# Consistency of Emergency Medical Dispatchers' Decisions Using a Protocol-Based Triage System

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## ABSTRACT

**Introduction:** Central to the effectiveness of prehospital care is the ability of emergency medical dispatchers (EMDs), to rapidly categorise '999' calls and subsequently facilitate the dispatching of appropriate emergency ambulance personnel. There are many factors which affect productivity and/or performance in a work setting. These include shift work and experience. The London Ambulance Service (LAS) uses a structured, symptom- and incident-based protocol to triage emergency '999' calls. To our knowledge, factors potentially affecting compliance with this system have not been assessed in the UK.
**Objective:** To evaluate the effect of shift work and experience on the performance of Emergency Medical Dispatchers (EMDs).
**Methods:** An anonymised dataset consisting of a three-month consecutive sample of emergency calls that had been randomly reviewed for compliance with the structured protocol was used. Calls were reviewed for specific shift worked and length of experience.
**Results:** Call records for 1,373 cases were reviewed. The overall International Academies of Emergency Dispatch compliance score for the total sample was 96.81% (95%CI: 96.51%-97.12%). There was no statistically significant difference between the levels of compliance when adjusted for shift worked (p=0.600). We also observed a statistically significant association between years of experience and shift worked (0.048). Overall, compliance varied significantly when adjusted for the experience of an EMD (p=0.001); this was evident for EMDs with experience of > 5 years.
**Conclusion:** This paper has highlighted that there is no difference between day and night shift in terms of protocol compliance. This finding suggests that a protocol-driven process helps alleviate some of the many factors that contribute to mistakes, errors, and omissions. These are important conclusions in the world of the ambulance service, where seconds can be crucial to a patient's outcome and where the accurate triage of a patient can directly impact the speed of response.

## BACKGROUND

The outcome of a life-threatening event such as a cardiac arrest is dependent on a series of cumulative actions. It is imperative that a patient in such a situation receives medical attention rapidly, as each passing minute without intervention decreases the chances of survival. Cummins[1] described this defined series of actions as the "chain of survival." The aim of emergency services in such situations is, not only to promote survival, but also to limit the effects of secondary injuries attributed to inappropriate or late intervention.

Central to the effectiveness of emergency prehospital care is the ability of ambulance emergency medical dispatchers (EMDs) to rapidly and accurately categorise '999' calls, provide essential information and instruction, and subsequently facilitate the dispatching of appropriate emergency medical personnel. EMDs should be regarded as the first link in the "chain of survival."

In order for proper categorization to occur, specific questions must be asked. In the past, EMDs believed that they should ask their own questions and pursue

avenues which they felt were most appropriate to '999' calls they were dealing with.[2] However, this approach did not assure quality and consistency.[2,3] Furthermore, EMDs have been regarded as one of the weak links in the "chain of survival," as they are often the least clinically trained.

It is for this reason that Clawson[6] outlined that the goals of the emergency services are best accomplished through careful compliance with structured and comprehensive Emergency Medical Dispatch protocols.[3] This led to the development of emergency medical priority dispatching systems designed to be used by EMDs to interrogate callers with the ultimate goal of sending the right response, to the right patient, at the right time.[4] Crucial items of the protocol include:[5]

- Systematised formal caller interrogation process
- Systematised scripted instructions prior to the arrival of emergency personnel
- Protocols matching the dispatcher's evaluation of the injury or illness type and severity with vehicle response mode and configuration.

### Protocol Compliance

Concise emergency protocols must be followed strictly due to the non-visual nature of the provision of instructions or advice by EMDs and the need in some cases to rapidly teach callers intricate procedures in real-time.[6,7] Essential to the successful execution and maintenance of an EMD program is a quality management program.[8] Assurance of quality is dependent on the understanding of the working definition of quality, and this has led to the development of objective measurements with regard to performance of EMD activities.[4] A comprehensive quality management program for EMDs has many components, of which selection, initial training, continuing dispatch education, data generation, and performance evaluation or case review are included.[8] Standardized and reproducible Dispatch Life Support[9] is dependent on the adherence of EMDs to the written protocols, in order for instructions to be delivered and used effectively and allowing any revision to be based on measurable factors. Adherence to the protocol is therefore an overriding issue in the evaluation of EMD performance.

### Performance

Factors affecting work performance (protocol compliance) include:

- Somatic factors such as health and age
- Psychological factors such as attitude to work, motivation, sleep deprivation, and stress
- Nature of work to be performed. For example the type (physical or mental), complexity, and schedule (day work or shift work).

### Shift Work and Performance

In her book, *Asleep in the Fast Lane: The Impact of Sleep on Work*, Dotto captured the dilemma faced by all 24-hour dispatch systems. "Industrialized societies are the ones most divorced from the natural, primitive cycle of day and night and they are also the most dependent on—and vulnerable to—complex technologies whose failure (often brought about by human error) can exact a huge social and economic toll."[10]

Physiologically, humans were designed to work during the day and recuperate at night.[11] Individuals function variably at different times of the day, and it is widely accepted that our performance may vary with the time of the day.[12,13]

Human performance is, in most cases, influenced by changes in circadian rhythms, and this suggests that ideally, humans are not suited for working at night.[14] Despite this, some individuals in certain occupations work unconventional hours either in a shift system or around the clock. This includes EMDs.

Shift work is a recognised factor for ill health. Studies have shown that in comparison to controls, shift workers have an increased predisposition to medical ailments including cardiovascular disease,[15] and gastrointestinal disorders such as peptic ulcer disease and irritable bowel syndrome.[16]

Major factors predisposing to poor performance, human errors, and reduced accuracy and efficiency during shift work include fatigue and disturbance of sleep due to the difficulties of sleeping during the day.[17,18] There appears to be a bio-psycho-social dimension to the negative effects of shift work on different individuals and this might extend to EMDs.

## METHODS

### Design and setting

This quantitative study was conducted in conjunction with the London Ambulance Service (LAS) NHS Trust. The LAS receives one of the highest call volumes in the world, and its control room has been accredited by the International Academy of Emergency Medical Dispatch (IAEMD) with the status of a Center of Excellence for use of the Advanced Medical Priority Dispatch System (AMPDS), currently using version 11.2. Over 90,000 calls a month (approximately one-fifth of the total number of calls received in the United Kingdom) are handled in the headquarters of the LAS. The local Ethics committee was approached regarding this study and determined that Ethical Approval was not required.

### Call processing process

The AMPDS uses scripted caller interrogation protocols to provide symptom-based information with the aim of accurately categorizing the call and facilitating the appropriate response to the individual in distress. An additional benefit of this system is that of potentially alleviating the workload of the emergency services due to unnecessary or inappropriate responses.[19]

As most individuals dealing with calls are not medically trained, optimum delivery of medical care is only attained through strict adherence to AMDPS protocols. Evaluation of the performance of the EMDs is thus constantly occurring as part of a "total quality manage-

ment" process,[8] and this involves reviewing a selection of dispatch cases.

'999' calls are recorded as they are being handled, and EMD performance can subsequently be precisely assessed by comparing the content of the call to the scripted protocol.

Highly qualified LAS staff, referred to as Quality Assurance Advisors, trained in the process of emergency call review and certified as EMD-Qs by IAEMD, randomly select recorded cases to be reviewed on a daily basis. Automated case-review software (AQUA™) based on the AMPDS aids this process, and the total case EMD compliance (given as a percentage) is calculated after considering protocol adherence in the following key areas: Case Entry interrogation; Chief Complaint selection; Key Questions interrogation; Determinant code selection; Pre-Arrival Instructions; and Post-Dispatch Instructions.[8]

For the purposes of this retrospective study, the "total" compliance score was collected as raw aggregated data for every case that were reviewed during three months (June–August 2006).

### Data Analysis

Statistical analysis was performed using the Intercooled Stata for Windows® software (Stata Statistical Software: Release 9, StataCorp, College Station, TX). For continuous data on compliance rates, histograms were plotted to check if the data were normally distributed. It was observed that compliance rates data were skewed, and therefore the data were log-transformed before any analysis testing for mean compliance differences (using t-test method) were performed. Findings were considered statistically significantly associated or different at an alpha cut-off of 0.05, i.e., association or differences that yielded p-values ≤ 0.05 were considered significant. All the data analysis categories were classified into two groups: EMD's shift (day or night), and Dispatcher's experience.

The duration of experience of a controller was defined as the length of time that the individual controller involved in the case reviewed had worked with the LAS handling emergency calls as part of their job. This particular variable was categorised into 6 groups (1: <6 months, 2: 6-12 months, 3: 1-2 years, 4: 2-5 years, 5: 5-10 years, 6: >10 years) as the LAS recruits new dispatchers in blocks. Analysis of variance (ANOVA) and linear regression techniques were used to look at the variance and correlations of compliance rates, adjusted for EMDs' experience.

## RESULTS

1,373 cases were reviewed (one case was missing its compliance score). Day shift workers were those working between the hours of 07:00 and 19:00, and night shift workers were those working between 19:00 and 07:00. All staff work through a 24/7 rotating shift pattern. Those on the day shift handled more cases than the night-shift workers (55.0% vs. 45.0%). Fisher's exact test was used on log-transformed data (due to data skewedness) for comparison of mean compliance difference by shift. The results showed that there was no statistically significant difference in mean compliance when adjusted for shift worked (p=0.672) (Table 1).

| Shift Worked | n | Compliance Percentage | | p* |
|---|---|---|---|---|
| | | Mean ± SD | 95%CI | |
| Day Shift | 754 | 96.75±5.77 | 96.34-97.17 | 0.672 |
| Night Shift | 618 | 96.89±5.60 | 96.45-97.33 | |
| Overall | 1,372 | 96.81±5.69 | 96.51-97.11 | |

* 2-sided Fisher's exact p-value testing for statistical differences between mean log-transformed compliance by shift

**Table 1.** Shift worked and compliance with AMPDS protocol

There was a borderline statistically significant association between EMD's experience and shift worked (p=0.048) (Table 2).

| Shift | Experience in months: n, row %, column % | | | | | | | p |
|---|---|---|---|---|---|---|---|---|
| | < 6 | 6-12 | 12-24 | 24-60 | 60-120 | > 120 | Total | |
| Day | 168 | 225 | 89 | 118 | 80 | 75 | 755 | 0.048 |
| | 22.25 | 29.8 | 11.79 | 15.63 | 10.6 | 9.93 | 100 | |
| | 56.95 | 50.79 | 50.57 | 56.19 | 65.04 | 59.52 | 54.99 | |
| Night | 127 | 218 | 87 | 92 | 43 | 51 | 618 | |
| | 20.55 | 35.28 | 14.08 | 14.89 | 6.96 | 8.25 | 100 | |
| | 43.05 | 49.21 | 49.43 | 43.81 | 34.96 | 40.48 | 45.01 | |
| Total | 295 | 443 | 176 | 210 | 123 | 126 | 1,373 | |
| | 21.49 | 32.27 | 12.82 | 15.29 | 8.96 | 9.18 | 100 | |
| | 100 | 100 | 100 | 100 | 100 | 100 | 100 | |

**Table 2.** Association between EMD experience and shift worked

By stratifying the compliance rates by the EMD's years of experience, overall, through analysis of variance (ANOVA), we observed a statistically significant variability in compliance rates based on EMD's years of experience (p<0.001) (Table 3). Further, linear regression analysis demonstrated that a lower compliance rate was more likely to be predicted by ≥5 years of experience (p<0.001).

Average compliance varied marginally across the categorised groups for EMD experience (Table 3). The rates ranged from 95.04 (95%CI: 93.57% - 96.51%) for those with 5-10 years of experience (n=123) to 97.53% (95%CI: 97.07% - 97.99%) for those with between 6-12 months of experience (n=443).

| Experience of EMD (months) | n | Mean ± SD | 95%CI |
|---|---|---|---|
| < 6 | 294 | 97.23±4.90 | 96.67-97.79 |
| 6-12 | 443 | 97.53±4.92 | 97.07-97.99 |
| 12-24 | 176 | 96.70±5.60 | 95.87-97.54 |
| 24-60 | 210 | 96.87±4.60 | 96.25-97.50 |
| 60-120 | 123 | 95.04±8.25 | 93.57-96.51 |
| >120 | 126 | 95.11±7.66 | 93.76-96.46 |
| Total | 1,372 | 96.81±5.69 | 96.51-97.12 |

EMD: Emergency Medical Dispatcher.

**Table 3.** Compliance with AMPDS protocol adjusted for EMD's length of experience

By adjusting for the EMD's years of experience, the t-test (on the log-transformed compliance data) of the difference between the mean compliance rates between each pair of categories of EMD years of experience demonstrated that the compliance for the EMDs with ≥5 years (i.e., 60 to over 120 months) of experience was significantly lower than that for the rest of the groups (Table 4). EMDs with >10 years' experience had similar patterns except that their mean compliance score did not significantly differ from that of the EMDs with 5-10 years of experience (p = 0.917).

| Experience of EMD (months) | Experience of EMD (months) | | | | | |
|---|---|---|---|---|---|---|
| | < 6 | 6-12 | 12-24 | 24-60 | 60-120 | >120 |
| < 6 | - | 0.479 | 0.295 | 0.473 | 0.0008* | 0.001* |
| 6-12 | - | - | 0.093 | 0.162 | <0.001* | 0.0001* |
| 12-24 | - | - | - | 0.678 | 0.036* | 0.042* |
| 24-60 | - | - | - | - | 0.007* | 0.008* |
| 60-120 | - | - | - | - | - | 0.917 |
| >120 | - | - | - | - | - | - |

EMD: Emergency Medical Dispatcher.
* The only statistically significant p-values for mean difference from matrix of log-transformed compliance by experience.

**Table 4.** Matrix of 2-sided t-test of difference between mean compliance rates by EMD's length of experience

## DISCUSSION

The results of this study show that the use of a structured set of symptom- and incident-based protocols for triaging emergency '999' calls leads to equally high levels of compliance irrespective of the shift being worked, whether day or night. The structured protocols may also help alleviate the natural impact that circadian rhythms have on shift work.

Lastly, this study compared EMD experience with compliance to AMPDS protocols. The LAS started using the scripted AMPDS protocol in June 1999 (7 years before the calls analyzed were handled). The variation in compliance between those EMDs with over 5 years of experience and those with less could be because the former feel they have a wealth of experience to draw on and may rely on their own abilities to do better than the scripted AMPDS protocol. The lower compliance scores reflect such deviations from the protocol, which are potentially dangerous as controller confidence may be misguided and their own questioning style may turn out not to improve the categorization of patients. Such deviations may potentially increase call duration, prolonging the dispatching time and ultimately reducing the likelihood of responders arriving at the scene within the critical period.[2]

### Limitations

Two limitations with this study should be acknowledged. Firstly, we do not report call volumes per EMD. However, it is well known that London Ambulance Service EMDs have some of the highest 999 call handling volume in the world. The general number taken across the study period has been used. Additionally, although we looked at a number of other issues, we did not look at age. This may be a study factor in further work in this area.

## CONCLUSION

The accurate and efficient matching of callers' needs to the appropriate responding personnel is vital to both the emergency medical service and the patient. The assurance of quality, the management of risk, and medical control are absolutely necessary for the ongoing maintenance of any emergency medical system. In order to ensure the optimum delivery of care, the ambulance service has to engage in appropriate ongoing quality management. One way of achieving a consistent outcome is the use of a structured, scripted, protocol-driven system operated by trained EMDs. Central to this is the issue of compliance to the scripted protocols, which appears in this study to ensure that a standard level of delivery is achieved regardless of shift undertaken. And as Clawson[4,6] noted, results obtained when using an EMD system can only be directly attributed to the protocol through consistently high compliance to it.

This paper has highlighted that there is no difference between day and night shift, suggesting that a protocol-driven process helps alleviate some of the many factors that contribute to mistakes, errors, and omissions being made, especially across periods of time in which the mind and body may not function at their best. This is an important conclusion in the world of the ambulance service where seconds can be crucial to a patient's outcome and where the accurate triage of a patient can directly impact the speed of response and care.

One area that requires far more study is the relationship between length of service and compliance. Lower compliance appears, at face value, to tie in with the length of time that the LAS has used the AMPDS, but could also be for other reasons and needs to be the subject of more detailed analysis now that this has been identified.

This study has attempted to contribute to the quality management process of emergency dispatching. The role of Emergency Medical Dispatchers has never been more important, and it is for this reason that such studies must continue, with the aim of optimizing performance and improving understanding.

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