%) groups, whereas it was significantly lower in the C (30%) and AB (22%) groups, as compared to that of the total cases (31%) as per the residual analysis. Factor D (D group with the combination of other groups) had a significant relationship with cases with severity (Table 2).

Table 2.1
Summary of cases in every group triaged using ABCD approach

Group	A	B	C	D	AB
Total number	52	8	8,676	4	140
Age (median)	0-89 (16)	1-74 (40)	0-104 (41)	1-82 (13)	0-96 (8)
Gender (male: %)	26 (51)	4 (50)	4,026 (46.4)	3 (75.0)	66 (47.1)
Outcome (%)					
Mild	37 (71.2)	5 (62.5)	5,905 (68.1)	4 (100)	105 (75.0)
Moderate	12 (23.1)	1 (12.5)	2,393 (27.6)	0 (0)	24 (17.1)
Severe	1 (1.9)	1 (12.5)	89 (1.0)	0 (0)	4 (2.9)
Lethal	0 (0)	0 (0)	22 (0.3)	0 (0)	1 (0.7)
Dead	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)
The cases of severity: proportion (%)*	13 (26)	2 (29)	2505 (30)	0 (0)	29 (22)
Expected value	16	2	2668	1	43
Standardized residual	0.7	0.1	3.1	1.1	2.1
P value of residual analysis	0.384	0.585	<0.001	0.173	0.012
* The cases of severity were defined as moderate, severe, lethal and dead, and the proportion of the cases of severity was calculated using the formula: (amount from moderate, severe, lethal and dead ceases) / (amount of total cases).					

Table 2.2
Continued

Group	AC	AD	BC	BD	CD
Total number	7	109	3,943	0	838
Age (median)	0-92 (6)	0-101 (44)	0-102 (39)	-	0-100 (20)
Gender (male: %)	3 (43)	64 (59)	1719 (44)	-	436 (52)
Outcome (%)					
Mild	6 (86)	45 (41)	2,504 (64)	-	514(61)
Moderate	1 (14)	36 (33)	1185 (30)	-	228 (27)
Severe	0 (0)	11 (10.)	87 (2.2)	-	28 (3.3)
Lethal	0 (0)	4 (3.7)	19 (0.5)	-	17 (2.0)
Dead	0 (0)	0 (0)	0 (0)	-	4 (0.5)
The cases of severity (%)*	1 (14)	51 (53)	1291 (34)	-	277 (35)
Expected value	2	30	1204		251
Standardized residual	0.8	-3.7	-2.5	-	-1.6
P value of residual analysis	0.322	<0.001	<0.001	-	0.040
* The cases of severity were defined as moderate, severe, lethal and dead, and the proportion of the cases of severity was calculated using the formula: (amount from moderate, severe, lethal and dead ceases) / (amount of total cases).					

Table 2.3
Continued

Group	ABC	ABD	ACD	BCD	ABCD	Total
Total number	38	50	41	366	34	14,306
Age (median)	1-92 (32)	0-99 (51)	0-83 (29)	0-104 (25)	0-93 (12)	0-104 (39)
Gender (male: %)	18 (47)	28 (56)	25 (61)	168 (46)	18 (53)	6601 (46)
Outcome (%)						
Mild	26 (68)	20 (40)	21 (51)	210 (57)	16 (47)	9,418 (66)
Moderate	7 (18)	22 (44)	10 (24)	109 (30)	10 (29)	4,038 (28)
Severe	2 (5.3)	3 (6.0)	4 (9.8)	16 (4.4)	4 (12)	250 (1.7)
Lethal	1 (2.6)	3 (6.0)	1 (2.4)	9 (2.5)	2 (5.9)	79 (0.6)
Dead	0 (0)	0 (0)	1 (2.4)	1 (0.3)	1 (2.9)	8 (0.1)
The cases with severity: proportion (%)*	10 (28)	28 (58)	16 (43)	135 (39)	17 (52)	4375 (32)
Expected value	11	15	12	109	10	-
Standardized residual	0.4	-3.3	-1.2	-2.4	-2.0	-
P value of residual analysis	0.611	<0.001	0.131	0.003	0.014	-
* The cases with severity were defined as moderate, severe, lethal and dead those, and the proportion of the cases with severity was calculated using the formula: (amount from moderate, severe, lethal and dead ceases) / (amount of total cases)						

Binary logistic regression analysis was conducted based on age, sex, and factor D, excluding groups A, B, C, and D. Age (OR, 1.027; 95 % CI, 1.025–1.030), male sex (OR, 1.339; 95 % CI, 1.187–1.152), and factor D (OR, 1.566; 95 % CI, 1.36–1.802) were significantly ($p < 0.0001$) associated with cases with severity (Table 3).

Table 3
Binary logistic regression analysis with D factor for the cases with severity at ABCD approach

Variants	B	OR	95% C.I. for OR		p value
			Lower	Upper	
Age	0.027	1.027	1.025	1.030	<0.0001
Gender (Male)	0.292	1.339	1.187	1.512	<0.0001
Factor D	0.448	1.566	1.36	1.802	<0.0001
Intercept	-2.022	0.132	-	-	<0.0001
Factor D; D group with the combination of other groups					
OR; Odds Ratio					
C.I.; Confidence interval					

Discussion

In this study we evaluated the outcome of cases through the assessment of abnormal physiological signs using the ABCD approach at a telephone triage. In this approach, the outcome of 31% of total cases was either moderate, severe, lethal, or dead. We transferred these cases to the hospital soon by ambulance without taking time to listen to the “patient’s other status indicators. The groupwise analysis found AD, BC, CD, ABD and ABCD groups have a significantly larger proportion of the cases with severity, while C and AB groups significantly smaller, as compared to that in the total cases. Therefore, cases having a combination of the factor D may be predicted to be severe cases. Each of older age, gender male and factor D was significantly associated with cases with severity.

We already showed that 33% of cases, who were assigned to category red by Step 3 (symptom-specific protocols) in the #7119 telephone triage were moderate, severe, lethal, and dead, as in cases with severity according to the definition of this study [22]. Katayama et al. reported that 29.2% of patients transported by ambulance after telephone triage were hospitalized [23]. We share almost the same protocol of telephone triage and prehospital emergency ambulance system as their study in Japan. Patients with our definition of severity will be hospitalized at least (Table 1). In the present study, 31% of the cases were triaged using the ABCD approach (Step 2 in #7119) were the cases with severity and were hospitalized. These facts suggest that, at the telephone triage system in Japan, about 30% of cases, who are assigned to the red category by telephone triage and transported to hospital by ambulance, would be hospitalized at least based on their severity.

Wouters et al reported that telephone triage nurses interpret the vocal - but not worded - elements in communication (paralanguage) such as tone of voice and shortness of breath and create a mental image

to compensate for lack of visual information [24]. Croskerry pointed that two fundamental approaches to clinical reasoning have been recognized at a diagnosis. This dichotomy is now widely recognized as dual process theory, as System 1 which is automatic, fast and intuitive, and System 2, which is deliberate, reliable and analytical [25]. In the present study, triage nurses may assess patients with D to have abnormal paralanguage signs using tone of voice and shortness of breath, although they can't see patients and can't approach patient's physical signs. It may indicate that triage nurses could pick up such severe patients by paralanguage signs with System 1 and could dispatch them by ambulance sooner. Further studies involving the analysis of the real records of each consultation are needed to revise the ABCD approach.

Haraldseide et al. reported that male sex was associated with a higher degree of urgent priority than female sex at the consultation, including by telephone and at primary healthcare centers. The urgent priority degree is a decision support tool used to determine response patterns and the degree of urgency at the consultation scene with the Norwegian Index of Emergency Medical Assistance. They discussed that consultation nurses generally perceive men as more urgent cases than women, partially because of symptom presentation [26]. In the present study, male sex was associated with severe outcomes, decided by physicians even after transport to hospital, in cases with red category triaged by telephone triage nurses. Cases of male sex, assigned to the severe category by telephone triage, may be associated with severe medical situation. However, our data does not contain enough information to analyze these sex differences. Therefore, future studies should be conducted based on nurses' triage decisions to elaborate on sex differences.

This study has a limitation. Unfortunately, we have not yet developed a standard to validate the acuity evaluated in the prehospital setting. Therefore, in order to check the validity of the "acuity," we had to use a 5-category "severity" scale, including lethal, severe, moderate, mild, and dead upon admission in the ED categories. This is a limitation of this study. We need to discuss how to validate the outcomes of telephone triage referring to other criteria, such as the use of lifesaving interventions [16], guidelines for intensive care unit admission, discharge, and triage [27] or therapeutic intervention scoring system [28, 29].

Conclusion

We concluded that at the #7119 telephone triage, we can pick up the severe cases soon without resorting to many questions by using the ABCD approach. These results can contribute to the prompt transportation of severe patients to hospitals by dispatch ambulance cars by the #7119 telephone triage. In the future, we need more investigation on why complaints involving combinations of factors D indicate severe cases using the ABCD approach in telephone triages.

Abbreviations

MTS: Manchester Triage System; CTAS: Canadian Emergency Department Triage and Acuity Scale; ED: emergency department; A: airway; B: breathing; C: circulation; D: dysfunction of the central nervous system

Declarations

Authors' contributions

AS drafted and revised the article and contributed to the design, statistical analyses and interpretation of the results. SO drafted the methods, contributed to the design, statistical analyses and interpretation of the results. JO, TM, TA and NM contributed to the design, interpretation of the results and revision of the article for intellectual content. All authors have approved the final version.

Availability of data and materials

The excel data used to support the findings of this study may be released upon application to the #7119 handling committee of the Tokyo Medical Association who can be contacted at sakurai.atsushi@nihon-u.ac.jp.

Ethics approval and consent to participate

This study was approved by the #7119 handling committee of the Tokyo Medical Association. All data are anonymized, no patient identifiable data were recorded at any time, hence there was no need for informed consent from participants.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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