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The "unclear problem" category: An analysis of its implications and effects on the emergency medical dispatch process in Copenhagen, Denmark

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Abstract

Objective: An effective emergency medical dispatch process is vital to provide appropriate prehospital care to patients. It increases patient safety and ensures the sustainable use of medical resources. Although Copenhagen has a sophisticated emergency medical services (EMS) system with a significant focus on public welfare, more than 10% of emergency calls are still being categorized as an "unclear problem" and are thus not categorized as "symptom-specific". Therefore, the objective of this research is to gain a better understanding of underlying implications that lead to the categorization of an emergency call as "unclear". This research investigates the effects of the "unclear problem" category (UPC) on the medical dispatching process at the emergency medical dispatch center in Copenhagen. Also, it explores the effectiveness of educating medical dispatchers about the use of the UPC to reduce its use.

Methods: This was a register-based study based on medical emergency call data. Descriptive analyses were conducted to investigate the effect of using the UPC on the medical dispatching process and determine the impact of alerting medical dispatchers to reduce its use.

Results: The UPC accounted for 11.4% of the calls. Elderly patients were most often dispatched with the UPC. The UPC could impact the medical dispatching process in several potentially harmful ways. Namely, it could lead to under or over triage and lead to inefficient use of EMS resources. Sensitizing medical dispatchers about the use of the UPC could have contributed to the decrease in the use of the UPC.

Conclusion: The use of the UPC could have negative implications on patients' outcomes and the efficient use of EMS resources due to its possible impact on over-or under triage. The UPC is mainly used when dispatching the elderly. Nonetheless, the use of the UPC decreased throughout the study period after the medical dispatchers were alerted about the implications of its use.

Keywords: Emergency Medical Services, dispatch centers, "unclear problem" category, Copenhagen

Introduction

The World Health Organization identifies emergency medical services (EMS) as an integral part of any effective and functional healthcare system. The emergency medical dispatch center (EMDC) is the first point of contact in the case of a life-threatening or medical emergency. In some settings, it acts as a gatekeeping system to subsequent medical services¹. A prompt prehospital response is conducive to a better prognosis of patients and timely access to EMS².

Denmark has a long tradition of focusing on public welfare, including the provision of health services. Denmark promotes society-wide health and social equity through tax-financed services, including universal health care³. Each region in Denmark has an EMDC center responsible for the EMS⁴.

Throughout Denmark, all emergency or 1-1-2 calls are first answered by the police, except the Capital Region of Denmark, where the Copenhagen fire brigade answers these calls. The call-taker assesses the situation according to the information provided via the call and locates the incident's site. As of 2011, a call of medical nature is then forwarded to a regional EMDC⁴.

At the EMDC, healthcare professionals, either nurses or paramedics, answer and handle the calls. They must then assess the situation using the criteria-based emergency medical dispatch (CBD) system, also referred to as the Danish Index for Emergency Care. This index is inspired by a system developed in Seattle, Washington, in 1990 and was adapted according to the Scandinavian context. The Danish Index, used by all regions in Denmark⁴, consists of 38 criteria, including the "unclear problem" category (UPC). These various criteria correspond to clinical signs, symptoms or incidents and it aids the professional decide the response based on the implicated level of urgency⁵.

While identifying a specific complaint is crucial, the UPC remains a common category used by dispatchers to classify emergency calls. The categorization of an emergency call as UPC discloses that the medical dispatcher cannot determine the exact medical cause of the case in

question. Nonetheless, an assessment of the level of urgency is still performed based on the description of the caller⁶.

One of the most crucial problems resulting from the categorization of calls as "unclear" instead of symptom-specific is that a higher or even lower emergency priority level than required might be assigned to the case. This is also known as over-triage or under-triage. Over triage entails using EMS transport for non-acute cases or when the patient does not make use of alternative transportation available. The inappropriate use of EMS results in inefficient use of medical resources. It could even be considered unethical for paramedic personnel as it holds them back from getting their much-needed sleep, meals and education.

Moreover, it could cause delayed responses to other life-threatening incidents with a potentially higher level of urgency⁷. Under triage from EMDCs represents an inappropriately low response without priority signs in an acute case. This type of response may not meet patients' actual medical needs and delay their access to the appropriate level of care⁸. Medical dispatch accuracy is vital in optimizing the balance between patient needs and available prehospital resources⁵.

Møller et al.⁵ found a higher mortality rate for emergency priority level B calls categorized as UPC. Their research states that this might imply that a higher priority level should have been used in the medical dispatch process. There was a problem of under-triaging and a subsequent detrimental effect on patient outcomes. Moreover, they stated that it might pose issues regarding EMS resources' availability for situations that truly require these resources.

Medical dispatchers have been made more aware of the use of the UPC at the EMDC in Copenhagen during the specified study period with the attempt to reduce the use of the UPC in the categorization process. It is relevant to investigate whether this sensitization has had an impact on the use of the UPC in medical dispatching.

Although Copenhagen already has a sophisticated emergency care system with a significant focus on public welfare³, more than 10% of emergency calls remain categorized as UPC and further improvements in the system can thus be made. Considering the potentially harmful implications of using the UPC, their investigation is needed to improve the dispatching process further. Therefore, this study aims to create a structured overview of the effects that the use of

the UPC has on the medical dispatching process at the EMDC in Copenhagen and investigate the results of sensitizing medical dispatchers to reduce the use of the UPC.

It is hypothesized that using the UPC will lead to a less efficient medical dispatching process, leading to either over or under triage, subsequently leading to a waste of resources or endangerment of patients.

Methodology

Study design

A register-based study based on emergency medical call data over 3 years (January 1, 2017 – December 31, 2019) from the EMDC in Copenhagen was conducted. The research was done according to the framework of the EMDC Copenhagen, Denmark's quality assurance protocol. The project was approved by the executive level of the EMDC and Maastricht University.

Categorization in emergency medical dispatching

The categorization is the first step in the emergency medical dispatching process. It leads to more specific questions that enable the medical dispatcher to initiate the appropriate and corresponding priority level (ranging from A-E). Level A includes life threatening/potentially life-threatening symptoms; B includes urgent, yet not life-threatening symptoms; C is for non-urgent conditions that still require an ambulance; D has non-urgent cases requiring supine patient transport; and E is for cases that merely require medical advice⁵. Simultaneously, a red response (an immediate response with lights and sirens), an orange response (an immediate response without lights and sirens), a yellow response (a non-urgent response with the needed resources available), a green response (non-urgent) and a blue response (merely medical advice, for instance referring the patient to their general practitioner) can be dispatched⁵.

Research population and data collection

The study period entailed data from January 1st, 2017, until December 31st, 2019 and all results pertain to an average number over this study period. The main research population was identified based on those emergency calls categorized as UPC. The control group was based on individuals of all emergency calls gathered over the same time period, including all 38 Danish Index categories.

Data analysis

Age and deployment area characteristics of the cases triaged with the UPC were identified through descriptive statistical analyses. Comparisons were made to patients that were allocated to any of the 38 categories.

Descriptive analyses with numbers and percentages were also used to discover how the categorization with "unclear problem" could impact the medical dispatching process and the trends about the EMS units sent out. Moreover, the usage of the UPC over time was explored, to investigate the effect after making medical dispatchers more aware of the implications related to the use of the UPC.

To describe the study population, descriptive analyses were done by the use of numbers and percentages.

Results

Register-based results of all 1-1-2 calls in general

Table 1 (medical dispatch information based on all 1-1-2 calls) illustrates sociodemographic and medical dispatch information of all 1-1-2 calls in general (symptom-specific and the UPC combined) over the same study period, from 01-01-2017 to 31-12-2019.

Table 1. Medical dispatch information of all 1-1-2 calls & UPC calls specifically registered at EMDC Copenhagen, Denmark. B3 = a car is dispatched within an hour and, the case could be related to the heart or a potential stroke, F = no response sent out, A3 = high urgency level, usually associated with the heart or a potential stroke.

	All 1-1-2 calls in general	UPC calls specifically
The average age of the dispatched patients	55 years old	61.22 years old

Most common final responses dispatched to incidents	B3 A3 F	B3 F A3
Most common number of emergency medical vehicles dispatched to incidents	#1: 1 #2: 2 #3: 3	#1: 1 #2: 0 #3: 2
Percentage of transports dispatched that were subsequently cancelled	23% of the dispatched transports	28.62% of the dispatched transports
Most common reasons of transport cancellation	#1: Patient does not want to be brought in #2: Assignment was redispensed #3: Other	#1: Patient does not want to be brought in #2: Assignment was redispensed #3: The transport was no longer being necessary.
How often did the initial dispatch criteria assigned during the call by the EMDC differ from the actual dispatch criteria reported by paramedics on-scene?	In 9.3% of the cases	In 12% of the cases
How often was the dispatched response changed?	16% of the time	14.02% of the time

This table demonstrates some key trends about all 1-1-2 calls reported in general. Some notions that stand out from this table are that all patients dispatched overall are younger than those dispatched with the UPC. Moreover, the number of vehicles cancelled is lower for all 1-1-2 calls in general than for those dispatched with the UPC. Furthermore, fewer transports are sent out for all 1-1-2 calls in general than for calls dispatched with the UPC. Lastly, the emergency center's

first message differs less often from the actual incidents when the paramedics arrived when considering all 1-1-2 calls overall. A similarity between all 1-1-2 calls overall and those dispatched with the UPC are the reasons for transport cancellation. Lastly, the number of all calls conducted has shown a fairly consistent trend over the years while the use of the UPC has decreased.

Register-based results of the "unclear problem" category

33,753 emergency medical calls out of 296,079 calls overall were registered with the UPC at the EMDC in Copenhagen during the study period of 01-01-2017 and 31-12-2019. This accounted for an average of 11.4% of all registered emergency calls during this time period. The average age of the patients dispatched with the UPC was 61.22 years.

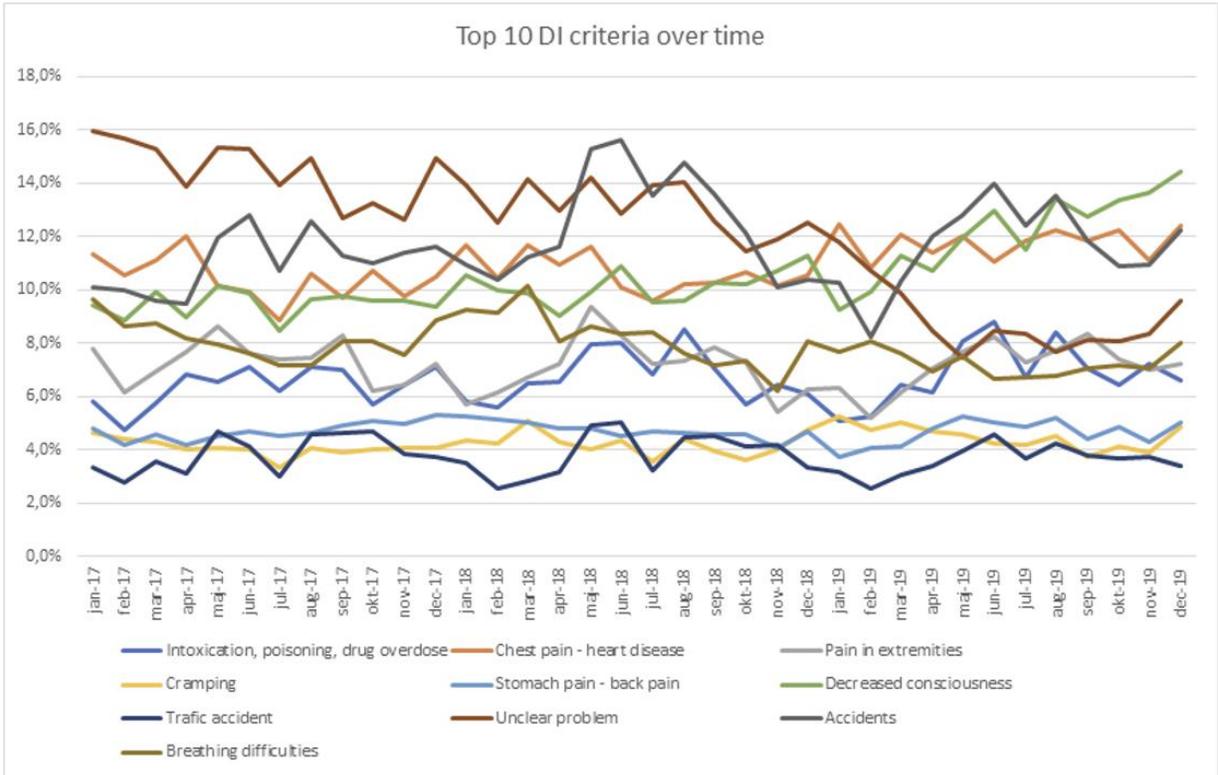
The most common final responses of the incidents triaged as "unclear" were B3, F and A3. A B3-response implies that a car is dispatched within an hour and that the case could be related to the heart or a potential stroke, an F-response means that no response is sent out. An A3-response implies a potentially life-threatening situation and thus results in a high urgency level. In most cases A3 is related to the heart or a potential stroke.

The data showed that the most common number of EMS units sent out for a call assigned to the UPC was ¹ (58.41% of the time), the second most common was 0 (30.36% of the time) and the third most common was ² (9.74% of the time). After having been dispatched with the UPC, 28.62% of the calls ended up being cancelled. The most common reasons for the cancellation of the first transport were either due to the patient cancelling their transport, due to an assignment rerouted to a more important case or due to the transport no longer being necessary.

In 12% of the cases, the initial dispatch criteria registered at the dispatch center differed from the actual dispatch criteria reported when the paramedics arrived. During the emergency call, the initial response changed instead of the primary evaluation 14.02% of the time.

The histogram in Fig 5 below depicts the top dispatch criteria reported at the EMDC in Copenhagen during the study period. It can be seen that at the beginning of 2017, the most used dispatch criteria used by medical dispatchers were related to "unclear" cases. However, the trend is visibly declining and faster than any other symptom-specific dispatch criteria.

Figure 1. Line chart demonstrating the top 10 dispatch criteria used over time at the EMDC from January 1st, 2017 until December 31st, 2019. Data source: system data from the emergency medical dispatch Center Copenhagen, 2019.



Discussion

This study aimed to create a structured overview of the effects that the use of the UPC has on the medical dispatching process at the EMDC in Copenhagen, as well as to investigate the effects of sensitizing medical dispatchers to reduce the use of the UPC.

The research demonstrated that the UPC was most often used for the elderly and its use showed an impact on over and under triage in medical dispatching. Moreover, the UPC's use has been declining over the years, demonstrating a possible effect of alerting medical dispatchers about the implications of using the UPC.

Sociodemographic determinants related to the use of the "unclear problem" category

The average age of patients who were triaged with the UPC was higher than the age of those patients reported for the overall number of emergency medical services calls (55 vs. 61.22 years).

In line with these results, a study based on emergency medical patients in hospitals in Denmark and California has demonstrated that non-specific diagnoses such as "other symptoms" and "other factors" constituted large groups in the elderly patient population¹⁰. Although this study considered the patient population in hospitals, it correlates with the increased use of UPC in emergency medical calls for elderly patients.

The fact that a relatively large number of elderly patients are triaged with the UPC may be explained by their reduced capability to exchange information in a clear and precise way⁵. Moreover, elderly patients often present with more difficult problems. Namely, a study conducted by Wachelder et al.¹¹ explained that elderly patients who visit the emergency room often have non-specific complaints due to numerous factors including comorbidities, cognitive and functional impairment and communication problems. This could similarly be an issue during the dispatching process at the EMDC. It has been shown that cardiac arrest, which frequently occurs in the elderly¹², is a medical condition that is difficult to spot¹³. Related to this notion, the data in our study demonstrates that one of the most common final responses of the incidents triaged with the UPC were related to the heart.

The impact of the "unclear problem" category on under and over triage

The data demonstrated that 28.62% of the dispatched transports after triage with the UPC end up being cancelled. This number is higher than the amount cancelled for all 1-1-2 calls in general, which is 23%. These results could indicate that, in general, over-triage might be an issue in Copenhagen, and particularly when regarding the UPC, as it might suggest that in the first instance, more or higher-level emergency vehicles are sent out than necessary. However, it could also denote the opposite – if more cars are cancelled, it might mean that cases are more often under-triaged as vehicles could be cancelled in instances where they were essential.

This study's scope did not allow for the determination of the exact amount of under and over triage. However, a study conducted in Vaud, Switzerland, evaluated the accuracy of the criteria-based dispatch system. One of their aims was to investigate the amount of under and over triage. They found an over-triage rate of 78% compared to an under-triage rate of merely 4.6%. In both cases of under and over triage, "undefined problem", was the most used criterion. This criterion represented 38 % of over triage and 83.6 % of under triage cases⁸. Considering the same dispatch system was used as in the EMDC, this could indicate that over triage occurs more often

in emergency medical dispatching using the CBD system than under triage. Moreover, it could imply that the UPC indeed leads to more over and under triage and influences under triage.

A study conducted by Staudenmayer et al.¹⁴ found that the under-triage rate in elderly patients was high. Of cases with patients aged 55 years or older, 33% were under-triaged. This finding could be related to the complexity underlying the medical conditions of elderly patients. They are often harder to identify and specify, such as cardiac arrest¹³, and often present with comorbidities or cognitive and functional impairment, as well as communication issues¹¹.

A study conducted in France by Travers et al.¹³ depicted the difficulties medical dispatchers face with detecting cardiac arrests and found that reasons of non-recognition were due to the bystander not being near the victim, the medical dispatcher not asking the right questions, too many calls arriving at the EMDC simultaneously, as well as the presence of agonal breathing. This could explain why medical dispatchers often choose the UPC over more symptom-specific categories. They may not be fully confident or lack information to determine an explicit category for the patient.

With regards to the cancellation of initially dispatched transports, the results could imply that the use of the UPC in dispatching does not impact over or under triage much, as there are no significant differences in reasons of transport cancellation between all 1-1-2 calls in general and those calls dispatched with the UPC. Furthermore, the reasons for transport cancellation for both 1-1-2 calls in general and the calls triaged with the UPC do not infer any concerns related to under triage – if anything, it suggests that more transports are sent out than necessary.

Technical dispatchers are required to choose how many vehicles they send out to the emergency situation⁹. The results indicate a difference between the number of transports sent to cases dispatched with the UPC instead of all 1-1-2 calls in general. For instance, when dispatched with the UPC, the technical dispatcher's second most common action is to send out no transport at all. On the other hand, when regarding all 1-1-2 calls in general, 2 vehicles is the second most common number of transports sent out to the emergency. This might suggest that the UPC could cause either under or over triage. It could imply that individuals dispatched with the UPC more often call for concerns that are not emergencies, and therefore it might have been more efficient for them to call another number, such as 1813 or their GP. On the other hand, it might indicate

that patients calling with the UPC are more often under triaged, as there are more often no transports sent out, whilst transport might have been necessary in reality.

The effect of the use of the "unclear problem" category on patient outcomes

The data demonstrates that the first message from the emergency center differs from the actual incident reported when the paramedic arrives in 12% of cases when the calls are dispatched with the UPC compared to 9.3% when it comes to all 1-1-2 calls in general. The medical dispatchers might have a wrong or even misguided understanding of the situation. This might cause an increased amount of either over or under triage. This could cause the paramedics and the acute medical teams in the hospital emergency departments to be less prepared or over-prepared for what they have to deal with, possibly negatively influencing patient outcomes or rather causing inefficient use of resources⁵.

The impacts of sensitizing medical dispatchers about the use of the UPC to reduce its use

As can be seen from the register-based results, the use of the UPC has been steadily decreasing over the period of the study. Throughout the period of the study, medical dispatchers have been alerted about the implications of using the UPC with the attempt to reduce its use. The use of the UPC has shown the greatest decrease out of all the different categories. This could indicate that alerting medical dispatchers about the implications of the use of the UPC at the EMDC in Copenhagen had a positive effect.

Other studies have also shown positive effects after the implementation of a new protocol in EMDCs. The introduction of a new protocol in EMDCs to improve cardiac arrest identification by medical dispatchers and increase conduction of medical-dispatcher-assisted CPR to patients has shown to be effective^{15 16}. Although these studies were not related to the UPC, it further exemplifies that new protocols can have beneficial effects in the medical dispatching process, similarly to how the protocols implemented at the EMDC in Copenhagen have reduced the usage of the UPC.

Implications

This study shows that the UPC is most often registered for cases concerning elderly patients. It demonstrates that UPC usage could have an impact on either under or over triage, and therefore have negative effects on patient outcomes or the efficient use of resources. Moreover, this study

reports a reduction in the use of the UPC after educating medical dispatchers with the aim to improve the triage process and reduce the use of the UPC.

This research shows the effects of using the UPC on the dispatching process. These possible related complications can occur and it sheds light on research opportunities and improvements with regard to UPC use.

Limitations

A limitation of the study is that although observations can be drawn from the results, no causal inferences can be established, and further research is required to achieve that. Qualitative research could indicate why medical dispatchers decided to opt for the UPC, their opinion is about the use and existence of this category, and this could show where improvements could be made in the EMDC. Moreover, suppose the patient outcomes could be linked to the data. In that case, it could clarify whether the triage is not excessive or rather insufficient and measures could subsequently be taken to provide a more accurate medical dispatching process.

Moreover, it is known that the dispatchers were alerted about the use of the UPC, yet there is no further information about how this process was undertaken. The decrease of the UPC could be related to educating medical dispatchers about the implications of using the UPC, yet this cannot be proven.

Additionally, the analysis does not include the medical dispatchers' factors, which might affect emergency call categorization, such as sociodemographic factors, their professional background, or mental state.

Further research

This research showed that the UPC has different impacts than the overall reported 1-1-2 calls in general. To better investigate the impacts of the UPC, qualitative research and research on patient outcomes need to be done.

Moreover, if it is known how the medical dispatchers were alerted about the implications of the use of the UPC, then this could facilitate implementation of future improvements in medical dispatching, not only at the EMDC but also in other Danish regions or even internationally. Another

topic that could be interesting to regard for future research is how artificial intelligence could aid medical dispatchers in choosing a correct medical dispatching category and thereby reduce their use of the unclear category. Blomberg et al.¹⁷ emphasize artificial intelligence's skill to recognize out of hospital cardiac arrest, yet acknowledge that future studies are needed to improve human-computer interaction.

Although this research has denoted some possible gaps in the system that could be improved to reduce the use of the UPC, it would be interesting to look into other tools to reduce its use. This study could lead to further research and serve as a starting point for an improved, more efficient EMDC in Copenhagen. A better EMDC could subsequently benefit Danish society. Furthermore, other EMDCs in Europe could take note of this research. This report could be a stimulus for EMDC leaders to investigate their medical dispatching categorization system and the implications that come along with it, to make further improvements.

Conclusion

The usage of the UPC could negatively impact patient outcomes and the efficient use of EMS resources. It was found that the UPC is mainly used when dispatching the elderly. Nonetheless, the UPC has been decreasing over time after the medical dispatchers were alerted about the implications of using the UPC. Notably, this research has illustrated which aspects of the UPC need further research to make future improvements.

Supplementary Materials:

Sociodemographic characteristics that were collected about patients triaged with the UPC as well as about all 1-1-2 calls in general in this study period (01-1-2017 – 31-12-2019) was:

- The average age of the dispatched patients

Dispatching data gathered about the UPC in this study period (01-1-2017 – 31-12-2019) were:

- The most common final responses of the incidents
- The most common number of transports sent out
- The percentage of transports sent out that were cancelled
- The most common reasons of transport cancellation
- How often the first message from the emergency central differed from the actual incident when the paramedics arrived
- How often the response changed

For means of comparison, sociodemographic and dispatching data that was collected about all 1-1-2 calls in general during this same study period (01-1-2017 – 31-12-2019) were:

- How often the top 10 dispatch criterion were used in the study period
- The most common number of transports sent out
- The percentage of transports sent out that were cancelled
- The most common reason of transport cancellation
- How often the response changed
- How often the first message from the emergency central differed from the actual incidents when the paramedics arrived
- The most common final responses of the incidents
- The most common reasons of transport cancellation
- Trends over time in number of calls
- The criterion that were used most frequently during medical dispatching over time

Abbreviations:

- EMS (emergency medical services)
- EMDC (emergency medical dispatch center)
- CBD (criteria based emergency dispatch system)
- UPC (unclear problem category)

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