



STANDARDS RESEARCH

Canadian Paramedic Landscape Review and Standards Roadmap

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Authors

Alan M. Batt, PhD, Fanshawe College

Jeanne Bank, Consultant

Jennifer Bolster, BPara (Hons.), Fanshawe College

Priya Pithia, BHSc, Fanshawe College

Project Advisory Panel

Brett Williams, Monash University, Australia

Jennie Helmer, BC Emergency Health Services

Paul Raftis, Toronto Paramedic Service

Pierre Poirier, Ottawa Paramedic Service

Shane Knox, University College Cork, Ireland

Dragica Nikolic, CSA Group (Research Manager)

Nancy Bestic, CSA Group (Director)

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Executive Summary

The paramedic profession in Canada has evolved significantly in the last decade in terms of the professional scope of practice, contexts of paramedic practice, paramedic education, paramedic research, and relevant standards development. This rapid evolution, along with emerging issues in Canadian society, have led to new standards work, increased research activities, and novel policy developments. A clear understanding of these activities is required to provide direction to the paramedic community on future standards development work, as well as to guide additional research activities.

This report seeks to identify developments in paramedicine—both in Canada and internationally—that could inform Canadian paramedic activities. These activities include current service delivery priorities, as well as forecasted areas that will impact the delivery of paramedic education, research, and operations. This was achieved through an extensive review of relevant published and grey literature, national and international standards, and national and international guidelines. These results were combined with a stakeholder engagement exercise conducted with paramedic stakeholders from various contexts across Canada.

The report outlines a framework for future developments under seven main domains and several sub-categories that form the basis for the research and analysis undertaken. The domains used to organize the findings and recommendations are:

- Equipment;
- Paramedic Service Operations;
- Communications;
- Management Systems and Program Development;
- Practice Settings and Specialty Models of Care;
- Education, Research, and Data Management; and
- Emergency Management.

The findings of this report will guide the paramedic community toward the future and will help to facilitate discussions with the stakeholders and rightsholders involved in paramedicine at all levels about standardization work. It may also guide, coordinate, and enhance the standards development and research landscapes to further support the evolving needs of the paramedic community in Canada.



“As the paramedic sector has expanded beyond the role of transporting patients to become an integrated part of the health care sector, standards have been developed to provide requirements and guidance for PSOs to benefit the health, safety, and well-being of workers and the public and to improve the quality and efficiency of paramedic services.”

1 Introduction

Since the publication of the Canadian Paramedic Services Standards Roadmap in 2014 [1], the paramedic profession in Canada has evolved and has undergone significant developments related to professional scope of practice, contexts of paramedic practice, paramedic education, paramedic research, and relevant standards development. In addition, contemporary issues in Canadian paramedicine (e.g., demands of the ongoing overdose crisis) have led to new standards work, research activities, and policy developments.

The purpose of this project was to identify priority areas for future work in terms of standards development, best practices, and application tools pertinent to paramedic practice in Canada.

It is important to emphasize that the focus of this roadmap is not merely to identify gaps and then to suggest the development of new standards to fill them. Rather, it is also to identify opportunities where gaps can potentially be filled by revising or harmonizing existing standards, or to highlight other initiatives that may fill the identified gaps.

1.1 Use of Standards by the Paramedic Community in Canada

Paramedics and paramedic services organizations (PSOs) require safe, reliable, and interoperable equipment that can be used with confidence for the

protection of both workers and patients. For many years, the paramedic sector has used equipment standards for ambulances, personal protective equipment (PPE), and medical supplies. As the paramedic sector has expanded beyond the role of transporting patients to become an integrated part of the health care sector, standards have been developed to provide requirements and guidance for PSOs to benefit the health, safety, and well-being of workers and the public and to improve the quality and efficiency of paramedic services. In some cases, these standards have been developed by regulatory agencies that have legislative authorities. In the last decade, several voluntary, consensus-based standards have also been developed by accredited standards development organizations to provide specific guidelines for paramedics and PSOs to address areas such as personnel competency, emergency management, paramedic health and safety, and programs in new areas of practice (e.g., community paramedicine, the use of drones, opioid response).

The paramedic community has actively championed and participated in the development of voluntary, consensus-based standards to meet the needs of Canadian PSOs, paramedics, and communities. However, as the role of paramedicine in Canada continues to expand, there is a need to assess the current standards landscape and develop a roadmap to meet the needs of stakeholders.

1.2 Research Question

The following research question guided this work: What developments have occurred since 2014 related to paramedic service operations that would help to inform future paramedic standards and research activities in Canada?

1.3 Goals

The goal of this report is to provide a roadmap to advance the standards environment from the limited number of existing standards and guidelines available for paramedic services in Canada today to address the current and future needs of the Canadian paramedic community. The report outlines an organizing framework of seven domains and a number of sub-domains that form the basis for the research and analysis undertaken.

1.4 Objectives

This research report aims to:

- Understand and outline the peer-reviewed and grey literature, standards, and guidelines related to developments in paramedicine in Canada; and
- Explore the potential role these developments may have in informing future standards activities in paramedicine.

2 Methods

To address the research questions, a restricted literature review and a review of standards and guidelines focused on Canadian paramedicine contexts was conducted, followed by a stakeholder survey to gain feedback on the proposed framework.

The framework was informed by the framework published in the Canadian Paramedic Services Standards Roadmap [1]. The framework was then iteratively and inductively shaped by the findings of the literature review, standards review, and Project Advisory Panel feedback.

The seven domains of the framework are outlined below with a brief explanation for each:

- **Equipment** – Equipment used by paramedics and PSOs in the conduct of operations, including ambulances, personal protective equipment, patient handling equipment, and point-of-care testing (POCT) equipment.
- **Paramedic Service Operations** – Operational considerations in the delivery of paramedic services, including resource management (e.g., offload delays, staffing, key performance indicators, metrics), infection prevention and control, triage systems, and driver competency.
- **Communications** – Traditional and emerging forms of paramedic service communications, including call-taking and dispatch, social media, and radio communications.
- **Management Systems and Program Development** – Systems for the management of personnel and quality in paramedic services delivery, including quality management, paramedic health and well-being, patient safety, and human factors.
- **Practice Settings and Specialty Models of Care** – The contexts and settings in which paramedic services are delivered, including traditional 911 response, primary and community care (including low-acuity and care at home), public health, and other specialty settings.
- **Education, Research, and Data Management** – The educational needs and structures for initial and continuing education of paramedics, including competency standards, assessment guidance, career pathways, and educator requirements. This also includes research management in paramedic services, including methods, data collection and sharing, research priorities, and patient and public engagement.
- **Emergency Management** – The role and operational considerations of paramedic services in response to large-scale disasters and mass casualty events, such as chemical, biological, radiological, and nuclear events (CBRNE), mass gatherings, pandemics, and public health crises (e.g., opioid crisis), including incident command and business continuity.

2.1 Literature and Standards Review

A restricted literature review was conducted [2]–[4] focused on Canadian paramedicine literature published from 2011 to present. Restricted review recommendations used in this study included date restrictions, context restrictions, database limits, single reviewer data extraction, and narrative synthesis. Databases searched included CINAHL, MEDLINE, and EMBASE. Grey literature searches were conducted with guidance from the Canadian Agency for Drugs and Technologies in Health (CADTH) Grey Matters toolkit [5] on multiple organizational websites (including CSA Group, the Public Health Agency of Canada, Health Canada, Canadian Institute for Health Information, Paramedic Association of Canada and CADTH), Google Scholar [6], and Google web. In addition, a manual review of *Canadian Paramedicine* magazine issues from 2014 to 2022 was conducted. The search terms included terms to describe paramedicine and paramedic service delivery (e.g., paramedic, EMT, EMS) [7], combined with terms used to describe the Canadian context (e.g., Canada, Canadian). Subject headings were used where appropriate, and keywords and subject headings were adapted as required for individual databases.

Articles of all types that discussed paramedicine in Canada were included, with news reports and media updates excluded during grey literature searches. Studies in both English and French were included.

A standards search was conducted through searches of standards bodies' websites and standards distribution channels to identify international standards, regional standards (e.g., European norms), and national standards relevant to paramedicine. These included, but were not limited to, the following:

- International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) (international standards bodies);
- European Committee for Standardization (CEN) (European standards body);
- British Standards Institute (BSI);
- Standards development organizations and certification organizations accredited by the American National Standards Institute (ANSI);
- Standards development organizations and certification organizations accredited by the Standards Council of Canada (SCC);
- Standards Australia; and
- Standards New Zealand.

A scan of best practice guidelines was conducted through searches of websites of professional and industry associations, relevant United Nations agencies, national and regional government agencies, health system organizations, and related non-governmental organizations. A deductive content analysis informed by the framework domains, followed by a narrative synthesis of each source, was conducted. This review is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Statement [8].

2.2 Stakeholder Survey

The second part of the research project engaged stakeholders representing various aspects of paramedicine across Canada. An anonymous online survey was conducted via Google Forms. The survey was distributed to members of the Paramedic Association of Canada and the Paramedic Chiefs of Canada. Respondents were asked two non-identifying demographic questions (role and geographical location) and then asked to rank items identified via the literature and standards review for each domain in order of importance on a five-point Likert scale. In addition, free-text responses were sought to identify additional suggestions for standards development, research, and additional stakeholders to engage in the development process, as well as to solicit feedback on the perceived utility of existing standards. A copy of the questions is provided in Appendix A.

2.3 Ethics Approval

The literature and standards review involved published and publicly accessible literature and did not require ethics approval. The stakeholder engagement exercise received ethics approval from the Research Ethics Board at Fanshawe College in Ontario (#22-05-19-2).



“A final total of 302 studies and reports (216 peer-reviewed articles and 86 grey literature items), 81 standards, and 49 best practice guidelines informed the creation of this report.”

2.4 Limitations

The restricted review methodology may not have captured all literature related to paramedicine in Canada. In addition, due to variations in terminology used by organizations, all relevant standards and guidelines may not have been identified. This limitation would also prevent end-users from identifying and using such information.

3 Results and Discussion

3.1 Literature Review

The search strategy identified 13,537 studies. After removing 2,711 duplicates, 10,826 studies were screened, resulting in the exclusion of 10,399 studies that did not answer the research questions. The remaining 427 studies underwent full-text review, during which a further 117 were excluded. A final total of 302 studies and reports (216 peer-reviewed articles and 86 grey literature items), 81 standards, and 49 best practice guidelines informed the creation of this report (See Figure 1 and Table 1). Articles were published between January 2011 and April 2022.

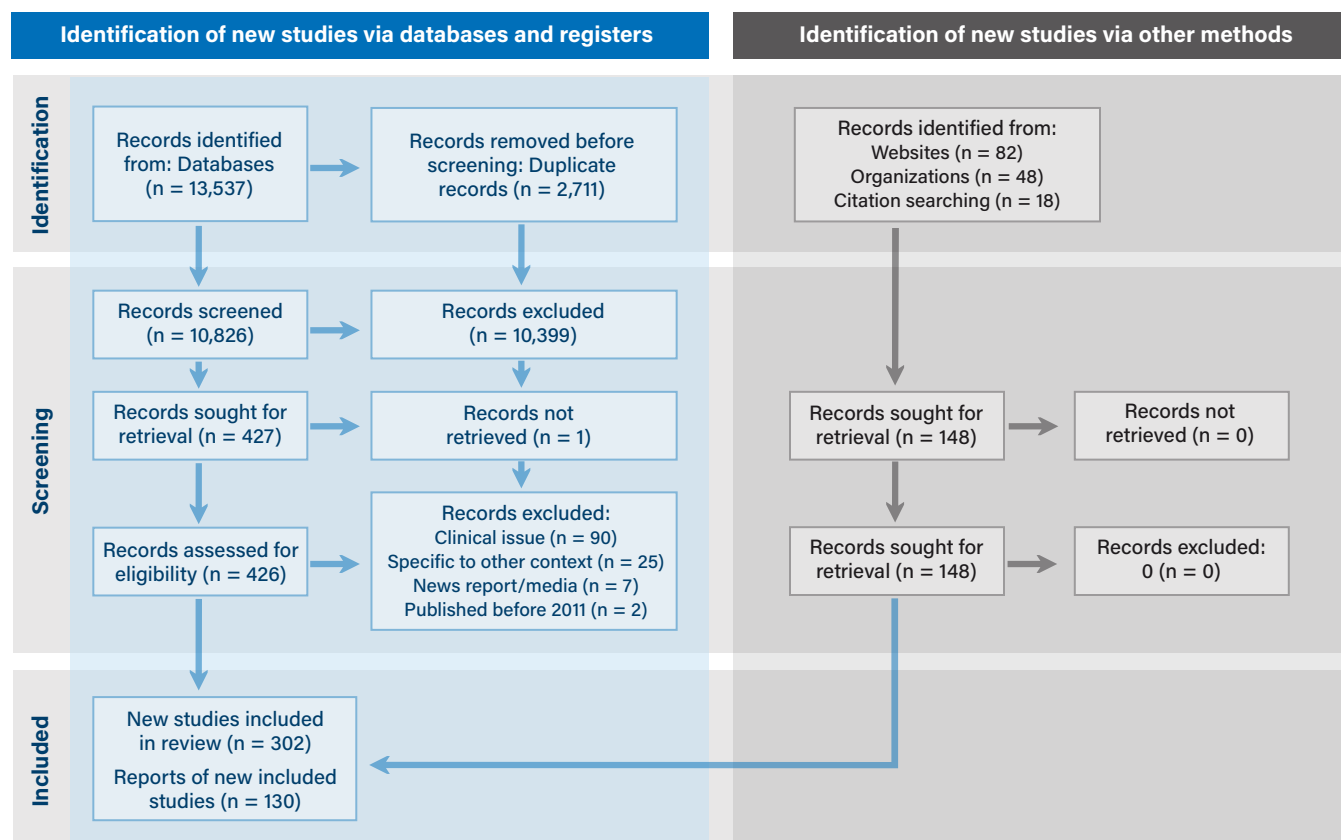
3.2 Stakeholder Engagement

A total of 31 responses were received over a three-week period in June 2022, with respondents indicating they worked in managerial roles (n=19, 61%), education roles (n=3, 10%), regulatory roles (n=2, 6%), research and quality improvement

roles (n=3, 10%), and other roles (n=4, 13%). Most responses were from Alberta (n=14, 45%), followed by Ontario (n=7, 23%), Saskatchewan (n=5, 16%), Manitoba (n=4, 13%), and New Brunswick (n=1, 3%). No responses were received from British Columbia, Quebec, Nova Scotia, Prince Edward Island, Newfoundland and Labrador, or the territories.

3.3 Domain 1: Equipment

Since 2014, a number of studies have explored point-of-care testing (POCT). This is testing, such as ultrasound and blood testing, that is performed near or at the patient's site, with the result leading to possible change in patient care [9]. Results indicate that POCT is beneficial to patient outcomes and helpful in supporting interventions [10], [11]. While use of POCT by PSOs varies considerably across jurisdictions, it is anticipated that it will increase with the expansion of community paramedicine programs and technical advances in POCT equipment and systems. Standardized practices and guidelines in this area could help support consistency across providers and programs [12], including when and how the use of equipment is appropriate. Survey respondents also suggested a gap in standards focused on device evaluation and maintenance, as well as personnel training requirements to integrate POCT in PSOs in Canada. A number of international standards related to POCT exist, such as ISO 22870 and ISO/TS 22583 [9], [13], and they should be considered for adoption or amendment to inform POCT standards for PSOs.

Figure 1: PRISMA Flow Diagram**Table 1: Search Results per Domain**

Total articles (n=432)	Literature review	Standards review	Best practice guidelines
Domain	302*	81	49
Equipment	24	19	6
Paramedic Service Operations	32	9	10
Communications	3	8	3
Management Systems and Program Development	96	14	5
Practice Settings and Specialty Models of Care	124	8	8
Education, Research, and Data Management	66	16	6
Emergency Management	11	7	11

*Note: Some articles addressed more than one domain; therefore, the sum of this column exceeds 302

Technological advancements have resulted in first responders using remotely piloted aircraft systems (RPAS)—or drones. Studies suggest RPAS are useful for responding to mass casualty incidents [14], as well as delivering automated external defibrillators (AEDs) to remote communities [15], [16]. Standards and guidelines on the use of drones by public safety or emergency service organizations have been developed in recent years to meet the increasing use of this equipment. For example, CSA EXP15 [17] and NFPA 2400 [18] provide requirements for the operation, deployment, and implementation of drones by all public safety agencies, while ASTM F3379 establishes minimum training requirements for drone pilots in the public safety arena who work remotely [19]. Survey respondents suggested that while the use of RPAS was still in its infancy, continued use may highlight areas for future standards development or guidance for standards adaptation specific to PSOs.

Transport equipment may be the least examined area in the last decade of paramedicine research. Although specialty transport units, such as specialist neonatal transport units, have been researched [20], it appears that most of the focus has been on improving technology for ergonomic patient handling and ergonomic ambulance design. For example, in the area of ambulance design and equipment, CSA D500:20 [21] is a standard that provides guidance on ergonomic design principles for ambulances to help prevent occupational injuries and illnesses and maximize the ability of paramedics to provide safe and effective patient care. It also includes guidance on infection prevention and control in ambulances. Survey respondents suggested that the layout and ergonomics of ambulances are areas for future standards development, highlighting the need to further inform the paramedic community of CSA D500. BNQ 1013 -110 [22] outlines requirements for the design and construction of ambulances, including chassis, interior layout, doors and windows, and warning signals. BNQ 1013-110 is used as the basis of a supporting certification program for ground ambulances in Canada. However, according to the BNQ website, only one manufacturer is participating in this program [22]. An opportunity exists within Canada to develop and/or consolidate standards related to

ambulance design (e.g., ergonomics, layout, warning signals, environmental impacts) into one portfolio of standards. For example, EN 1789 represents the current European standard for the design of ambulances. This standard is intended to gradually transform the existing “patchwork” of ambulance design and equipment across Europe into a single set of standards [23].

Efforts to consolidate standards related to broader PSO activities are also underway in the United States. In 2019, the National Fire Protection Association (NFPA) outlined a consolidation plan for the emergency response and responder safety (ERRS) standards to address stakeholder concern about the efficiency of the process and the need to better coordinate and streamline the documents [24]. The new standards consolidated by topics will include all NFPA standards that cover ERRS equipment, operational concerns, professional qualifications for responders, and the care, selection, and maintenance of PPE, as well as various guides and best practices.

Survey respondents suggested other areas that present opportunities for standards development, including equipment user interfaces (e.g., consistency of interfaces across monitors, defibrillators, ventilators, and e-PCR software), virtual health delivery platforms, and PSO-specific requirements for PPE.

3.4 Domain 2: Paramedic Service Operations

The increased number of 911 calls received by PSOs requires systems for managing the calls [25], and result in paramedics across Canada now routinely facing prolonged wait times with patients on arrival at emergency departments (ED). While poorly described in the literature, this wait time is commonly referred to in the paramedic community as “offload delay” or “ramping”, and it has been magnified over the last decade [26]. This delay in handover to ED staff has resulted in critical ambulance shortages in cities across North America, Europe, and Australasia. This phenomenon can see paramedics waiting anywhere from hours to days with patients in the ED, and some of the patients are never transferred to an ED bed or admitted to the hospital. The resource implications of these delays are placing severe pressure on

PSOs, and result in situations where there are no ambulances available in a given jurisdiction or prolonged responses times where ambulances must travel from elsewhere in a jurisdiction or province to attend a 911 call. This phenomenon also places patient safety at risk from several perspectives: delayed responses to life-threatening calls; prolonged duration on transport stretchers; out-of-scope procedures and medications initiated by physicians and nurses while patients are under paramedic care; and the sharing of personal and private health information in the hallways and public areas of ED. This resource management issue represents an area requiring urgent attention, and there is a need for a pan-Canadian effort to guide PSOs on this issue.

Community paramedicine programs may be one solution to reducing call volumes and delays in appropriate care [27] by scheduling calls with high-frequency callers and reducing inappropriate transports, and may be supplemented by paramedic-initiated referral and/or transport to urgent care centres for low-acuity calls [28], [29]. A standardized prehospital triage system would also help guide paramedics when they are making decisions about transporting or referring patients to other avenues that may be more appropriate for their situation. While the Canadian Triage Acuity Scale exists, it was designed for ED use and, as such, it presents challenges to paramedics when it is used in the prehospital context [30], [31]. An opportunity exists for standards development in PSO resource management, addressing issues such as reducing offload delays, call acuity management, triage approaches, and staffing requirements. Survey respondents indicated the urgent need for such a standard given the unclear nature of who is ultimately responsible for patient safety and well-being in the context of “hallway medicine” (i.e., patients still on ambulance stretchers but in hospital hallways awaiting handover to ED staff).

Infection prevention and control (IPAC) was previously identified as a priority area for research and standards development [1], and several efforts have focused on this area. However, there is an observable lack of published research conducted within Canadian paramedicine on IPAC understanding and compliance. A 2018 CSA Group research report on IPAC in

ambulances informed the development of guidance in CSA D500:20 [32]. In addition, best practice guidance for IPAC in emergency vehicles was developed by Infection Prevention and Control Canada (IPAC Canada) [33]. Survey respondents indicated there was confusion during COVID-19 about the IPAC guidelines to meet PSO, regulatory, health service, and provincial requirements, which were at times contradictory. An opportunity exists to develop a pan-Canadian standards portfolio for IPAC requirements for personnel training, hand hygiene practices, ambulance and equipment, walk and drive-through testing sites, and pandemics. Existing standards, such as CSA D500:20 [21], ISO 5258 [34], and ISO 5472 [35], may provide foundational guidance within such a portfolio.

Driving competency is another area of operations that requires attention, as the paramedic role includes not only clinical management of patients but often the transport of patients to hospitals or other receiving destinations. Driving under emergency conditions requires advanced driving skills due to urgency and stressful situations [36], [37]. In 2018, the Road Safety Authority (RSA) in Ireland published the Emergency Services Driving Standard to address the risk of driving vehicles under emergency conditions and to improve safety for drivers, the public, and passengers [38]. It provides guidance on laws, control in traffic, risk evasion, and driving in a professional context. The standard has been used to inform education and training activities for paramedics and others who drive vehicles in emergency settings in Ireland. Survey respondents indicated that there is an urgent need for a pan-Canadian driver competency standard, which could in turn inform standardized driver training in Canada.

Survey respondents suggested other areas for standards development, including the creation of a suite of pan-Canadian foundational clinical standards and standardized medication administration options (e.g., dose, route, presentation) across Canada to allow for increased interoperability and cross-jurisdictional support. Such a suite would aim to remove the multiple intra- and interprovincial variations in practice that pose a barrier to such cross-jurisdictional support. This would also facilitate easier interprovincial movement of personnel to address health human resources issues.



“As population growth in Canada continues to increase, so does the demand on existing 911 systems.”

3.5 Domain 3: Communications

As population growth in Canada continues to increase, so does the demand on existing 911 systems. One factor that impacts this situation is the use of services by “frequent callers.” The frequent use of paramedic services by this subgroup of patients leads to the inappropriate allocation of already limited resources and increases the burden on health and social care systems at large [39], [40]. These calls most commonly stem from patients with chronic health conditions, mental health issues, mobility issues, non-injurious falls, and social isolation [40]. Further, perceptions about the purpose of paramedic services, as well as a patient’s individual social circumstances (e.g., access to health care services, cost of services), contribute to the evolution of complex health issues that lead to frequent use of 911 services. As a result, some PSOs have implemented “secondary triage” systems, whereby callers are passed to an experienced clinician after speaking to the initial 911 operator. That clinician asks an additional series of questions to determine acuity and severity, which, in turn, informs care decisions [41]. Other PSOs have implemented criteria-based dispatching solutions (e.g., triage to identify priority cases based on certain criteria) to determine appropriate resource use; however, their implementation is inconsistent across Canada and within provinces. A pan-Canadian approach to dispatch and secondary triage would facilitate the sharing of best practices and improve service delivery.

As with all aspects of modern society, social media use has impacted PSOs in several ways. It is a

medium for sharing information with the public and staff and an avenue for public feedback. While no standards specific to the use of social media by PSOs have been developed (e.g., guidance related to the sharing of images from scenes, discussion of cases), ISO 22329:2021 was recently published to guide the use of social media as part of emergency management practices [42]. In addition, regulators such as the College of Paramedics of Nova Scotia have published best practice guidelines on the use of social media [43]. Such guidance focuses on the use of appropriate language and the protection of patient information. Survey respondents suggested that pan-Canadian guidance on the use of social media by PSOs and paramedics as a public education tool would be welcomed.

While no literature or standards were identified on radio communications pertaining to PSOs, survey respondents suggested the need for a pan-Canadian or interprovincial radio communications standard. This would support increased interoperability and facilitate cross-jurisdictional support during major emergencies or disasters.

3.6 Domain 4: Management Systems and Program Development

Paramedics work in a physically and mentally demanding environment, which can inevitably affect their well-being, morale, and retention. The literature suggests that preventive and educational programs may be key to managing occupational stress and mental health. Structured debriefing programs

with peers and management [44], as well as online educational tools for stress management [45], are some of the methods used to mitigate the mental burden of the profession. Both PSOs and paramedics need to respond in a proactive manner [46], and recent literature may inform guidance or updates to standards that are effective and that help prepare PSOs to support paramedics for the demands of their career [47]. Fatigue is another factor that can affect a paramedic's mental state. Sleep disturbances are common [48], and can cause paramedics to be three to seven times more likely to develop a mental disorder than the general population. In recent years in Canada, there has been significant standards development work related to worker well-being in high-priority areas for paramedics, such as mental health, work disability, and fatigue, as addressed in CSA Z1003.1, CSA Z1011.1, and CSA Z1615, respectively [49]–[51].

While working as a paramedic can affect an individual's mental well-being, it is also a very physically demanding career. Over 50% of paramedics reported chronic pain and indicated that the pain was associated with an injury related to active duty [52]. The literature demonstrates that paramedic work is a mix of prolonged sedentary time interspersed with bouts of high physical demand exposures [53]. Shift work can negatively impact one's health and, as such, paramedic service leadership must have the tools to help paramedics make healthy eating choices and make physical fitness a priority [54]. Mechanical interventions, such as power stretchers, help to prevent injuries and should be made available by PSOs; however, the profession may also benefit from a pan-Canadian paramedic fitness standard [55]. This was also highlighted by survey respondents, who suggested that fitness standards were a priority, as was the need for guidance on standardized pre-employment screening of applicants (e.g., physical and mental health) to inform individualized physical and mental health support for paramedics by PSOs. A holistic perspective on these issues may provide additional benefit, such as through the consolidation of standards or the creation of a suite of standards related to health and well-being.

Patient and provider safety in paramedicine requires a renewed focus and may benefit from further research. The paramedic community would benefit from a better understanding of the multitude of

patient safety issues that occur in the paramedic system and during paramedic care. In addition, research illustrates a high proportion of fear-based barriers to self-reporting patient safety incidents [56]. The paramedic community may benefit from the development of standards to guide the establishment and implementation of comprehensive patient safety programs in PSOs, including guidance on reporting incidents and conducting investigations. In addition, the issue of violence against paramedics is increasing, with the majority of paramedics having experienced some form of violence [57]. Many of these incidents go unreported to management and/or police. Guidance related to violent incident management, universal reporting requirements (to improve understanding of the issue), and evidence-based mitigation strategies may be beneficial for the paramedic community.

Finally, the literature related to this domain highlighted issues around inclusivity, diversity, equity, and accessibility' (IDEA). The last decade has seen increased inclusion of women in the paramedic profession [58]. Despite these advances, women continue to be under-represented in leadership roles [59], [60]. There is an onus on those in senior leadership roles to reduce bias [61], [62], and the same onus is applicable to anti-racism work in paramedicine [63]. In addition, considerations of disability are rarely discussed in paramedicine [64]; however, CSA Z1011.1 [50] can be used by PSOs to address the health needs of workers in order to prevent and/or manage work disability. Additional research is needed in all areas of paramedicine surrounding IDEA, and the paramedic community may benefit from guidance in the areas of disability management, inclusive hiring and personnel practices, and leadership development for under-represented groups. Survey respondents strongly agreed with the need for initiatives focused on IDEA in paramedicine.

3.7 Domain 5: Practice Settings and Specialty Models of Care

3.7.1 Community Care, Primary Care, and Public Health

Successful community paramedicine programs are integrated with health, aged care, and social services, and benefit from strong clinical governance and

paramedic leadership. Standardization of assessment and reporting procedures was recommended to improve integration of paramedic-delivered care with other community-based and primary care services and to reduce inconsistencies in care planning and resources across the services.[65], [66]. Proactive (i.e., scheduled care) and reactive (i.e., unscheduled care) models of community paramedicine were described, many targeted at reducing 911 calls. In addition, the creation of low-acuity pathways, the provision of paramedic care in the home and residential settings, and community care of marginalized populations, such as mental health crises, were described in the literature. Studies reported that paramedics have an important and meaningful role to play in caring for the palliative care population, and paramedics themselves describe palliative care as rewarding. Patient and family satisfaction with paramedic-provided palliative care appears high and provides patients with peace of mind [67]–[71]. Health Standards Organization has updated the CAN/HSO 13001 palliative care standard [72], which, while not specific to paramedic services, may provide additional guidance for PSOs. Aside from this resource, there remains an opportunity to guide PSOs on integrating with palliative care services and implementing palliative care initiatives within 911 and community paramedicine models.

Considerable standards development work on the expanded role of community paramedicine has occurred in Canada and other countries in recent years. For example, with the support of various agencies and the paramedic community, the CSA Group led the development of the CAN/CSA-Z1630 standard that provides guidance for community care program development [73]. In addition, CSA Group published a research report that outlines lessons learned from community paramedicine programs during the COVID-19 pandemic [74]. The report highlights the ability of paramedic services to collaborate in the delivery of public health, including conducting mass testing, home visits, and vaccination clinics, and providing equitable health care access to remote and isolated communities. In the United States, the NFPA and the Commission on Accreditation of Medical Transport Systems (CAMTS) have developed new standards for community paramedic and mobile integrated health care programs [75], [76].

Paramedics have a role to play in addressing the health care needs of a number of marginalized populations, such as those experiencing homelessness, older adults, and those experiencing intimate partner violence [77]–[81]. However, there is a lack of engagement in the literature with the health and social needs of vulnerable and marginalized populations. In response, the need for revised curriculum to prepare paramedics for emerging roles in community care, primary care, and public health was highlighted [82]–[84]. The reporting of education requirements for paramedics in such settings represents a significant gap in the literature. Similarly, evidence-based guidance on community needs assessments for developing community paramedicine programs is also scarce. As such, an opportunity exists for pan-Canadian guidance on education requirements for specialty areas of practice and community needs assessments.

3.7.2 Critical Care and Interfacility Transport

The literature in the critical care and interfacility transport domain is largely focused on the introduction of new technology or new clinical programs into paramedicine practice, such as prehospital blood transfusion and prehospital ultrasound [11], [85]–[87]. In addition, articles highlighted the need for and importance of improved communication between paramedics and transport medicine physicians in critical care and interfacility transport (IFT) settings during transport [88], [89]. There is a lack of formal standards development work in Canada related to critical care or IFT operations. Accreditation Canada has published the EMS and Inter-facility Transport accreditation standard that addresses air and ground ambulance services, interfacility transport (emergent and non-emergent), and communication services (emergency call taking and ambulance dispatch). This standard may provide some guidance to PSOs [90].

3.7.3 Care of Indigenous Communities

Patient transportation, especially emergency air evacuations, is an essential component of the health care system serving Canada's northern and isolated communities [91]. PSOs that provide air ambulance services help to improve access to care for remote Indigenous communities whose citizens face stark

inequities in access to emergency services [92]. In addition, the literature provides insight into first response education programs in isolated and resource-poor settings as a key component of delivering timely care to these communities [93]. Paramedics are ideally positioned to improve Canadians' access to health care through programs such as community paramedicine or virtual health, including Indigenous communities that may be remote or isolated [94]–[97]. Opportunities exist to develop guidance for alternative paramedic system designs in remote and isolated Indigenous communities (e.g., integrating PSO-trained community responders with the existing 911 and community resources) and standards for service delivery, including culturally appropriate outcome measures (i.e., patient-oriented outcomes) and cultural competency when caring for members of Indigenous communities. Such guidance must be developed in collaboration with rightsholders from Indigenous communities and PSOs with experience in delivering care to remote and isolated Indigenous communities.

3.7.4 Mental Health and Substance Use

The findings from the literature in the mental health and substance use specialty area of practice support the need for enhanced training and education for paramedics in a variety of areas, including social determinants of health; scenario training; practicum placements in mental health or social services; collaboration with mental health and social services; and the importance of working conditions for both care providers and care recipients [84], [98], [99].

Paramedics' role in caring for patients with substance use disorders and overdose experience is not extensively examined. Despite this, paramedic response data can potentially serve as a novel source of information for event surveillance, such as those related to overdoses, providing near real-time epidemiological information (person, time and place) on the overdose epidemic and assessing trends and opportunities to develop alert triggers [100]. In addition, prehospital events and circumstances surrounding overdoses provide unique opportunities to collect evidence that can contribute to prevention, harm reduction, and health promotion efforts [101].

Joint response by paramedic services and police at overdose events was reported to increase hesitancy to call 911, indicating the need for further consideration of the value of police response to routine, non-fatal overdose calls [102], [103]. CSA Group led the development of the CSA Z1650 Standard [104], which provides guidance to PSOs on a coordinated response to overdose events, including education, training, and service delivery considerations.

The literature related to paramedic response to mental health crisis calls also highlighted several gaps related to education, service design and delivery, and interprofessional practice [84], [99]. However, no widely adopted standards for paramedic practice in relation to mental health crisis calls were identified in Canada or elsewhere. There remains an opportunity to develop guidance for the paramedic community on the appropriate response to mental health calls, including education guidance, training standards, novel service delivery models, and the importance of lived experiences in informing policy decisions [98]. PSOs should seek to engage with ongoing efforts to provide training and education to support responders [105]. Similar to the substance use findings described above, there needs to be further consideration of the value that police response adds to mental health calls and more appropriate models of service delivery may be identified [106].

3.7.5 Virtual Care and Telehealth

Telemedicine has emerged as an alternative mode of care for patients who have limited access to in-person health care consultations. The benefits of teleconsultation include reduced costs for both the patient and the health system, particularly for patients in rural communities [107], [108]. Telemedicine appears most worthwhile where there is “value added” for the patient, meaning the 911 caller is getting the right care, when they need it, in their home, reducing the burden on them to seek care. Survey respondents also agreed with the potential value of telemedicine use for low-acuity calls, thereby reducing 911 demand and preventing unnecessary transport. Health Standards Organization/ Accreditation Canada has published standards and

supporting toolkits on virtual health (CAN/HSO 83001) and integrated health care systems (CAN/HSO 76000) [109], [110], which, while not specific to paramedics, could provide general guidance for PSOs.

Virtual care delivery by paramedics increased dramatically in response to COVID-19 restrictions, and much of the literature discussing the topic is in the context of the pandemic. Paramedics had positive perceptions of delivering virtual care while improving patient safety and their own knowledge. Paramedics who facilitated physician-delivered teleconsultations, by contrast, reported a tension in the relationship between paramedics and physicians, as well as a lack of understanding of the prehospital context that had an impact on patient care [108]. Existing guidance in this area that may be useful in informing or developing a standard for PSOs in Canada includes CAN/HSO 83001 at an organizational level [110], the College of Physicians & Surgeons of Alberta's *Standard of Practice for Virtual Care (reissued 2022)* [111], and the College of Physicians and Surgeons of British Columbia's *Standard of Practice – Virtual Care (revised 2022)* [112] at the individual level. Future developments should seek to explore and inform the role of paramedics as “virtual-care extenders” of physicians in primary care settings.

3.8 Domain 6: Education, Research, and Data Management

Paramedic education is challenged in needing to constantly develop content that is not only evidence-based but that also reflects contemporary contexts of practice. Relative to other professions, paramedicine has evolved rapidly [113], [114]. As the paramedic role evolves, there is an urgent need for an expanded curriculum that addresses health and social service education, social determinants of health, acute and chronic mental health, chronic disease management, wound care, and geriatric emergency management, and that understands both community and sociology [115]. A closer match between curriculum and the emerging roles of paramedics is needed if paramedics are to realize their true value as members of multidisciplinary health care teams. However, defining competencies and providing curriculum guidance is challenging, and the optimal approach to do so in

health professions remains largely unknown [83]. The National Occupational Competency Profile (NOCP) lacks the competencies required for contemporary paramedic practice [116]. The current revision of the NOCP through the development of CSA Z1660 will identify and describe the competencies required of paramedics across Canada in all contexts and settings of practice [117]. This will subsequently inform the development of revised curriculum guidance.

Contemporary paramedic education approaches include simulation-based learning and distance or hybrid learning programs. Simulation-based learning is important, especially for rural health providers who may have less exposure to a variety of emergency scenarios [118]. Learning in professionally distant contexts has also become a more widely recognized and adopted practice [119]. In addition, paramedic leadership development should begin during formal education as part of the core curriculum [120]. This is because paramedic work is largely independent, without direct oversight or management. It should be noted that, although informally enacted, paramedics unanimously view leadership as an important competency for clinical practice. Paramedic students should be introduced to mentorship early, as mentors facilitate professional and personal growth and create ample opportunities for synergistic and universal learning [121].

The revised NOCP will also inform a career framework that enables career growth and job prospects for paramedics. For example, the use of advanced care paramedics (ACPs) in emergency departments improves patient flow and offers a viable alternative to traditional physician-centred emergency care for low-acuity patients [122], [123]. Paramedic-integrated models have been trialed in general practice, and transition into these non-contemporary roles is feasible but requires further training and enhanced education. Evolving contexts and constructs of practice are resulting in boundaries that may require the profession to rethink how it is defined. Six roles of a paramedic have been proposed: clinician, health and social advocate, team member, educator, professional, and reflective practitioner [124]. These roles suggest a rethinking of what it means to be a paramedic and align more closely with other health



“COVID-19 highlighted the importance of the role of health care providers, and paramedics and their organizational leadership were no exception.”

care professions instead of with other first responders. As such, the paramedic community would benefit from standards development or further research on the design and implementation of education programs, including educator requirements, evidence-based curriculum design, mentorship implementation, and assessment strategies. Survey respondents indicated that guidance on educator and preceptor requirements and qualifications was a priority.

As the profession continues to advance and be redefined, priority should be placed on continued engagement with research and the development of research capacity within the profession. Future efforts should be focused on engaging patients with research, which can be challenging due to the sometimes brief interaction between paramedic and patient [125]. In addition, the paramedic community should prioritize the development of a contemporary research agenda to ensure research is focused on the needs of the community and the diverse stakeholders who are involved. PSOs represent a novel, yet underutilized, data source for monitoring public health events, such as the overdose epidemic [100]. For example, data collected from reports on paramedic-attended overdoses predicted the arrival of fentanyl in advance of media reports [100]. In the United States, the National Emergency Medical Services Information System (NEMSIS) [126] database outlines data elements that can be implemented by an EMS system and provides a framework for collecting, storing, and sharing standardized data, facilitating the

transfer of data between systems. A similar initiative has occurred in Canada with the development of CSA Z1635, which outlines the elements of a pan-Canadian information standard for paramedic services and the paramedic community [127]. Further awareness of and engagement with this standard by PSOs, researchers, and other stakeholders is required to begin the process of creating a pan-Canadian framework for collecting, storing, and sharing data.

3.9 Domain 7: Emergency Management

COVID-19 highlighted the importance of the role of health care providers, and paramedics and their organizational leadership were no exception [128]. In a 2015 study, paramedics reported low levels of confidence in organizational pandemic planning, yet this did not impact their willingness to report to work during a pandemic [129]. While there is little published literature related to paramedicine in Canada and COVID-19, the paramedic community's response to COVID-19 should be an area of ongoing research focus to aid in future pandemic planning. In response to COVID-19, ISO published a publicly available specification of safe working during the pandemic: ISO/PAS 45005 [130]. While not specific to the paramedic workplace, it provides generic guidance for this specific emergency. COVID-19 has also spurred the development and publication of several guides and toolkits that address emergency medical care and that could be applied by PSOs to assist with pandemic planning, response, and recovery. The development of the guidance has

primarily come from public health organizations. These include the Assistant Secretary for Preparedness and Response (ASPR – US) – *COVID-19 Healthcare Planning Checklist* [131], Public Health England – *COVID-19 – Guidance for Ambulance Trusts* [132], and the Pan American Health Organization's *Prehospital Emergency Medical Services (EMS) COVID-19 Recommendations* [133]. There is an opportunity to develop a consolidated suite of pandemic preparation, planning, and response standards and guidelines for use by PSOs in Canada. In addition, the development of interoperability standards between PSOs, health authorities, public health bodies, and others involved in pandemic response should be considered.

Several recent heat events in Canada, where excessive temperatures were recorded for prolonged periods, have led to pause and reflection on the way PSOs respond to the increased number of calls resulting from extremes in temperature. For every degree Celsius of temperature rise, there is a 32% increase in the number of ambulance calls [134]. Despite the implications of such increased demand, there is a gap in the literature pertaining to climate change and PSO response, despite awareness in other areas of health care [135], [136]. There is an observable lack of awareness of future implications of increased service and personnel demands related to adverse weather events, such as wildfires, heatwaves, and storms. As temperatures continue to rise and adverse weather events become more common, there should be an emphasis on preparing PSOs and paramedics for climate change-related emergencies. Improved access to health care for those living in climate-affected rural and remote locations like the Canadian Arctic also needs to be prioritized. Despite the implications for PSO service delivery in Canada, climate change was not considered a priority by survey respondents. One respondent suggested that any focus on this area by paramedics merely represented “woke blathering.” These types of responses may be partly explained by a lack of engagement with (and understanding of) the potential and future impacts of climate change on PSOs. Development of standards for climate change-related management in PSOs is recommended, with a focus on triage during large-scale weather events, modifications to service delivery models, personnel safety, and initiatives to reduce the impacts of large vehicle fleets.

4 Summary

The following opportunities are described in greater detail in earlier sections of this report. This summary can be used to inform discussions about the priority of topics related to standards development or research focus within the paramedic community in Canada.

4.1 Domain 1: Equipment

- Adopt, develop, or adapt standards for POCT in PSOs to inform consistency in equipment use, including when and how the use of equipment is appropriate, device evaluation, maintenance, and personnel training requirements to integrate POCT.
- Adopt, develop, adapt, and/or consolidate standards related to ambulance design (e.g., ergonomics, layout, warning signals, environmental impacts) into one portfolio.
- Adopt, develop, adapt, and/or consolidate standards related to equipment, PPE, qualifications, and operational concerns relevant to PSOs into one portfolio.
- Adopt, develop, or adapt standards for equipment user interfaces (e.g., monitors, defibrillators, ventilators, e-PCR software) and PSO use of virtual health delivery platforms.

4.2 Domain 2: Paramedic Service Operations

- Adopt, develop, or adapt a standard for PSO resource management, addressing issues such as resource management to reduce offload delays, call acuity management, triage approaches, and staffing requirements.
- Adopt, develop, adapt, and/or consolidate standards for IPAC, including personnel training, hand hygiene practices, ambulance and equipment considerations, walk and drive-through testing sites, and pandemic IPAC guidance into one portfolio.
- Develop a driver competency standard that could, in turn, inform standardized driver training in Canada. Consideration may be given to developing this standard as a public safety standard for drivers of all emergency vehicles.

- Develop a suite of pan-Canadian clinical practice guidelines and standardized medication administration options (e.g., dose, route, presentation) to allow for increased interoperability and cross-jurisdictional support.

4.3 Domain 3: Communications

- Develop a standard on dispatch and secondary triage to facilitate the sharing of best practices and improve service delivery.
- Adopt, develop, or adapt standards on virtual care and integrated health care systems pertaining to PSOs.
- Adopt, develop, or adapt guidance on the use of social media by PSOs related to its use as a public education tool.
- Develop a radio communications standard to support increased interoperability and facilitate cross-jurisdictional support during major emergencies or disasters.

4.4 Domain 4: Management Systems and Program Development

- Develop a personnel health standard, including guidance on pre-employment screening to inform the provision of individualized physical and mental health support to paramedics.
- Develop guidance related to violent incident management, universal reporting requirements (to improve understanding of the issue), and evidence-based mitigation strategies.
- Adopt and/or develop guidance in the areas of disability management, inclusive hiring practices, and leadership development for under-represented groups in PSOs.

4.5 Domain 5: Practice Settings and Specialty Models of Care

- Conduct research and develop guidance on education requirements and community needs assessments for paramedics in specialty contexts.

- Develop a consolidated suite of standards for critical care and interfacility transport operations. These may include transport, personnel requirements, air ambulance operations, communications, and other areas.
- Develop and assist other organizations with developing guidance for the paramedic community on the appropriate response to mental health calls, including education guidance, training standards, novel service delivery models, and the importance of lived experiences in informing policy decisions.
- Research and develop guidance in collaboration with Indigenous communities and PSOs for alternative system designs in remote and isolated communities (e.g., integrating community responders) and standards for service delivery, including culturally appropriate outcome measures and cultural competency when caring for members of Indigenous communities.
- Adopt, develop, or adapt a standard for PSOs that provides guidance on telehealth and virtual care program design and implementation. Future developments should seek to explore and inform the role of paramedics as “virtual-care extenders” of physicians in primary care settings.

4.6 Domain 6: Education, Research, and Data Management

- Develop standards and conduct further research on the design and implementation of education programs, including educator requirements, evidence-based curriculum design, mentorship implementation, and assessment strategies.
- Prioritize the development of a contemporary research agenda to ensure research is focused on the needs of the community and the diverse stakeholders who are involved.
- Promote further engagement with the CSA Z1635 Canadian paramedic information system standard by PSOs, researchers, and other stakeholders to begin the process of creating a pan-Canadian framework for collecting, storing, and sharing data.

4.7 Domain 7: Emergency Management

- Adopt, develop, adapt, and/or consolidate a suite of pandemic preparation, planning, and response standards and guidelines for use by PSOs across Canada.
- Develop interoperability standards between PSOs, health authorities, public health bodies, and others involved in pandemic response.
- Develop standards for climate change management in PSOs, with a focus on triage during large-scale weather events, modifications to current service delivery models, personnel safety, and initiatives to reduce the impacts of large vehicle fleets.

5 Conclusion

In the last decade, the paramedic profession in Canada has undergone a significant evolution in the professional scope of practice, contexts of paramedic practice, paramedic education, paramedic research, and relevant standards development. This report identifies several contemporary issues within Canadian paramedicine that have led to new standards work, research activities, and policy developments. The paramedic community in Canada can use the results and findings of this report to guide further development of the profession and standardization of activities across Canada. These activities include current priorities of service delivery, as well as forecasted areas that will impact the delivery of paramedic education, research, and operations.

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Appendix A – Survey Questions

1. Current Role – Please select **all options** that **best reflect** your current professional standing
 - a. Paramedic working in specialist role/setting (e.g., community paramedicine, special operations team)
 - b. Communications Officer (e.g., dispatcher)
 - c. Managerial role (e.g., supervisor, duty officer, commander, chief)
 - d. Educator role (e.g., faculty member, instructor, coordinator)
 - e. Researcher role (e.g., institution or service-based researcher)
 - f. Regulatory role (e.g., member of regulatory body committee)
 - g. Other (please provide details)
2. Please indicate your Province/Territory of Practice. We are only seeking feedback from respondents based in and working within Canadian paramedicine contexts.
 - a. Alberta
 - b. British Columbia
 - c. Manitoba
 - d. New Brunswick
 - e. Newfoundland and Labrador
 - f. Northwest Territories
 - g. Nova Scotia
 - h. Nunavut
 - i. Ontario
 - j. Prince Edward Island
 - k. Quebec
 - l. Saskatchewan
 - m. Yukon

Domain 1 – Equipment and Technology – equipment used by paramedics and paramedic services in the conduct of operations including ambulances, personal protective equipment, patient handling equipment, new and emerging technology, and near-patient testing equipment.

- The following topics have been identified as potential areas for national standards. In your opinion, how important would a national standard be for these topic areas?
 - a. Near patient testing equipment operations
 - b. Remote piloted aircraft system operations
 - c. Specialty transport operations
- Please provide brief details on any item you selected i.e., what specific issues for standardization need to be addressed.
- Are there any additional topics related to this domain of Equipment and Technology that would benefit from further research and/or standards development?

Domain 2 - Paramedic Service Operations – operational considerations in the delivery of paramedic services, including – management (e.g., staffing, flow, key performance indicators and metrics), infection prevention and control, triage systems, self-regulation of paramedics, and driver competency.

1. The following topics have been identified as potential areas for national standards. In your opinion, how important would a national standard be for these topic areas?
 - a. Operational standards similar to the NFPA standards in Fire
 - b. Paramedic resource management in hospital from arrival to clear (recognizing the specialized nature of this resource).
 - c. Infection prevention and control
 - d. Driving competency
 - e. Triage systems
2. Please provide brief details on any item you selected. i.e., what specific issues for standardization need to be addressed.
3. Are there any additional topics related to this domain of Paramedic Services Operation that would benefit from further research and/or standards development?

Domain 3 - Communications – traditional and emerging forms of paramedic service communications including call-taking and dispatch, social media, radio communications, video communications, and body-worn cameras.

1. The following topics have been identified as potential areas for national standards. In your opinion, how important would a national standard be for these topic areas?
 - a. Dispatch and telephone triage
 - b. Social media
 - c. Telemedicine and virtual visits
2. Please provide brief details on any item you selected. i.e., what specific issues for standardization need to be addressed.
3. Are there any additional topics related to this domain of Communications that would benefit from further research and/or standards development?

Domain 4 - Management Systems and Program Development – systems for the management of personnel and quality in paramedic services delivery, including quality management, paramedic health and well-being, patient safety, and human factors.

1. The following topics have been identified as potential areas for national standards. In your opinion, how important would a national standard be for these topic areas?
 - a. Fatigue
 - b. Shift work
 - c. Physical and mental health and fitness
 - d. Physical and mental health supports
 - e. Patient safety
 - f. Paramedic occupational health & safety
 - g. IDEA (Inclusion, Diversity, Equity and Access)

2. Please provide brief details on any item you selected. i.e., what specific issues for standardization need to be addressed.
3. Are there any additional topics related to this domain of Management Systems and Program Development that would benefit from further research and/or standards development?

Domain 5 – Practice Settings and Specialty Models of Care – the contexts and settings in which paramedic services are delivered, including traditional 911 response, community (including low-acuity, care at home) and primary care, public health and other specialty settings

1. The following topics have been identified as potential areas for national standards. In your opinion, how important would a national standard be for these topic areas?
 - a. Community care, primary care and public health (including long-term care at home, palliative care and other specialty contexts)
 - b. Community needs assessments
 - c. Critical care and interfacility transport
 - d. Care of Indigenous Communities
 - e. Mental health and substance use
 - f. Virtual care
2. Please provide brief details on any item you selected. i.e., what specific issues for standardization need to be addressed.
3. Are there any additional topics related to this domain of Practice Settings and Specialty Models of Care that would benefit from further research and/or standards development?

Domain 6 – Education, Research and Data Management – the educational needs and structures for initial and continuing education of paramedics, including competency standards, assessment guidance, career pathways, and educator requirements. Research management in paramedic services including methods, data collection and sharing, research priorities, and patient and public engagement.

1. The following topics have been identified as potential areas for national standards. In your opinion, how important would a national standard be for these topic areas?
 - a. Paramedic competencies and education
 - b. Educator requirements (preceptor to faculty)
 - c. Curriculum guidance/design
 - d. Non-technical skills (e.g., empathy)
 - e. Assessment
 - f. The use of simulation in paramedic education
 - g. Specialty education (e.g., community paramedicine)
 - h. Research guidance
 - i. Data management and sharing

2. Please provide brief details on any item you selected. i.e., what specific issues for standardization need to be addressed.
3. Are there any additional topics related to this domain of Education, Research and Data Management that would benefit from further research and/or standards development?

Domain 7 – Emergency Management – the role and operational considerations of paramedic services in response to large-scale disasters and mass casualty events, such as chemical, biological, radiological, and nuclear events (CBRNE), mass gatherings, pandemics, and public health crises (e.g., opioid crisis), including incident command and business continuity.

1. The following topics have been identified as potential areas for national standards. In your opinion, how important would a national standard be for these topic areas?
 - a. Pandemic planning
 - b. Interagency cooperation
 - c. Emergency Management education requirements
 - d. Incident Management System education requirements
 - e. Rural, remote and isolated settings emergency management
 - f. Climate change management
2. Please provide brief details on any item you selected. i.e., what specific issues for standardization need to be addressed.
3. Are there any additional topics related to this domain of Emergency Management that would benefit from further research and/or standards development?

Standards process feedback

- Do current standards meet industry needs or what improvements would you like to see?
- Does your organization currently use any paramedic standards?
 - a. If yes, please indicate which standards and your thoughts on them.
 - b. If no, please elaborate on why.
- What interest groups are currently missing from participation in standards development in your opinion?
- Would standards information be more useful in other formats such as guides, tools, written in a different way?
 - c. If yes, please provide some thoughts on what formats would be useful
- Do you have any other comments or suggestions?

CSA Group Research

In order to encourage the use of consensus-based standards solutions to promote safety and encourage innovation, CSA Group supports and conducts research in areas that address new or emerging industries, as well as topics and issues that impact a broad base of current and potential stakeholders. The output of our research programs will support the development of future standards solutions, provide interim guidance to industries on the development and adoption of new technologies, and help to demonstrate our on-going commitment to building a better, safer, more sustainable world.