





BMJ Open Development of indicators for avoidable emergency medical service calls by mapping paramedic clinical impression codes to ambulatory care sensitive conditions and mental health conditions in the UK and Canada

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ABSTRACT

Objective Paramedic assessment data have not been used for research on avoidable calls. Paramedic impression codes are designated by paramedics on responding to a 911/999 medical emergency after an assessment of the presenting condition. Ambulatory care sensitive conditions (ACSCs) are non-acute health conditions not needing hospital admission when properly managed. This study aimed to map the paramedic impression codes to ACSCs and mental health conditions for use in future research on avoidable 911/999 calls.

Design Mapping paramedic impression codes to existing definitions of ACSCs and mental health conditions.

Setting East Midlands Region, UK and Southern Ontario, Canada.

Participants Expert panel from the UK-Canada Emergency Calls Data analysis and GEospatial mapping (EDGE) Consortium.

Results Mapping was iterative first identifying the common ACSCs shared between the two countries then identifying the respective clinical impression codes for each country that mapped to those shared ACSCs as well as to mental health conditions. Experts from the UK-Canada EDGE Consortium contributed to both phases and were able to independently match the codes and then compare results. Clinical impression codes for paramedics in the UK were more extensive than those in Ontario. The mapping revealed some interesting inconsistencies between paramedic impression codes but also demonstrated that it was possible.

Conclusion This is an important first step in determining the number of ACSCs and mental health conditions that paramedics attend to, and in examining the clinical pathways of these individuals across the health system. This work lays the foundation for international comparative health services research on integrated pathways in primary care and emergency medical services.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Clinical impression codes available to paramedics in their mandatory reporting forms are an underused source of health system data and were mapped to ambulatory care sensitive conditions (ACSCs) and mental health conditions using a novel method.
- ⇒ The mapping was conducted for both the UK and Ontario, Canada contexts, supporting future inter-country comparisons between these regions with similar healthcare systems but varying policies and resources.
- ⇒ Though paramedic data can be linked to ACSCs using the mapping from this study, it cannot be absolutely certain that the conditions with these codes are manifestations of ACSCs.
- ⇒ The mapping was only completed for ACSCs as defined by the UK and Ontario, Canada healthcare systems and the mapping method would need to be repeated for other countries to permit their inclusion in future international studies.

INTRODUCTION

Paramedic assessment data are often used in prehospital research,^{1 2} but rarely for research on avoidable calls.¹ Paramedic impression codes are designated by paramedics during a 911/999 medical emergency response after completing a patient assessment.^{3 4} This is critical information for primary care research, capturing the hitherto unknown clinical ‘pathway’ of a patient, namely: (a) the clinical situation between the primary care setting and the emergency department (ED) or (b) details of clinical cases assessed by paramedics but not transported to hospital. Importantly, the latter scenario typically comprises lower acuity calls contributing

to emergency health system burden that may be better addressed by primary care.¹

Ambulatory care sensitive conditions (ACSCs) are non-acute health conditions not requiring hospital admission when properly managed or prevented by accessible primary care in the community.⁵ ACSCs are routinely monitored and are quality indicators for primary, community and hospital care.⁶ While there are some ACSC complications that cannot be prevented, in the majority of cases they can usually be successfully managed within the community; however, ACSCs are still placing significant demand on hospitals.^{7–9} Canadian data demonstrate that, excluding physician costs, ED visits for unmanaged ACSCs average \$C280⁹ and hospitalisations \$C5700.⁹ Recent studies indicate that ACSCs may also be contributing to the rise in 911/999 calls for emergency medical services.^{1 10 11} UK 999 calls have been rising by 7% each year,¹² while 911 calls in Ontario increased by 4.2%,¹³ outpacing population growth. To address this burden and reduce avoidable calls for ACSCs, community paramedicine or alternative paramedicine models are being developed and implemented.¹ Literature examining ACSCs and 911/999 calls has used dispatch data,¹⁴ ED visits via ambulance¹⁵ and patient self-reported reasons for calling.¹² However, research has found that dispatch data do not correspond closely with paramedic clinical impression,¹⁶ suggesting that dispatch data are not representative of the true nature of the call after the paramedic has completed their assessment. Increasingly, prehospital research studies are using clinical impressions for this reason.^{1 17}

Next, ED visit research may underestimate the burden of ACSCs on 911/999 because 16%–38% of patients are not transported to ED^{17–19} and these non-transports may be primarily for low-acuity conditions.^{18 19} Finally, self-report data may suffer from bias in who can be contacted, self-selection bias, recall bias, social desirability bias and errors due to incorrect responses (eg, poor health literacy). Therefore, being able to identify ACSCs from paramedic impression codes in administrative datasets would be valuable for health system research; for example, studies on the differential rates in 911/999 non-transports for ACSC and non-ACSC calls, and potential primary care interventions.

Although mental health conditions are not traditionally considered ACSCs, they have similar characteristics and health system implications. Specifically, the majority of depressive and mood-related disorder cases can be better managed in primary care and community settings,^{20 21} avoiding visits to the ED.²² However, mental health conditions represent 4% of ED visits²³ based on hospital discharge data, and 8%–11% of 911/999 calls,^{24 25} based on dispatch data. As with ACSCs, these data sources provide some indication but do not accurately represent the true prevalence of mental health conditions in the prehospital emergency environment; instead, this would be better captured using paramedic clinical impression codes—a gap in the current literature.

This study focused on paramedic impression codes from the East Midlands Region, UK and from Southern

Ontario, Canada. These are two international regions with universal healthcare, established ambulance/paramedic services and electronic records for each prehospital emergency patient interaction. Comparative research to understand the variation between healthcare systems is critical to inform future improvements. In understanding the differences, the revealed complexity provides opportunities for multiple areas of health-systems learning. Though this type of research has been initiated in primary care,²⁶ it has not been conducted internationally between ambulance services. A detailed understanding of patient pathways as they negotiate healthcare from the emergency 911/999 call through prehospital health services, with or without a hospital visit, is required. ACSCs, therefore, provide an excellent way to explore and trace similar conditions through the primary care and prehospital system.

Our objective was to map paramedic clinical impression codes to ACSCs and mental health conditions in two international regions (UK and Ontario, Canada) with universal healthcare but different contexts (eg, policy, programmes, resources, built environment), thereby laying groundwork for future cross-jurisdictional comparative primary care or prehospital research.

METHODS

Study design

The mapping was accomplished iteratively with two main phases: (a) identifying the common ACSCs shared between the two countries and (b) identifying the respective clinical impression codes for each country that map to those shared ACSCs as well as to mental health conditions. The results of this study will be integral to subsequent international health services research examining out-of-hospital emergency responses for ACSCs and mental health conditions.

Setting and participants

A panel of experts from the UK-Canada Emergency Calls Data analysis and GEospatial mapping (EDGE) Consortium contributed to both phases. The EDGE Consortium was formed in 2019, comprising academics from relevant disciplines, including but not limited to primary care, paramedicine, rural health, health services and policy, biostatistics, and geography. Some members of the EDGE Consortium are also senior leaders of paramedic services and/or practising primary care physicians (ie, family doctors or general practitioners). For the first phase (identifying the list of common ACSCs), all 13 members of the EDGE Consortium as of 3 April 2020, participated. The second phase (mapping clinical impression codes to ACSCs and mental health conditions), involved one paramedic and one primary care physician from each country.

Patient and public involvement

No patients were involved in this study.

Data sources

Ambulance services under the National Health Service (NHS) in the UK record the paramedic's clinical

impression in the ‘ambulance electronic patient record system’ after patient assessment; this is the main diagnostic source of paramedic clinical data.⁶ Similarly, paramedic services in Ontario, Canada, have paramedics record their clinical impression after patient assessment using ‘problem codes’ in the ‘ambulance call report’.²⁷ On first encounter with the patient, both a primary and secondary problem code can be documented as the main clinical impression, and then a final set of primary and secondary problem codes can be documented as the ultimate clinical diagnoses when transferring care of the patient to the receiving facility, when the interaction has been resolved, or when the patient has refused transport.^{5 6} The initial secondary problem code and the set of final problem codes are optional, but an initial primary problem code must be recorded for each patient encounter. In both settings, these codes are from a predetermined list provided by the respective governing bodies and are entered into a structured form. Though paramedics can choose which code to enter, they cannot change the actual codes themselves, and other areas of ambulance electronic health records may allow notations.

Data collection

Phase 1

The ACSCs used as health system indicators by each government were retrieved from institutional websites. In Ontario, the Canadian members of the EDGE Consortium identified the Canadian Institute for Health Information²⁸ and Health Quality Ontario²⁹ as the most appropriate institutional sources for ACSCs used for health system indicators. In the UK, the NHS Institute for Innovation and Improvement was identified as the most appropriate source.^{7 26}

Phase 2

The clinical impression codes common to all Ontario paramedic services were obtained from the Ontario Ministry of Health and Long-Term Care (a provincial governmental body) manual for completing ambulance call reports, under the heading ‘problem codes’.³ This ministry is responsible for ongoing review and updating of the clinical codes. For the UK, the list of clinical impression codes was obtained from the East Midlands Ambulance Service (a regional institutional body) electronic patient report template within the Medusa electronic medical record platform. These UK codes are used nationally and were developed by a multidisciplinary panel of NHS clinicians.³⁰ These codes, both in Ontario and the UK, provide a common structure for clinicians to use within an ambulance electronic health record despite the multiple different care settings and contexts.

Analysis

Phase 1

The ACSCs were first compared within each location (Ontario and UK) and then between locations. Within each location, the institutional lists of ACSCs were

cross-referenced to determine if they contained the same conditions. All conditions were maintained, even if they only appeared on one list, but discrepancies were noted. Next, the lists for each location were compared against each other in a meeting with all EDGE Consortium members, aligning the conditions from each location by consensus. The final list of ACSCs was restricted to the conditions both locations had in common (ie, shared ACSCs).

Phase 2

Using the shared ACSCs from phase 1 and ‘mental health’, paramedic clinical impression codes were matched to each condition. Within each location, a physician and paramedic independently matched the clinical impression codes to the conditions. Next, these results were compared for agreement. The paramedic and physician discussed any inconsistencies until they achieved consensus; the rationale for final codes selected is described in the results below. Where consensus could not be achieved, the paramedic/physician pair from the other country formed an arbitration panel to resolve disagreement.

RESULTS

Phase 1: ACSCs

The ACSC list from Health Quality Ontario²⁹ contained seven conditions: (a) angina, (b) asthma, (c) congestive heart failure (CHF) and pulmonary oedema, (d) chronic obstructive pulmonary disease (COPD), (e) diabetes, (f) grand mal status and other epileptic convulsions, and (g) hypertension. The Canadian Institute for Health Information list of ACSCs²⁸ had two groups: group A had the same seven conditions as those from Healthy Quality Ontario listed above and group B was solely lower respiratory infections. Therefore, there was substantial agreement between the two institutional lists, and all eight conditions were maintained for the Ontario ACSC list (see [table 1](#)).

The lists of ACSCs from UK institutional sources were much more extensive and included gynaecological, dental, gastroenterological, upper respiratory and vaccine preventable conditions. A King’s Fund Report from 2012⁷ highlighted and clarified the NHS Institute for Innovation and Improvement’s²⁶ definition of 19 ACSCs: (a) angina, (b) asthma, (c) cellulitis, (d) CHF, (e) convulsions and epilepsy, (f) COPD, (g) dehydration and gastroenteritis, (h) dental conditions, (i) diabetes complications, (j) ear, nose and throat infections, (k) gangrene, (l) hypertension, (m) influenza and pneumonia, (n) iron-deficiency anaemia, (o) nutritional deficiency, (p) other vaccine preventable diseases, (q) pelvic inflammatory disease, (r) perforated/bleeding ulcer and (s) pyelonephritis (see [table 1](#)).⁷

When the two regional lists were compared by the EDGE Consortium members, agreement was readily reached that the following conditions were common ACSCs for

Table 1 Ambulatory care sensitive conditions common to both Ontario, Canada and the UK

| Ontario ACSC list | UK ACSC list | Ontario/UK agreement |
|--|---------------------------------------|-------------------------------|
| Diabetes | Diabetes complications | Agree |
| Chronic obstructive pulmonary disease | Chronic obstructive pulmonary disease | Agree |
| Asthma | Asthma | Agree |
| Angina | Angina | Agree |
| Grand mal status and other epileptic convulsions | Convulsions and epilepsy | Agree |
| Congestive heart failure and pulmonary oedema | Congestive heart failure | Agree |
| Hypertension | Hypertension | Agree |
| | Cellulitis | No comparable ACSC in Ontario |
| | Dehydration and gastroenteritis | No comparable ACSC in Ontario |
| | Dental conditions | No comparable ACSC in Ontario |
| | Ear, nose and throat infections | No comparable ACSC in Ontario |
| | Gangrene | No comparable ACSC in Ontario |
| Lower respiratory | Influenza and pneumonia | Agree |
| | Iron-deficiency anaemia | No comparable ACSC in Ontario |
| | Nutritional deficiency | No comparable ACSC in Ontario |
| | Other vaccine-preventable diseases | No comparable ACSC in Ontario |
| | Pelvic inflammatory disease | No comparable ACSC in Ontario |
| | Perforated/bleeding ulcer | No comparable ACSC in Ontario |
| | Pyelonephritis | No comparable ACSC in Ontario |

ACSC, ambulatory care sensitive condition.

both countries: (a) diabetes, (b) COPD, (c) asthma, (d) angina, (e) grand mal status and other epileptic convulsions or convulsions and epilepsy, (f) heart failure and pulmonary oedema, (g) HTN, and (h) lower respiratory or influenza and pneumonia. Terminology was slightly different for seizure-related conditions and lower respiratory conditions. Notably, all ACSCs from the Ontario list were captured within the UK list and neither list included mental health conditions (see [table 1](#)).

Phase 2: clinical impression codes mapped to ACSCs and mental health

Clinical impression codes for paramedics in the UK were more extensive than those in Ontario (see [table 2](#) and online supplemental file 1). For example, Ontario had three problem codes for respiratory conditions describing the aetiology and the general presenting issue or symptom, whereas the UK had five codes covering a mixture of causes, symptoms and diagnoses or diseases. For mental health, the Ontario clinical impression codes were extremely broad, including a whole medical discipline, while the UK codes covered both mechanisms and diagnoses.

The physician and paramedic pair from Ontario each independently selected the clinical impression codes that best matched each condition based on their clinical expertise (see online supplemental file 2). The physician selected more codes in order to reflect the breadth of

scope of conditions, though the paramedic had selected mainly one code. Agreement was reached that in actual practice, a single impression code would be chosen by paramedics to represent conditions encountered. A greater number of codes was likely to cause a low specificity in mapping of clinical conditions. For example, for COPD, the physician chose five separate codes to represent conditions that may have caused respiratory changes that a paramedic could have observed attending to someone experiencing a COPD exacerbation; codes covered ‘dyspnoea’, ‘temporary loss of consciousness’ and ‘weakness/dizziness/unwell’ were identified. The paramedic chose two codes: ‘dyspnoea’ as the main code and ‘respiratory arrest’ as an alternate code. At the ensuing discussion, the common clinical circumstances requiring 911 calls were elucidated and discussed in detail. Extremes of presentation were considered, as well as the usual paramedic options for clinical impression and those that were most often used in reality. Consensus was reached that a code of ‘dyspnoea’ would be the most specific in capturing people who called 911 for COPD.

The physician and paramedic pair from the East Midlands also each selected the clinical impression codes that best matched each condition based on their clinical expertise (see online supplemental file 2). Both physician and paramedic selected clinical impression codes independently, followed

Table 2 Paramedic impression codes in Ontario and the UK for respiratory and mental health conditions

| Category | Ontario problem codes | UK clinical impression codes |
|---------------|--|---|
| Respiratory | 21: Dyspnoea 24: Respiratory arrest 11: Obstruction (partial/complete) | COPD Other respiratory problem Chest infection Choking Asthma Influenza |
| Mental health | 45: Behaviour/psychiatric 81: Drug/alcohol overdose | Attempted suicide Intentional drug overdose Deprivation of liberty safeguards Anxiety Psychosis Effects of alcohol Social problem Under Mental Health Act section Accidental overdose/poisoning Depression Panic/anxiety attack Other mental health problem Dementia Query intoxicated |

by a discussion of any differences. For example, for ‘angina’ the paramedic only selected ‘cardiac chest pain’ whereas the physician selected ‘cardiac chest pain’, ‘ECG confirmed ST segment elevated MI’ and ‘cardiac problem’. Similar to the selection in Ontario, the paramedic was more selective, and the physician was more inclusive. They agreed for the purpose of this exercise to be inclusive rather than exclusive. The UK paramedic and physician selected identical clinical impressions for all other conditions.

In both Ontario and the UK, there was no clinical code found for hypertension. In Ontario, three of the ACSCs have the same code (dyspnoea) whereas, in the UK, each ACSC has a more unique descriptive code. The mental health codes were completely different between Ontario and the UK.

DISCUSSION

This paper has successfully mapped clinical impression codes generated by paramedics attending to patients with ACSCs and mental health conditions in Canada and the UK. However, some interesting factors have emerged that researchers should be aware of when analysing any paramedic clinical impression codes for primary care or prehospital research purposes. Hypertension, though classified as an ACSC, could not be distinguished specifically enough from any of the existing paramedic impression codes for either Canada or the UK. The codes, however, did contain clinical scenarios that might have

included hypertension-induced emergencies, such as cerebrovascular accidents or heart failure. Therefore, although hypertension is very common in primary care and its complications lead to emergency situations, it cannot easily be detected in paramedic impression codes. However, the issue of clinical misclassification is not limited only to this situation. Literature shows that International Classification of Diseases 10th Revision (ICD-10) codes used by clinicians often do not match the ACSC codes.³¹ This can make it difficult for clinicians when trying to classify the presentation of the patient they just saw.

As noted in [table 1](#), there are many more paramedic impression codes in the UK compared with the Canadian codes in Ontario. The inconsistency in the two countries’ codes resulted in the mapping process being more difficult, though it was achieved. Having too many or too few paramedic impression codes may result in paramedics not being able to choose the appropriate codes for certain conditions when in the clinical field. Therefore, it is possible that some Canadian clinical impression codes may be undifferentiated between the clinical impressions, leading to a lack of variability in the data. When Ontario chooses to revise their ACSC lists, they may consider looking at some of the UK codes to provide a greater breadth of conditions. However, the UK has a much greater degree of granularity, combining diagnoses as well as symptoms and causes, which may be too detailed, leading to misclassifications. Ultimately, both scenarios will render the identification of ACSCs retrospectively technically difficult and might warrant more consideration as ambulance services refine their data collection tools. The best scenario would be to have a unified system of paramedic impression codes that would be relevant for all countries and adopted internationally, allowing for ease of comparison.

Although mental health was not an ACSC according to either country’s institutional lists, our international research team included it because it is a term that encompasses conditions that could be better managed through primary care but that often lead to emergency health system use, for example, suicidal crisis as a result of chronic depressive disorder. It would be appropriate for mental health to be included whenever the institutions revise their ACSC lists in the future. It is important to note that mental health constituting an ACSC would not describe any acute psychotic presentations, but rather depression and other mood-related disorders that are commonly managed in general practice.

Intercountry comparison of ACSCs has occurred though focusing on the reduction of hospitalisations for these conditions.^{32 33} However, this work has not used ambulance call data, which remains methodologically novel. The existing research literature has highlighted the importance of making appropriate comparisons, and ensuring that the ACSCs selected for study are appropriate for the demographics, epidemiological profile and primary care practices across countries, and that they are similar.³² This paper has followed this caveat, as it is comparing similar countries that have similar ACSCs,

and this work is designed to ensure future comparative inter-country work will be truly comparable due to the mapping work we have done.

Having any information about patient pathways is important in healthcare systems as we try to set up integrated care. As discussion around integrated care proceeds, understanding the unmet healthcare needs of patients with certain avoidable conditions is crucial in healthcare planning. These types of discussions are already happening at healthcare planning tables in the UK and Canada. Now that paramedic indicators for potentially avoidable calls have been identified in this paper, these discussions may fuel a series of quality improvement and research papers on these unique patient pathways. Indeed, for patients who have health issues that lead to a 999/911 call, but are not needed to be transported to the hospital, paramedic clinical impression codes are the only place this function of the healthcare system is captured, therefore, they are a very important tool to use. This paper lays down important groundwork to allow future between-country comparisons to start, and to determine which health service practices may benefit our patient populations more or less, as we learn from each other's mistakes and successes.

Limitations

Though paramedic data can be linked to ACSCs, we cannot be absolutely sure that we have identified the conditions that have manifested as ACSCs. This study has uncovered how vague (Canada) or overprescriptive (UK) some of the impression codes are. This will definitely affect the quality of any data analytical work that would ensue from any epidemiological examination of the paramedic data. Future work should focus on subsequent validation studies, such as a more rigorous Delphi method, followed by validation against actual administrative data that includes details about hospital visits and diagnostic codes further down the line of health system patient involvement. We also acknowledge that not all ACSCs require solely community healthcare access in order to avoid hospitalisation. Some chronic disease complications simply cannot be prevented upstream and will need ED access and prehospital care in certain specific situations. However, in the field of prehospital care, the concept of ACSCs provides a relevant and interesting benchmark from which to launch enquiry into our practices of care and as such, is a suitable indicator.

CONCLUSION

Clinical impression codes generated by paramedics on attending to acute call patients can be mapped to cover ACSCs and mental health conditions, both in the UK and in Ontario, Canada. This is an important first step in determining the number of ASCs and mental health conditions that paramedics attend to, and in examining the clinical pathways of these individuals across the health system. This work lays the foundation for international

comparative health services research on integrated pathways in primary care and emergency medical services.

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Contributors GA, ANS, BM, RS, GAW, RF, MP, RA, HM and MG conceived of the study as a necessary step in the work of the EDGE Consortium. GA and ANS served as the scientific advisors and led the study activities in Canada and the UK, respectively. GA, ANS, BM, RS and MP collected the codes and data to be mapped. GA, ANS, BM, RS and GAW participated in the mapping and arbitration process. All authors contributed to the interpretation of the study results. GA, ANS and MP drafted the manuscript. All authors provided critical comments on manuscript drafts, and reviewed and approved the final manuscript. GA is responsible for the overall content as guarantor.

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