



# Using Routine Ambulance Inspection Report Application to Reduce Wasted Time in Emergency Medical Services

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## Abstract

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**BACKGROUND:** Ambulance inspections make up part of the emergency medical services (EMS) to keep operations running smoothly as well as to maximize and maintain the safety of vehicles used for delivery of both staff and patients. The EMS of Srinagarind Hospital has been using an ambulance inspection report application since January 2020. Nevertheless, there has been no comparative study of the benefits associated with the use of this specification.

**AIM:** The aim of this study was to compare the advantages of an ambulance inspection report application and paper checklist.

**METHODS:** This cross-sectional study was conducted amid the EMS at a university hospital in Thailand. Data gathering was carried out by employing the Srinagarind Hospital database and ambulance inspection report application throughout January 1, 2019, and December 31, 2020.

**RESULTS:** A total of 2350 ambulance inspections were recorded during the 2-year study period. Recognition times for ambulance inspections incorporating paper checklist and inspection with application were  $35.5 \pm 9.4$  min and  $1.02 \pm 0.5$  min, respectively ( $P < 0.001$ ). Action times were  $25.2 \pm 5.1$  min and  $1.04 \pm 0.2$  min, respectively. Ambulance inspection compliance rate with the application was 95.3% and 70.1% with a paper checklist.

**CONCLUSION:** Ambulance inspections carried out with an application can reduce recognition and action time, and increase ambulance inspection compliance rate.

## Introduction

Routine ambulance inspections are part of emergency medical services (EMS) to keep operations running smoothly to ensure the safety of vehicles employed for delivery of both staff and patients. Usually, as standard, there should be checks during each shift 2–3 times a day, including when the ambulance is used in other missions, such as in the issuance of sports competitions.

The previous studies have shown that ambulance inspections ought to be given priority with time taken to closely examine medical supplies and resuscitation equipment in the ambulance to maximize performance [1]. This duty incorporated ambulance drivers or EMS crew members in conjunction with the head nurse of the shift. There is a paper checklist of items to be checked according to the standards of the Thai National Institute of Emergency Medicine [1], [2].

A problem was discovered according to a lack of regular checks or when abnormalities were detected.

Inspection results reported to the head responsible were delayed – especially during the afternoon or night shifts. A study of EMS safety incidences revealed that ambulance-related issues were the second highest reported with 16% of incidence. Therefore, it is recommended that ambulance safety checks take place regularly [2], [3], [4]. This information is aimed at both hospital personnel and the individual concerning ambulance safety to reduce both loss of life and morbidity [5], [6], [7]. It was also found that when ambulance inspections took place in full, such actions by the operator made the patient feel safer [8], [9], [10]. The use of incident reporting applications instead of paper reports plays an important role in both real-time reporting and the ability to assess the consistency of reporting. Hence, modified work processes reduce time wastage [11], [12], [13].

The EMS at Srinagarind Hospital have been using an ambulance inspection report application since January 2020. However, there has not been any comparative study of the benefits of the use of such an application.

## Methods

### Study design and setting

This cross-sectional study was conducted amid the EMS of Srinagarind Hospital, a tertiary care and university hospital with approximately 2500 annual operations in Khon Kaen, Thailand. EMS personnel consist of doctors, nurses, advanced emergency medical technicians (AEMTs), emergency medical technicians (EMTs), and the ambulance driver on duty. Data were obtained from the application for ambulance inspection and database of the EMS at Srinagarind Hospital throughout the years 2019–2020. Ethical approval was provided by the Khon Kaen University Ethics Committee for Human Research (HE641153). The requirement for informed consent was waived since confidentiality protection had already been guaranteed. Accordingly, participants were not identified by name, but instead by a unique study number.

### Participants

We included all routine ambulance inspections between January 1, 2019, and December 31, 2020, with (1) in 2019, data gathering from an ambulance inspection paper checklist and (2), in 2020, data gathering from the ambulance inspection report application. Cases with missing data were excluded from the study.

### Data collection

We utilized the EMS database and ambulance inspection report application to collect demographic data including age, sex, time of ambulance checking, recognition time, and action time. The ambulance inspection report is carried out through Google Forms which then generates a QR code attached to the front windshield of the ambulance for the EMS crews to scan before operations. The 20 protocol checklist items are as follows: (1) Battery, (2) fuel, (3) starter, (4) leakage, (5) radiator, (6) breaks, (7) wheels, (8) gears, (9) electricity, (10) lights, (11) steering wheel, (12) oxygen tank, (13) fire extinguishers, (14) air conditioning, (15) siren, (16) radio equipment, (17) ventilation system, (18) resuscitation box, (19) personnel protective equipment, and (20) traffic cones. After completion and sending information through the application, an e-mail will alert the chief nurse who has the duty to check and control ambulance operations.

### Definitions

Recognition time is defined as the period of time from the complete submission of the ambulance inspection to when the nurse in-charge of the inspection

is informed. Action time is defined as the period from accepting the ambulance inspection results to the order to fix the issue.

### Sample size and statistical analysis

Sample size was calculated based on the number of ambulance inspections in 2018 [14]. To achieve a significance level of 5% and power of test of 0.75, we determined that a sample size of 2350 would be required. Statistical analysis was performed using IBM SPSS for Windows version 26.0, Khon Kaen University license (SPSS Inc., Chicago, IL, USA). Categorical data were presented as percentages with continuous data presented employing mean and standard deviation. Univariable analysis was carried out using a two sample t-test for numerical data and Pearson's correlation for data relationship between groups.

## Results

A total of 2350 ambulance inspections were recorded during a 2-year study period. Subjects' characteristics are shown in Table 1. EMS crew mean age amid ambulance inspection with the application was  $31.8 \pm 5.4$  years, with 94.5% ( $n = 1110$ ) being male. The most common EMS role of those completing ambulance inspections with the paper checklist and application were EMTs (87.6% and 88.6%, respectively). Operations were most commonly performed during the morning shift (8.00 am–4.00 pm) in both groups.

**Table 1: Characteristics of the subjects**

Characteristics	Ambulance inspection with paper checklist (n = 1175), n (%)	Ambulance inspection with application (n = 1175), n (%)	p-value
Age (years), mean $\pm$ SD	32.4 $\pm$ 5.6	31.8 $\pm$ 5.4	0.742
Gender			
Male	1085 (92.3)	1110 (94.5)	0.652
EMS role			
Nurse	51 (4.3)	45 (3.8)	0.522
AEMTs	95 (8.1)	89 (7.6)	0.620
EMTs	1029 (87.6)	1041 (88.6)	0.740
Operation duration			
Morning shift	410 (34.9)	405 (34.5)	0.654
Afternoon shift	385 (32.8)	388 (33.0)	0.620
Night shift	380 (32.3)	382 (32.5)	0.410
Recognition time (min), mean $\pm$ SD	35.5 $\pm$ 9.4	1.02 $\pm$ 0.5	< 0.001*
Action time (min), mean $\pm$ SD	25.2 $\pm$ 5.1	1.04 $\pm$ 0.2	< 0.001*

\*Statistical significance; SD: Standard deviation, EMS: Emergency medical services, AEMTs: Advanced emergency medical technicians, EMTs: Emergency medical technicians, min: Minute

Recognition times for ambulance inspection with paper checklist and inspection with application were  $35.5 \pm 9.4$  min and  $1.02 \pm 0.5$  min, respectively ( $p < 0.001$ ). Action times were  $25.2 \pm 5.1$  min and  $1.04 \pm 0.2$  min, respectively.

Observation of ambulance inspections with paper checklist revealed a total of 1175 indications with 824 compliances (70.1%), as shown in Table 2. We also found an ambulance inspection compliance rate with the application of 95.3% (1120/1175). In the application group,

according to all 20 ambulance inspection checklist items, subjects demonstrated a significantly higher compliance rate than the paper checklist group ( $p < 0.001$ ).

**Table 2: Checklist items of ambulance inspection**

Checklist items	Ambulance inspection with paper checklist (n = 1175), n (%)	Ambulance inspection with application (n = 1175), n (%)	p-value
Overall check	824 (70.1)	1120 (95.3)	< 0.001*
Battery	824 (70.1)	1119 (95.2)	< 0.001*
Fuel	820 (69.8)	1118 (95.1)	< 0.001*
Starter	815 (69.4)	1118 (95.1)	< 0.001*
Leakage	822 (70.0)	1118 (95.1)	< 0.001*
Radiator	821 (69.9)	1119 (95.2)	< 0.001*
Breaks	823 (70.0)	1120 (95.3)	< 0.001*
Wheels	820 (69.8)	1119 (95.2)	< 0.001*
Gears	822 (70.0)	1120 (95.3)	< 0.001*
Electricity	821 (69.9)	1120 (95.3)	< 0.001*
Lights	820 (69.8)	1118 (95.1)	< 0.001*
Steering wheel	821 (69.9)	1119 (95.2)	< 0.001*
Oxygen tank	820 (69.8)	1120 (95.3)	< 0.001*
Fire extinguishers	820 (69.8)	1119 (95.2)	< 0.001*
Air conditioning	815 (69.4)	1120 (95.3)	< 0.001*
Siren	819 (69.7)	1120 (95.3)	< 0.001*
Radio equipment	821 (69.9)	1119 (95.2)	< 0.001*
Ventilation system	821 (69.9)	1120 (95.3)	< 0.001*
Resuscitation box	822 (70.0)	1119 (95.2)	< 0.001*
Personnel protective equipment	821 (69.9)	1118 (95.1)	< 0.001*
Traffic cones	823 (70.0)	1120 (95.3)	< 0.001*

\*Statistical significance

## Discussion

The present study involved the use of an application to monitor ambulance inspection instead of paper to reduce wasted time amid EMS. The primary persons responsible for ambulance inspection were the EMTs, that is, ambulance drivers and the on-duty nurse who acted as the repeat inspector and supervisor. Traditional workflow starts from the EMS crews' paper-based reports sent to the responsible chief nurse who waits until the supervisor decides to order a solution and then communicates said solution to the operator. Unfortunately, this system of work includes delays [1], [2].

In addition, ambulance safety is critical because delaying ambulance inspection can pose a safety potential risk to both staff and patients using the service. Thus, by converting the process to this application, the supervisors have access to real-time reporting, resulting in immediate decision-making [5], [8], [10]. According to the study results, recognition time and action time in the application groups (wasted time) were reduced to almost 1 h per ambulance inspection. Hence, the utilization of the application improves the consistency of inspections. This may be due to the use of the reporting application, whereby the head of the unit will immediately know the results of the performance, which is different to the paper report which can be written at any other subsequent time [12].

We are aware that our study had some potential limitations. First, data were collected from just a single EMS center in a tertiary care hospital. Moreover, the study design was retrospective which may have resulted in incomplete data [14], [15], [16], [17].

## Conclusion

Ambulance inspections with an application can reduce recognition and action time, and increase ambulance inspection compliance rate.

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