

1 **Detection and Diagnosis of Sepsis in Rural and Remote**  
2 **Areas of Canada: an Environmental Scan**

3  
4 \*\*\*\*\*

5 The Canadian Agency for Drugs and Technologies in Health (CADTH) takes sole responsibility  
6 for the final form and content of this environmental scan. The statements and conclusions in this  
7 environmental scan are those of CADTH.

8 Production of this report is made possible by financial contributions from Health Canada and the  
9 governments of Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and  
10 Labrador, Northwest Territories, Nova Scotia, Nunavut, Prince Edward Island, Saskatchewan,  
11 and Yukon. CADTH takes sole responsibility for the final form and content of this report. The  
12 views expressed herein do not necessarily represent the views of Health Canada or any  
13 provincial or territorial government.

14  
15 \*\*\*\*\*

16  
17 Disclaimer: The Environmental Scanning Service is an information service for those involved in  
18 planning and providing health care in Canada. Environmental Scanning Service responses are  
19 based on a limited literature search and are not comprehensive, systematic reviews. The intent  
20 is to provide information on a topic that CADTH could identify using all reasonable efforts within  
21 the time allowed. Environmental Scanning Service responses should be considered along with  
22 other types of information and health care considerations. The information included in this  
23 response is not intended to replace professional medical advice nor should it be construed as a  
24 recommendation for or against the use of a particular health technology. Readers are also  
25 cautioned that a lack of good quality evidence does not necessarily mean a lack of  
26 effectiveness, particularly in the case of new and emerging health technologies for which little  
27 information can be found but that may in future prove to be effective. While CADTH has taken  
28 care in the preparation of the report to ensure that its contents are accurate, complete, and up  
29 to date, CADTH does not make any guarantee to that effect. CADTH is not liable for any loss or  
30 damages resulting from use of the information in the report. Copyright: This report contains  
31 CADTH copyright material. It may be copied and used for non-commercial purposes, provided  
32 that attribution is given to CADTH. Links: This report may contain links to other information  
33 available on the websites of third parties on the Internet.

34  
35 Canadian Agency for Drugs and Technologies in Health (CADTH)  
36 600-865 Carling Avenue,  
37 Ottawa, Ontario K1S 5S8

38

39 **Context**

40 Sepsis is a complex and potentially deadly cascade of physiological responses to infection,  
41 defined as:

42  
43 *“... life-threatening organ dysfunction caused by a dysregulated host response to*  
44 *infection...”, or “... in lay terms, sepsis is a life-threatening condition that arises when the*  
45 *body’s response to an infection injures its own tissues and organs”.*<sup>1</sup>  
46

47 In Canada, and throughout the world, sepsis is a major cause of death and is associated with  
48 significant health care costs — mainly due to longer hospital stays and intensive care needs.<sup>2-4</sup>  
49 Based on 2008 to 2009 data, Canadian patients with sepsis spent a median of 12 days in  
50 hospital — nine days longer than the median length of stay for other conditions.<sup>2</sup> Survivors of  
51 sepsis often experience long-term health problems, including physical, psychological, and  
52 cognitive impairments.<sup>3,5-8</sup> In 2011, an estimated one in 18 deaths in Canada involved sepsis  
53 (either as the underlying cause or as a contributing cause).<sup>9</sup> However, the incidence of sepsis is  
54 likely under-estimated for several reasons, including the different definitions used, clinical  
55 difficulties in diagnosing sepsis, and hospital coding practices that may attribute the cause of  
56 death to the source infection or sequelae of sepsis, rather than to sepsis.<sup>4,5,7,8,10,11</sup>  
57

58 The infection that results in sepsis can originate from virtually any type of pathogen (bacterial,  
59 viral, fungal, or protozoal), and the source of infection can vary.<sup>1,3,9,12-15</sup> The most common sites  
60 are the lungs (i.e., respiratory infections), gastrointestinal tract, bloodstream, kidneys and  
61 genitourinary tract, and skin.<sup>3,16</sup> Infants and the elderly are among those at highest risk for  
62 sepsis.<sup>2,17</sup> Others at greater risk are those who have recently undergone surgery, are  
63 immunocompromised, with chronic illnesses, and women who are pregnant or have recently  
64 been pregnant.<sup>2,6,13,17</sup>  
65

66 Early recognition and treatment of sepsis reduces adverse events and the risk of death.<sup>3,13,18</sup>  
67 Early treatment also reduces the health care costs associated with sepsis, in particular, the  
68 costs of intensive hospital care and subsequent costs for post-sepsis rehabilitation and care.<sup>5</sup>  
69 Detecting sepsis is challenging as the signs can be difficult to distinguish from those caused by  
70 other illnesses, and currently no diagnostic test specifically for sepsis is available.<sup>19-21</sup> Newborns  
71 and children have different risk factors for and symptoms of sepsis than adults.<sup>21,22</sup>  
72

73 There is no gold standard test for sepsis, and diagnosis relies on clinical assessment, diagnostic  
74 imaging, and laboratory tests to identify the pathogen causing the infection and the most  
75 appropriate antimicrobial treatment.<sup>6,23</sup> In many cases, laboratory tests cannot identify the  
76 pathogen.<sup>7,16</sup> Moreover, laboratory tests and blood cultures take time and require equipment  
77 that may not be available in pre-hospital care or remote health facilities.<sup>24,25</sup>  
78

79 **Rural and Remote Populations in Canada**

80 There is a lack of consensus on the definitions of rural and remote communities, but the  
81 following definitions have been used for the purposes of this report.

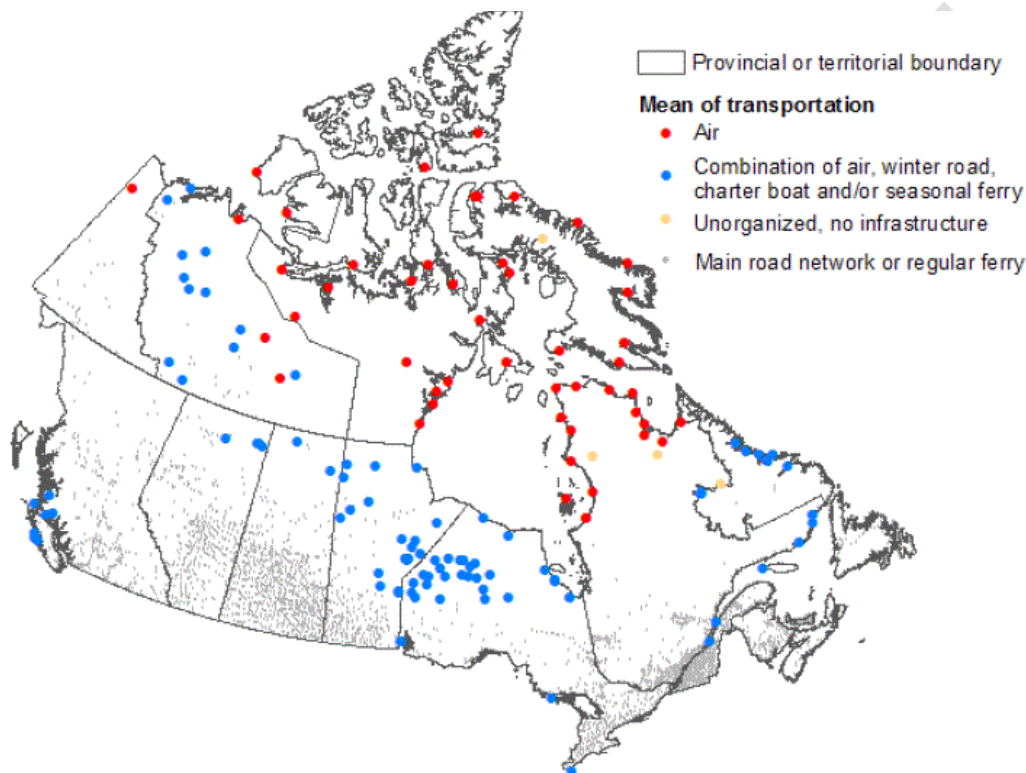
82  
83 **Rural** communities are considered those beyond commuting distance of large urban centres  
84 (centres with populations of 10,000 or more).<sup>26</sup> Over six million Canadians (approximately 20%  
85 of the population) lived in rural areas.<sup>27</sup>  
86

87 **Remote** communities include remote isolated (= no scheduled flights or road access, with and  
88 minimal telephone or radio service), through to non-isolated remote (= road access and less  
89 than 90 km away from physician services).<sup>28</sup> Approximately 200,000 Canadians live in remote  
90 communities (including larger remote communities, such as Whitehorse and Yellowknife).<sup>29</sup>  
91 About half of the Indigenous Peoples in Canada, live in rural or remote communities.<sup>30</sup>

92

93 **Figure 1. Remote communities in Canada.** Communities and type of transportation infrastructure (connected  
94 versus not connected to the main road network)

95



Note: Each dot is a CSD representative point.  
Source: authors' computations.

96  
97 This map displays the different types of transportation infrastructure by community for CSDs [census subdivisions]  
98 across Canada. Each CSD is shown by the location of its "representative point". The map shows the boundaries of  
99 Canada's provinces and territories. Four types of CSDs are displayed: CSDs connected to the main road network or  
100 regular ferry (gray dots). These are the vast majority of CSDs; CSDs connected with a combination of air, winter road,  
101 charter boat and/or seasonal ferry (blue dots), mostly located in the northern part of Canada; CSDs connected only  
102 by air (red dots), mostly in the far north of Canada; and Unorganized CSDs with no transportation infrastructures  
103 (light orange dots).

104 **Image and description source: Statistics Canada. Measuring remoteness and accessibility: a set of indices**  
105 **for Canadian communities. 2017. Reproduced and distributed on an "as is" basis with the permission of**  
106 **Statistics Canada.**<sup>31</sup>

107

### 108 **Determinants of Health in Rural and Remote Settings**

109 People in rural and remote communities may face barriers to care beyond those of geography,  
110 and the more limited health care resources available locally.<sup>32</sup> Many remote Indigenous  
111 communities are at increased risk for sepsis due to socioeconomic factors that affect their  
112 health. These factors include inadequate housing, poor nutrition, unsafe drinking water, and  
113 health comorbidities, with consequently higher rates of injuries, respiratory infections, and skin

114 and soft tissue infections.<sup>32-40</sup> The 2015 Yukon Health status report, for example, cites a sepsis  
115 rate of 9.28 per 100,000 population, compared to 4.35 per 100,000 elsewhere in Canada.<sup>41</sup>

116  
117 Tobacco use in rural and remote communities is higher than elsewhere in Canada, increasing  
118 the risk of respiratory infections.<sup>28,39</sup> Rates of respiratory infections in Nunavut, for example, are  
119 four times higher than the national average.<sup>42</sup> Higher rates of tuberculosis, also a risk factor for  
120 sepsis, are reported in some parts of Canada, including Newfoundland and Labrador, Alberta,  
121 Saskatchewan, Manitoba, Northwest Territories, and in particular, in Nunavut.<sup>43,44</sup>

122  
123 Compared to urban populations in Canada, rural populations are older and have poorer health  
124 overall.<sup>28,45,46</sup> Rural and remote populations also have higher rates of medical emergencies,  
125 including infectious diseases and injuries, than the national average.<sup>28,37,47</sup>

### 126 127 **Access to Health Care**

128 Health Canada reports that there are over 600 First Nations communities across Canada that  
129 are served by 79 nursing stations and over 195 health centres.<sup>48</sup> Over 95,000 Indigenous  
130 Peoples live in 85 remote communities where health services are mainly provided through  
131 nursing stations.<sup>40</sup> Responsibility for the provision of health services for Indigenous Peoples in  
132 rural and remote communities varies across Canada in a complex system of federal, provincial,  
133 territorial, and community-run health services.<sup>30,40,49</sup>

134  
135 Many remote communities are only accessible by air, and in medical emergencies, patients are  
136 transported by air ambulance or private air services to larger regional hospitals several hours  
137 away.<sup>37,42,47,50</sup> Remote communities may not have navigational equipment or landing strip  
138 lighting, meaning that pilots “fly by sight” and cannot land or take off in poor weather conditions,  
139 delaying emergency transport.<sup>50</sup>

140  
141 Remote communities often do not have local ambulance or 911 emergency response services  
142 and rely on family or community members to transport patients to the nursing station.<sup>50</sup> In many  
143 communities, basic first aid training may be provided to some community members, but the  
144 frequency and type of training varies and may not meet the needs of the community.<sup>37,50</sup>

145  
146 There is broad interest across Canada in developing protocols and identifying the optimal  
147 technologies for recognizing and diagnosing sepsis — including in rural and remote areas. This  
148 could be informed by a better understanding of current resources and practices for sepsis  
149 detection in these settings. In this context, CADTH conducted an Environmental Scan on  
150 detection of sepsis in rural and remote areas. This adds to previous CADTH work on health care  
151 in rural and remote areas,<sup>51</sup> and recognition and diagnosis of sepsis in adults.<sup>52-54</sup>

### 152 153 **Objectives**

154 The objectives of this Environmental Scan are:

- 155
- 156 • to describe the current guidance (i.e., policies, protocols, guidelines, algorithms) for  
157 detecting and diagnosing sepsis in rural and remote health care settings in Canada
  - 158 • to describe current practice for detecting and managing sepsis in rural and remote health  
159 care settings in Canada and how this compares with recommended practice
  - 160 • to identify the diagnostic technologies and other resources available for sepsis detection,  
161 diagnosis, and management in rural and remote health care settings in Canada.
- 162

## 163 **Methods**

### 164 **Approach**

165 The findings of this Environmental Scan are based on responses to a survey questionnaire  
 166 (Appendix 1) distributed to contacts in jurisdictions across Canada. Responses were received  
 167 from June 8 until September 7, 2018. Additional information was integrated from publications  
 168 identified through a literature search.

169  
 170 **Table 1. Components and Information Gathering Approach**

		Inclusion
<b>Components</b>	<b>Population</b>	Patients (of any age) with suspected (or possibly at risk for) sepsis
	<b>Intervention</b>	Protocols, guidelines, algorithms, procedures, current practices, diagnostic tests or other tools for detecting or diagnosing sepsis
	<b>Settings</b>	<ul style="list-style-type: none"> <li>Any remote or rural Canadian health care setting, including pre-hospital care, and care delivered remotely via telehealth or at a community health facility</li> </ul>
	<b>Outcomes</b>	<ul style="list-style-type: none"> <li>Canadian guidance for identifying or diagnosing sepsis in patients outside of urban areas/hospitals (guidance may be local, regional, provincial or at the national level)</li> <li>Barriers to and facilitators of use</li> <li>Strategies for improving and available resources for detection, diagnosis and management of sepsis in rural and remote areas</li> </ul>

### 171 172 **Literature Search**

173 A limited literature search was conducted on key resources including Ovid Medline, PubMed,  
 174 The Cochrane Library and the University of York Centre for Reviews and Dissemination (CRD)  
 175 databases. Grey literature was identified by searching relevant sections of the Grey Matters  
 176 checklist (<https://www.cadth.ca/grey-matters>) and by conducting a focused Internet search. No  
 177 methodological filters were applied to limit retrieval by study type. The search was limited to  
 178 English and French language documents published between January 1, 2008, and April 13,  
 179 2018. Monthly alerts updated the search and continued until October 19, 2018. Conference  
 180 abstracts were excluded from the search results.

### 181 182 *Research Questions*

183  
 184 The literature review attempted to address the following questions:

- 186 • What practices and resources are currently used to detect or diagnose patients with  
 187 sepsis in rural or remote areas of Canada?
- 188  
 189 • What are the barriers to or facilitators of the timely diagnosis and treatment of sepsis in  
 190 rural and remote areas?



191

### 192 *Screening and Study Selection*

193 One author screened the literature search results to select articles for full-text review using the  
194 criteria shown in Table 1. The reference lists of relevant papers were also scanned to identify  
195 further studies.

196

### 197 **Survey**

198 The survey included 12 questions (Appendix 1) covering the respondents' demographics and  
199 clinical setting of work; diagnostic strategies, challenges, barriers, and recent local strategies for  
200 improving detection or diagnosis of sepsis. Survey questions included dichotomous (i.e. yes/no),  
201 multiple choice, and open-ended questions. External stakeholders and CADTH research staff  
202 reviewed the draft survey questions.

203

204 We distributed the survey electronically using Hosted in Canada Surveys.<sup>55</sup> The distribution  
205 included over 140 contacts identified by the CADTH Implementation Support and Knowledge  
206 Mobilization team and Program Development staff and clinical experts identified through the  
207 published literature and through referrals. The survey was sent to contacts in:

- 208 • government (in particular, decision makers in provincial and territorial health ministries)
- 209 • regional health authorities
- 210 • hospitals
- 211 • academic research groups
- 212 • practitioners and associations involved in emergency medical care, and provision of  
213 health care services in rural and remote areas (such as, paramedics, nurse practitioners,  
214 rural and emergency care physicians).

215 Contacts were also asked to forward the survey link to their colleagues or to suggest further  
216 respondents. Due to this secondary distribution, we could not determine the total number of  
217 respondents invited to participate. Initial survey contacts who did not respond within the first  
218 deadline were sent one email reminder with a two-week extension.

219

220 Further stakeholder feedback will be obtained by posting the draft version of this report on the  
221 CADTH web site, email notices to CADTH mailing lists, and contacting the survey respondents  
222 who indicated they were willing to provide further information.

223

### 224 *Synthesis Approach*

225 Survey responses were abstracted by question, and organized by type of respondent and  
226 jurisdiction. Themes were identified for discussion and information from the published literature  
227 was summarized under these topics along with information from the survey responses.

228

## 229 **Findings**

230

### 230 **Literature Search**

231 The main database search identified 292 citations and the monthly search alerts identified  
232 another 62 citations. Of these, 37 papers were retrieved for full-text review. Additional  
233 references were identified through the grey literature search, previous CADTH reports on this  
234 topic,<sup>51-54</sup> the reference lists of relevant papers, further targeted searches, and publications  
235 suggested by survey respondents, for a total of 62 papers that were relevant to the objectives of  
236 this project.

### 237 **Summary of Survey Results**

238 Ninety survey responses were received, including four duplicate responses, for a total of 86  
239 unique responses. Of the survey responses, 38 (44%) were mostly incomplete, while 13 other  
240 respondents (12%) noted they were not involved in early detection of patients with possible  
241 sepsis in rural or remote areas (at which point they were able to opt out of the remainder of the  
242 survey). Ultimately, 28 responses (32%) were included in the report.

### 243 **Survey Respondent Characteristics**

245 Attempts were made to obtain responses from all provinces and territories. Responses came  
246 from a variety of organizations with at least one response received for most provinces and  
247 territories, with the exception of Ontario, Quebec, and New Brunswick. Information on the  
248 jurisdictions and organizations represented by survey respondents is summarized in Appendix 2,  
249 Table A1. Information on the professions and occupational settings of survey respondents are  
250 summarized in Appendix 2, Table A2.

251  
252 Respondents' involvement included:

- 253 • physicians providing health care in rural and remote areas (in rural or tertiary hospital  
254 emergency departments, through locums in the communities, or via telehealth consults)
- 255 • patient transfer
- 256 • clinical oversight, standards and quality
- 257 • policy and guideline development
- 258 • nurses and nurse practitioners
- 259 • staff training and education, and
- 260 • implementing laboratory initiatives to improve testing for and appropriate antimicrobial  
261 treatment of infectious diseases.

### 262 **Resources for Sepsis Management in Rural and Remote Areas**

#### 263 **Guidelines, Algorithms, and Protocols**

264  
265 Of the 28 survey responses, 19 (68%) respondents noted that their organization had guidance  
266 for detecting or diagnosing sepsis, and 15 (54%) provided references to these documents  
267 (clinical decision rules, protocols, guidelines, algorithms, or other clinical practice tools). Another  
268 eight (29%) respondents stated their organization had no such guidance. The guidance  
269 documents referenced by respondents are listed in Appendix 3.

270  
271 The literature search identified other Canadian sepsis tools intended for in-hospital or  
272 emergency department care, including the [British Columbia Emergency Department Sepsis  
273 Guidelines Algorithm](#) (2017),<sup>56</sup> and the [Canadian Patient Safety Institute sepsis kit](#).<sup>57</sup> Recent  
274 algorithms for detecting sepsis in children have been developed at Manitoba's [TREKK  
275 \(Translating Emergency Knowledge for Kids\) centre](#).<sup>58-60</sup>

276  
277 International guidelines and tools for sepsis detection and management include the [Surviving  
278 Sepsis Campaign](#) guidelines,<sup>18,61</sup> and the [UK Sepsis Trust Prehospital Sepsis Screening and  
279 Action Tool](#) checklist.<sup>62</sup> [Guidance from the UK National Institute for Health and Care Excellence  
280 \(NICE\)](#) includes algorithms and risk stratification tools for recognizing sepsis in both primary and  
281 acute care settings.<sup>22</sup> The [US Centers for Disease Control and Prevention \(CDC\) also offers  
282 clinical and patient education materials on sepsis](#).<sup>16</sup> In addition, WHO recommendations on  
283 sepsis management in resource-limited settings may be applicable to remote care settings.<sup>63</sup>

284 With the exception of the Health Canada guidelines for primary care nurses (currently being  
 285 revised),<sup>64</sup> the Canadian guidance and tools identified are intended for in-hospital use, rather  
 286 than for use in pre-hospital or remote settings.

287  
 288 One respondent commented on the need for national guidelines with expected care standards  
 289 for the detection, diagnosis and treatment of sepsis — particularly for remote fly-in communities  
 290 served by federal nursing stations. They also suggested these national standards could be  
 291 adopted by provincial health systems and monitored. This would track all patients who receive  
 292 emergency transport or who die of sepsis, allowing review of cases and reporting to provincial  
 293 standards committees to identify opportunities for system improvement. Another respondent  
 294 noted that they hoped an outcome of this work would be the development of protocols and  
 295 standards for organizations overseeing care in remote communities. A fourth respondent  
 296 remarked that although their organization did not have a local sepsis protocol, this had been  
 297 developed at another level in the organization and should be adopted locally.

298  
 299 In critical care, the Systemic Inflammatory Response System (SIRS) and Sequential Organ  
 300 Failure Assessment (SOFA) scores are used to assess the severity of sepsis and risk of death  
 301 in adults, but results of laboratory tests are needed for scoring.<sup>1,65</sup> A modified measure,  
 302 quickSOFA (qSOFA), relies on clinical examination, can be performed quickly and does not  
 303 involve laboratory tests.<sup>1</sup> However, these tools were intended to be used to predict patient risk,  
 304 rather than as diagnostic tools.<sup>23,65</sup> Other early warning scoring systems for sepsis are available  
 305 or in development, but their usefulness in pre-hospital settings is still unclear.<sup>20,25,66-68</sup> Different  
 306 risk factors and clinical signs are used for detecting sepsis in pediatric patients, depending on  
 307 their age.<sup>58,59,69,70</sup>

308  
 309 *Smartphone Applications*

310 Several smartphone apps have scoring systems to help health care providers identify patients  
 311 who may have sepsis. A UK National Early Warning Scoring System (NEWS) and Sepsis  
 312 Screening Tool, which combines the NEWS calculator (respiration rate, oxygen saturation,  
 313 supplemental oxygen, temperature, heart rate, systolic blood pressure, level of consciousness),  
 314 a qSOFA calculator, and sepsis care bundle, is freely available as a smartphone app.<sup>71,72</sup> The  
 315 Surviving Sepsis App, from the Surviving Sepsis Campaign, is included as part of the Society of  
 316 Critical Care Medicine (SCCM) guidelines app.<sup>73</sup> Other sepsis apps, such as the ESCAVO  
 317 Sepsis Timer, are also available.<sup>74</sup>

318  
 319 **Available Diagnostic Technologies**

320 Table 2 summarizes the responses to the survey question on the diagnostic tools available.  
 321 Respondents could make multiple selections. Additional comments provided by respondents are  
 322 included below the table.

323  
 324 **Table 2. Additional Diagnostic Tools Available On-site**

Survey question: What additional diagnostic tools does your facility have available on-site for detecting, diagnosing, or initially treating patients with suspected sepsis?	# of respondents/28 (%)
Protocols for referral of patients to other care settings	12 (42%)
Access to laboratory services for blood, wound, or respiratory culture, or measurement of sepsis-related markers (e.g., procalcitonin)	18 (64%)
Access to point-of-care tests for sepsis-related markers	7 (25%)



Urinalysis	23 (82%)
Imaging	18 (64%)
Specialist consultation via telemedicine	12 (42%)
Other <sup>a</sup>	6 (21%)

325 <sup>a</sup>The six respondents who answered yes to “Other” specified the following:

- 326 1) all of the above (specialist consult service)
- 327 2) X-rays only
- 328 3) Hospitals have a lab on site; remote nursing stations have urinalysis, glucometer, and point-of-care hemoglobin only
- 329 4) Specialist consultation via telephone
- 330 5) Tertiary care level diagnostic services and specialist support
- 331 6) On-site specialists [urban centre supporting rural/remote facilities].

332

333 One respondent noted that, rural areas in Manitoba have small hospitals and emergency

334 departments, which have some resources and trained professionals to diagnose, treat, and

335 transfer patients with sepsis. However, they also noted that this is not the case in nursing

336 stations. The nurses in these facilities may have access to a physician by phone, but seldom in

337 person, and they may be several hours away (by boat or air) from a facility that has the

338 resources needed.

339

340 Similarly, a respondent in the Northwest Territories commented that they have reasonably good

341 tools for the diagnosis and treatment of sepsis in the larger centres, but that in the remote areas

342 resources such as laboratory tests, diagnostics and treatments are “scant”, and diagnosis may

343 be based on clinical descriptions of the patient provided over the phone by a nurse in a remote

344 community to an emergency physician in Yellowknife or Inuvik.

### 345

### 346 Point-of-Care Testing

347

348 Lactate

349 Lactate is a marker of tissue perfusion and higher levels of lactate in the blood are associated

350 with severity of sepsis.<sup>75</sup> Rapid, inexpensive, point-of-care lactate test units are commercially

351 available in Canada, for example, the StatStrip, Nova Biomedical.<sup>67,75,76</sup> These devices provide

352 blood lactate values from a finger prick blood sample in about a minute.<sup>66,77,78</sup> Lactate

353 measurement in the pre-hospital setting is intended to reduce the time to obtaining a lactate

354 value, and provide an earlier baseline value for continued assessment once the patient reaches

355 the emergency department.<sup>77</sup>

356

357 The survey questionnaire did not specifically ask about the availability of point-of-care lactate

358 testing, and no respondents mentioned that this testing was available in remote health settings.

359 Nevertheless, one respondent from Manitoba described a pilot study of point-of-care testing,

360 underway in three communities, that includes lactate and white blood cell count (WBC). This will

361 be rolled out to all Manitoba communities in conjunction with provincial laboratory services.

362 Another survey respondent successfully advocated for getting point-of-care lactate in some

363 smaller hospitals in Nova Scotia. This respondent also provides health services in Nunavut, and

364 commented that having point-of-care lactate testing available there would be very helpful.

365 Another Nunavut respondent also noted that having the capacity for point-of-care blood work

366 would be helpful.

367

368 **Intravenous Fluids, Oxygen, and Antimicrobials**

369 Administration of intravenous (IV) fluids is a key element of sepsis treatment, but IV  
 370 resuscitation is not available in some remote health care settings. One survey respondent noted  
 371 that, in their experience, some nursing stations had only one IV pump, while others had none.  
 372

373 A recent study of injuries treated at nursing stations in northern Ontario found that, although  
 374 most (74%) administered IV fluids, only a few (less than 10%) provided oxygen or antibiotics,  
 375 and none administered vasopressors to stabilize blood pressure.<sup>79</sup> Vasopressors are  
 376 administered under the direction of a physician, but support from physicians via telemedicine  
 377 could have provided this direction before the patient was transported.<sup>79</sup>  
 378

379 **Storage and Access to Antimicrobials**

380 One survey question asked whether there were challenges with the storage or access to critical  
 381 first-line antimicrobial agents for the early treatment of suspected sepsis. Of the 28 responses to  
 382 this question, eight (28%) answered “yes” (there were challenges), and 20 (71%) answered “no”  
 383 (there were no challenges with access to antimicrobials).  
 384

385 Comments from the eight respondents who noted challenges in access to antimicrobials are  
 386 summarized in the table below.  
 387

388 **Table 3. Challenges with storage and access to antimicrobials for the early treatment of sepsis**

Survey question: In your jurisdiction or facility, are there challenges with the storage and ready access to critical first-line antimicrobial agents for prompt and early treatment of suspected sepsis? <sup>a</sup>
<ul style="list-style-type: none"> <li>- Limited choice of antibiotics available (and those that are offer only a narrow spectrum of coverage).</li> <li>- Some antibiotics (such as piperacillin/tazobactam, meropenem, and gentamicin) are used frequently and supplies often run out.</li> <li>- Broad-spectrum antibiotics may not be readily available.</li> <li>- Vancomycin [an antibiotic for the treatment of serious bacterial infections] cannot be used in many remote areas because the laboratory blood testing required for monitoring the safe use of this drug is not available locally.</li> <li>- Limited storage in medicines room and no local pharmacies.</li> <li>- Restocking of medications can be slow (e.g., this may take weeks after an urgent request is made, or be delayed due to bad weather and flight delays).</li> <li>- One respondent also mentioned a growing problem with extended spectrum beta-lactamase (ESBL)-producing <i>Escherichia coli</i> (<i>E. coli</i>) bacterial infections.</li> </ul>

<sup>a</sup>Themes summarized from survey responses

389  
 390

391 **Barriers to the Timely Detection of Sepsis**

392 In answer to the survey question about barriers to the timely detection of sepsis in their  
 393 organization or jurisdiction, 20 (71%) respondents answered “yes” to this question (i.e., there  
 394 were barriers). The answers to the types of barriers (multiple selections could be made) are  
 395 shown in Table 4.  
 396

397 **Table 4. Barriers to the Timely Detection of Sepsis**

Survey question: Which of the following barriers to the timely detection of sepsis are experienced in your organization or jurisdiction?	# of responses/20 (%)
Patients and family or home caregivers are unaware of signs and risks of sepsis	13 (65%)

Lack of local medical expertise or training in the initial detection and diagnosis of sepsis	10 (50%)
Lack of guidelines for identifying and managing patients with potential sepsis	8 (40%)
Appropriate rapid diagnostic tests are not available on-site	11 (55%)
Appropriate treatments are not available on-site (for example, broad spectrum antibiotics)	3 (15%)
Difficulty incorporating diagnostic or treatment options into care pathway	10 (50%)
Lack of coordination of care by multiple providers	11 (55%)
Geographic barriers to accessing services	14 (70%)
Delays in transporting patients for specialist care (see the following paragraph for the respondents reasons for these delays)	11 (55%)
Other <sup>a</sup>	3 (15%)

398  
399  
400  
401  
402  
403

<sup>a</sup>Other reasons provided were:

- 1) lack of good documentation or a tool that would effectively identify patients whose condition is deteriorating
- 2) busy emergency rooms resulting in delays in patients receiving blood work
- 3) emergency room consults in the receiving facility may also involve delays.

### Patient Transportation

404  
405  
406  
407  
408  
409  
410  
411  
412  
413  
414  
415  
416

Survey respondents provided further explanations of the reasons for delays in transporting patients for specialist care:

- remote communities are often accessible only by air, winter or gravel roads, while medical evacuation transportation (medevac) comes in from larger centres, which can delay transport considerably
- availability of air ambulance or medevac transport is limited, and flights in and out take several hours
- bad weather grounds flights in and out
- out-of-province transport and acceptance at referral hospital is required for severe endovascular infections

### Staff Training, Experience, and Resources

417  
418  
419  
420  
421  
422  
423  
424  
425  
426  
427

Survey respondents also noted that lack of training and experience of primary care staff is a barrier to early recognition of sepsis in remote health facilities. One respondent commented that First Nations communities in remote areas are staffed mainly by nurses who may lack the training and experience needed to recognize sepsis. In addition, the limited health care staff available may make it difficult for patients to access care, with delays meaning they present at a more advanced stage of illness.

Another respondent noted the lack of morbidity and mortality rounds (M & M rounds) was also a barrier to improvement. Further, they commented that bench marking for key sepsis indicators was lacking, and the need to recognize that some treatment interventions require two nurses.

428 **Recent Improvements or Changes**

429 We asked survey respondents whether there had been any recent improvements or changes  
 430 made to help quickly detect and treat patients with suspected sepsis at their facilities. Twelve  
 431 respondents (43%) answered “yes” (there had been changes). Thirteen respondents (46%)  
 432 answered “no” to this question, and three (11%) did not respond to this question. Of those who  
 433 answered yes, nine respondents provided the following examples of improvements or changes:

434 **Table 5. Recent Improvements or Changes to Detection and Treatment of Patients with Suspected Sepsis**  
 435

Survey question: Have recent improvements or changes been made to help quickly detect and treat patients with suspected sepsis in your facility?
<p><b>Education</b></p> <ul style="list-style-type: none"> <li>- Improved education of clinical staff and regular instruction for residents, for example, education regarding the importance of collecting cultures and then administering antimicrobials within the first hour of diagnosis of sepsis.</li> <li>- Patient safety events and recommendations are de-identified and shared.</li> </ul> <p><b>Guidance</b></p> <ul style="list-style-type: none"> <li>- Greater use of Systemic Inflammatory Response Syndrome (SIRS) /quick Sequential Organ Failure Assessment criteria (qSOFA) [criteria for assessing patients], development of protocols, and use of treatment guidelines.</li> <li>- Wide dissemination of guidelines and sharing of other jurisdictions’ patient safety information.</li> <li>- New guidelines and policies for primary care nurses in remote nursing stations are being drafted [by Health Canada / Indigenous Services Canada]. These will include guidance on identifying and treating sepsis.</li> <li>- Province-wide policy implementation.</li> </ul> <p><b>Emergency care</b></p> <ul style="list-style-type: none"> <li>- Prompt resuscitation in the emergency department.</li> <li>- Easy access to antibiotics in the emergency department/night cupboard.</li> <li>- In Manitoba, a pilot project of point-of-care testing, including lactate and white blood cell count (WBC) is being rolled out in three communities with a plan to roll it out to all communities in conjunction with provincial lab services.</li> <li>- Tracking the time it takes from ordering of antimicrobials to administration using the clinical informatics system.</li> <li>- Implementation of a Rapid Response Team to aid in the identification of sepsis and early fluid resuscitation with the aid of medical directives.</li> </ul>

436  
 437 **Limitations**

438 A limited literature search supplemented this Environmental Scan. Relevant published  
 439 information was scarce. This was not unexpected, as earlier CADTH work on remote health  
 440 care facilities and identification of sepsis also found limited published information.<sup>51-54</sup>

441  
 442 Although invaluable information was provided by the survey respondents, several other  
 443 agencies and health care providers were not represented. In addition, the response rate to  
 444 many of the questions varied and some survey responses were incomplete. Particular gaps  
 445 include a lack of responses from paramedic and other pre-hospital emergency care providers,  
 446 Indigenous communities, and nursing staff in rural and remote areas. Given these shortcomings,  
 447 and the few responses from some provinces and territories, the representation and  
 448 generalizability of the results might be limited.

449

450 Finally, we did not assess the quality of any of the information identified, including the quality of  
451 the guidance documents. Consequently, this report is not intended to provide recommendations  
452 on the appropriateness of any of the interventions cited.

453

### 454 **Discussion**

455 Beyond the barriers of geography and weather, the survey respondents noted many further  
456 barriers to the timely detection of sepsis, particularly in remote communities. Several survey  
457 respondents noted the lack of or limited supplies of basic equipment. Supplies of appropriate  
458 medications for early treatment of infections was also noted as inadequate, and restocking of  
459 medications could be slow. A 2018 CADTH Environmental Scan on remote health care facilities  
460 did not find any recent lists of essential equipment for remote facilities in Canada.<sup>51</sup>

461

### 462 **Diagnostic Equipment**

463 Patients in remote Canadian communities may face some of the same delays in diagnosis and  
464 treatment seen in resource-limited health care settings in developing countries.<sup>12,80</sup> Nursing  
465 stations in remote areas of Canada have limited diagnostic equipment and treatment options on  
466 hand.<sup>51,79</sup> In particular, diagnostic imaging to detect infections, such as chest X-rays or point-of-  
467 care ultrasound, and equipment for initial management of patients with sepsis, such as  
468 intravenous (IV) fluids, and oxygen, may not be available.<sup>47,51,80</sup>

469

470 No survey respondents mentioned the availability of other point-of-care technologies, such as  
471 portable ultrasound. Low-cost, point-of-care ultrasound, administered by trained health care  
472 providers in remote settings and supported by remote specialists, may be used to identify some  
473 sources of infection and early signs of sepsis.<sup>81</sup>

474

#### 475 *Point-of-Care Testing*

476 Two survey respondents noted the need for point-of-care lactate test units. A 2017 UK  
477 systematic review of point-of-care lactate testing for sepsis found limited evidence on these  
478 devices, but concluded this may be a useful diagnostic test in pre-hospital settings.<sup>82</sup> Point-of-  
479 care lactate testing is widely used in the UK.<sup>83</sup> The study of pre-hospital sepsis care in northern  
480 Australia also found that pre-hospital, serial lactate measurements may be useful.<sup>84</sup> In Canada,  
481 Health Canada has approved at least one point-of-care lactate test unit and the device is  
482 commercially available here.<sup>76</sup>

483

484 Other smartphone-based point-of-care technologies may soon be available for rapid detection of  
485 common infections that can lead to sepsis, for example devices to detect urinary tract infections  
486 that do not require laboratory testing or culture.<sup>85-87</sup>

487

488 Studies of their use in remote health care settings are lacking, but rapid, point-of-care tests for  
489 detecting common sepsis-related pathogens may be another emerging tool to improve early  
490 detection of sepsis.<sup>88,89</sup>

491

### 492 **Pre-Hospital Care**

493 As with enhanced emergency care for patients experiencing a heart attack or stroke, emergency  
494 medical care providers can play a role in early detection and treatment of patients who may  
495 have sepsis.<sup>77,83</sup> Studies in the US, UK, and the Netherlands have assessed whether training  
496 and equipment to improve early recognition and treatment of sepsis by paramedics can improve  
497 patient outcomes.<sup>68,77,90</sup> The US pilot study provided paramedics with an educational session on



498 sepsis and kits containing temporal artery thermometers, and portable lactate test units and test  
499 strips.<sup>77</sup> Other studies have noted regular measurement of vital signs, such as pulse, blood  
500 pressure, temperature and respiratory rate) as simple interventions that could help to identify  
501 patients whose condition is deteriorating and who may be at risk of sepsis.<sup>83,91</sup>

502  
503 The UK review of sepsis recognition in the pre-hospital setting found there was poor recognition  
504 of sepsis by ambulance personnel, and that most screening tools had not been validated in the  
505 pre-hospital setting.<sup>90</sup> Subsequently, researchers in the UK recently published a protocol for a  
506 randomized study of pre-hospital recognition of sepsis and administration of antibiotics.<sup>92</sup> The  
507 Netherlands study found value in improving training for emergency medical service personnel to  
508 recognize early signs of sepsis as this ultimately reduced time to treatment in the emergency  
509 department.<sup>68</sup> It is not clear whether the findings of these studies are applicable to remote health  
510 care settings in Canada, but, results of a 2016 study in northern Australia may be relevant.<sup>84</sup>

511  
512 The Australian study looked at interventions provided by air transport medical teams in patients  
513 with severe sepsis in remote areas.<sup>84</sup> Almost all (99%) of the 67 patients in the study received  
514 antibiotics in the pre-hospital setting, and 80% of patients received pre-hospital intravenous fluid  
515 resuscitation.<sup>84</sup> This, in addition to other interventions, such as supplemental oxygen, provided  
516 before or during transport to the hospital, may have contributed to the relatively low 30-day  
517 mortality (13%).<sup>84</sup>

518

### 519 **Improving Public Awareness of Sepsis**

520 As noted in the survey responses in Table 4, lack of patient, family and caregiver awareness of  
521 sepsis is one of the barriers to timely care. Despite media coverage of deaths due to sepsis,  
522 several publications have noted the need for greater public recognition of sepsis as a medical  
523 emergency.<sup>1,16,21,93,94</sup>

524  
525 A 2018 review found that improved clinician and public awareness of sepsis due to educational  
526 campaigns, such as the Surviving Sepsis Campaign, has improved patient outcomes.<sup>3,7</sup> Public  
527 awareness campaigns in the US, the UK, and Germany have also increased knowledge of the  
528 signs and symptoms of sepsis.<sup>8</sup> The US Centers for Disease Control (CDC) recommends that  
529 clinicians educate patients and their families about the signs and symptoms of sepsis —  
530 particularly in individuals at higher risk for infections — and that they encourage their patients to  
531 manage their chronic health conditions, stay up-to-date with vaccinations, and practice good  
532 hand hygiene to reduce the risk of infections.<sup>16</sup>

533  
534 The 2017 World Health Organization (WHO) resolution on sepsis also noted the importance of  
535 health care providers using the term sepsis to further promote awareness of the condition to  
536 other health care providers, patients, their families, and the community.<sup>8,15</sup> The WHO resolution  
537 included the recommendation for national programs to “increase public awareness of sepsis,  
538 particularly among high-risk groups, to ensure prompt recognition and presentation for  
539 treatment...”<sup>8,15</sup> The Global Sepsis Alliance also promotes patient and family awareness with  
540 infographics about maternal and neonatal sepsis.<sup>95</sup>

541

### 542 **Training and Provision of Care**

543 Survey respondents noted that lack of training or experience of primary care givers is a barrier  
544 to timely recognition of sepsis in remote health facilities. In most remote communities in Canada,  
545 primary and emergency care is provided by nurses at community health clinics.<sup>40,42</sup> Staffing is  
546 an ongoing problem. A recent report from Nunavut found that almost half of the health care

547 postings there had not been filled, and temporary health care providers were often needed to fill  
548 staffing gaps.<sup>42</sup> There is also documentation of high rate of staff turnover and inadequate  
549 training for nurses in Canada given the expanded scope of practice needed in remote areas.<sup>40,42</sup>

550

551 Many remote communities in Canada do not have a paramedic or 911 emergency dispatch  
552 service.<sup>37</sup> Researchers in Ontario have suggested one option may be a Community-Based  
553 Emergency Care model, where community members are trained as lay health providers.<sup>37,47</sup>

554

### 555 **National Standards and Reporting for Sepsis in Canada**

556 Several survey respondents commented that the way in which sepsis is reported and patient  
557 outcomes are tracked across Canada needs to be improved. The Chair of the Canadian Sepsis  
558 Foundation recently called for a national system to standardize definitions and improve reporting  
559 and tracking of sepsis.<sup>5</sup>

560

### 561 **Preventive Measures**

562 Preventive measures in at-risk populations, such as infants and the elderly and those with  
563 cancer or chronic illnesses, are reported to reduce the risk of infections that can lead to sepsis.  
564 Interventions reported in the literature include:

565

- 566 • breastfeeding to reduce infections in newborns<sup>5</sup>
- 567 • ensuring good hand hygiene practices<sup>5,7,16,91</sup>
- 568 • healthy diet, exercise and other interventions to encourage mobility and reduce frailty<sup>7</sup>
- 569 • interventions to promote smoking cessation<sup>36</sup>
- 570 • best practices to prevent pressure ulcers<sup>96</sup>
- 571 • optimal wound care<sup>7,96</sup>
- 572 • management of chronic health conditions,<sup>14,16,32</sup> and
- 573 • vaccinations to prevent infections that may lead to sepsis (such as meningitis  
574 vaccination for adolescents and young adults, and influenza and pneumococcal  
575 pneumonia vaccinations).<sup>5,7,16,91</sup>

576

577 A study of sepsis in northern Indigenous Australian communities concluded that efforts to  
578 prevent sepsis should include improved housing, access to health services, management of  
579 comorbidities, and initiatives to reduce alcohol and tobacco use.<sup>36</sup>

580

### 581 **Final Remarks**

582 As one survey respondent noted, sepsis continues to be a challenging clinical presentation. This  
583 report sought to identify the guidance (i.e., policies, protocols, guidelines, algorithms, and other  
584 tools) used to detect patients with sepsis in rural and remote health care settings in Canada.  
585 Survey respondents and the literature search identified a variety of guidance and other tools  
586 that are being used, but, with the exception of the Health Canada Clinical Practice Guidelines  
587 for Nurses in Primary Care<sup>64</sup> (currently being updated), most are not specific to practice in  
588 remote health facilities.

589

590 Guidance developed collaboratively by pre-hospital and primary care providers and clinical  
591 experts who support remote health services could streamline and reduce the time to treatment,  
592 and improve patient outcomes.<sup>24,83</sup> It is suggested that guidance should be easy to use and  
593 suitable for the local context (e.g., the available equipment, tests, and clinical expertise).<sup>97</sup> This  
594 may be less of an issue for rural health facilities, for which provincial, regional health authority or

595 hospital-level guidance is available. As there is no accepted national guidance it was not  
596 possible to address the question of how current practice compares with recommended practice.  
597 National standards and guidance may support improvements in care for people with sepsis.  
598

599 In the survey questionnaire we also sought to identify the diagnostic technologies and other  
600 resources available for sepsis detection, diagnosis, and patient management in rural and  
601 remote health care settings in Canada. Most of the information obtained focused on remote  
602 health care settings. In many of these facilities, basic equipment and essential medications  
603 needed to diagnose and treat sepsis are either not available or the supplies on hand are  
604 insufficient. A national standard on essential equipment and supplies for nursing stations and  
605 other small health facilities common to rural and remote settings would help to address these  
606 issues and support appropriate procurement of equipment and medications.  
607

608 The Canadian Institutes of Health Research recently announced funding for a new Sepsis  
609 Research Network Initiative to improve “prevention, detection, and management of sepsis”  
610 through supporting interdisciplinary, collaborative research projects.<sup>98</sup> Given the gaps in  
611 guidance and services identified through this Environmental Scan, research to improve care of  
612 patients with sepsis in remote health care settings could be used to help address these issues.  
613  
614

DRAFT

615 **References**

616 1. Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus  
617 Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016;315(8):801-810.  
618 2. In focus: a national look at sepsis. Ottawa (ON): Canadian Institute for Health  
619 Information; 2009: [https://secure.cihi.ca/free\\_products/HSMR\\_Sepsis2009\\_e.pdf](https://secure.cihi.ca/free_products/HSMR_Sepsis2009_e.pdf).  
620 Accessed 2018 Nov 9.  
621 3. Cecconi M, Evans L, Levy M, Rhodes A. Sepsis and septic shock. *Lancet*.  
622 2018;392(10141):75-87.  
623 4. Tsertsvadze A, Royle P, Seedat F, Cooper J, Crosby R, McCarthy N. Community-onset  
624 sepsis and its public health burden: a systematic review. *Syst Rev*. 2016;5:81.  
625 5. Vogel L. Think sepsis to stop deaths, urge advocates. *CMAJ*. 2017;189(38):e1219-  
626 e1220.  
627 6. Cohen J, Vincent JL, Adhikari NK, et al. Sepsis: a roadmap for future research. *Lancet*  
628 *Infect Dis*. 2015;15(5):581-614.  
629 7. Hotchkiss RS, Moldawer LL, Opal SM, Reinhart K, Turnbull IR, Vincent JL. Sepsis and  
630 septic shock. *Nat Rev Dis Primers*. 2016;2:16045.  
631 8. Reinhart K, Daniels R, Kissoon N, Machado FR, Schachter RD, Finfer S. Recognizing  
632 sepsis as a global health priority - a WHO resolution. *N Engl J Med*. 2017;377(5):414-  
633 417.  
634 9. Navaneelan T, Alam S, Peters PA, Phillips O. Deaths involving sepsis in Canada. *Health*  
635 *at a Glance*. Ottawa (ON): Statistics Canada; 2016:  
636 [https://www150.statcan.gc.ca/n1/en/pub/82-624-x/2016001/article/14308-eng.pdf?st=llp-  
637 4pLS](https://www150.statcan.gc.ca/n1/en/pub/82-624-x/2016001/article/14308-eng.pdf?st=llp-4pLS). Accessed 2018 Sep 28.  
638 10. Tsertsvadze A, Royle P, McCarthy N. Community-onset sepsis and its public health  
639 burden: protocol of a systematic review. *Syst Rev*. 2015;4:119.  
640 11. Jolley RJ, Sawka KJ, Yergens DW, Quan H, Jette N, Doig CJ. Validity of administrative  
641 data in recording sepsis: a systematic review. *Crit Care*. 2015;19:139.  
642 12. Dugani S, Veillard J, Kissoon N. Reducing the global burden of sepsis. *CMAJ*.  
643 2017;189(1):e2-e3.  
644 13. Sepsis can be difficult to recognize, but early diagnosis and treatment is essential.  
645 Ottawa (ON): Canadian Medical Protective Association (CPMA); 2015:  
646 [https://www.cmpa-acpm.ca/en/advice-publications/browse-articles/2015/sepsis-can-be-  
647 difficult-to-recognize-but-early-diagnosis-and-treatment-is-essential](https://www.cmpa-acpm.ca/en/advice-publications/browse-articles/2015/sepsis-can-be-difficult-to-recognize-but-early-diagnosis-and-treatment-is-essential). Accessed 2018 Nov  
648 9.  
649 14. Evans EE, Wang XQ, Moore CC. Distance from care predicts in-hospital mortality in  
650 HIV-infected patients with severe sepsis from rural and semi-rural Virginia, USA. *Int J*  
651 *STD AIDS*. 2016;27(5):370-376.  
652 15. Improving the prevention, diagnosis and clinical management of sepsis: report by the  
653 Secretariat. Geneva (CH): World Health Organization (WHO); 2017:  
654 [http://apps.who.int/gb/ebwha/pdf\\_files/WHA70/A70\\_13-en.pdf](http://apps.who.int/gb/ebwha/pdf_files/WHA70/A70_13-en.pdf). Accessed 2018 Nov 8.  
655 16. Making health care safer: think sepsis. time matters. Atlanta (GA): Centers for Disease  
656 Control and Prevention; 2016: <https://www.cdc.gov/vitalsigns/sepsis/index.html>.  
657 Accessed 2018 Sep 21.  
658 17. Tavare A, O'Flynn N. Recognition, diagnosis, and early management of sepsis: NICE  
659 guideline. *Br J Gen Pract*. 2017;67(657):185-186.  
660 18. Rhodes A, Evans LE, Alhazzani W, et al. Surviving sepsis campaign: international  
661 guidelines for management of sepsis and septic shock: 2016. *Intensive Care Med*.  
662 2017;43(3):304-377.  
663 19. Klompas M, Calandra T, Singer M. Antibiotics for sepsis-finding the equilibrium. *JAMA*.  
664 2018;320(14):1433-1434.

- 665 20. Bayer O, Schwarzkopf D, Stumme C, et al. An early warning scoring system to identify  
666 septic patients in the prehospital setting: the PRESEP score. *Acad Emerg Med*.  
667 2015;22(7):868-871.
- 668 21. Frankling CC, Yeung J, Dark P, Gao F. I spy with my little eye something beginning with  
669 S: spotting sepsis. *Br J Anaesth*. 2016;117(3):279-281.
- 670 22. Sepsis: recognition, diagnosis and early management. London: National Institute for  
671 Health and Care Excellence (NICE); 2016:  
672 [https://www.nice.org.uk/guidance/NG51/chapter/recommendations#risk-factors-for-](https://www.nice.org.uk/guidance/NG51/chapter/recommendations#risk-factors-for-sepsis)  
673 [sepsis](https://www.nice.org.uk/guidance/NG51/chapter/recommendations#risk-factors-for-sepsis). Accessed 2018 Sep 18.
- 674 23. Neviere R. Sepsis syndromes in adults: epidemiology, definitions, clinical presentation,  
675 diagnosis, and prognosis. In: Post TW, ed. *UpToDate*. Waltham (MA): UpToDate; 2018:  
676 [www.uptodate.com](http://www.uptodate.com). Accessed 2018 Nov 9.
- 677 24. Mohr NM, Skow B, Wittrock A, et al. Improving access to high quality sepsis care in a  
678 South Dakota emergency telemedicine network. Iowa City (IA): Rural Telehealth  
679 Research Center (RTRC); 2017: [https://ruraltelehealth.org/briefs/2017-8-](https://ruraltelehealth.org/briefs/2017-8-23-Access%20to%20Sepsis%20Care%20Emergency%20Telemedicine.pdf)  
680 [23-Access%20to%20Sepsis%20Care%20Emergency%20Telemedicine.pdf](https://ruraltelehealth.org/briefs/2017-8-23-Access%20to%20Sepsis%20Care%20Emergency%20Telemedicine.pdf). Accessed  
681 2018 Sep 18.
- 682 25. Williams TA, Tohira H, Finn J, Perkins GD, Ho KM. The ability of early warning scores  
683 (EWS) to detect critical illness in the prehospital setting: a systematic review.  
684 *Resuscitation*. 2016;102:35-43.
- 685 26. du Plessis V, Beshiri R, Bollman RD, Clemenson H. Definitions of rural. Rural and Small  
686 Town Canada Analysis Bulletin; 2001;3(3). Ottawa(ON): Statistics Canada:  
687 <http://publications.gc.ca/collections/Collection/Statcan/21-006-X/21-006-XIE2001003.pdf>.  
688 Accessed 2018 Aug 2.
- 689 27. Canadian demographics at a glance. Ottawa (ON): Statistics Canada; 2016:  
690 [https://www150.statcan.gc.ca/n1/en/pub/91-003-x/91-003-x2014001-](https://www150.statcan.gc.ca/n1/en/pub/91-003-x/91-003-x2014001-eng.pdf?st=3W4RaaCP)  
691 [eng.pdf?st=3W4RaaCP](https://www150.statcan.gc.ca/n1/en/pub/91-003-x/91-003-x2014001-eng.pdf?st=3W4RaaCP). Accessed 2018 Nov 9.
- 692 28. How healthy are rural Canadians? An assessment of their health status and health  
693 determinants. Ottawa (ON): Canadian Institute for Health Information (CIHI); 2006:  
694 [https://secure.cihi.ca/free\\_products/rural\\_canadians\\_2006\\_report\\_e.pdf](https://secure.cihi.ca/free_products/rural_canadians_2006_report_e.pdf). Accessed 2018  
695 Nov 9.
- 696 29. Status of remote / off-grid communities in Canada. Ottawa(ON): Natural Resources  
697 Canada; 2011:  
698 [https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/2013-](https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/2013-118_en.pdf)  
699 [118\\_en.pdf](https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/2013-118_en.pdf). Accessed 2018 Sep 18.
- 700 30. Access to health services as a social determinant of First Nations, Inuit and Metis Health.  
701 Prince George (BC): National Collaborating Centre for Aboriginal Health, University of  
702 Northern British Columbia; 2011: [https://www.ccnca-nccah.ca/docs/determinants/FS-](https://www.ccnca-nccah.ca/docs/determinants/FS-AccessHealthServicesSDOH-EN.pdf)  
703 [AccessHealthServicesSDOH-EN.pdf](https://www.ccnca-nccah.ca/docs/determinants/FS-AccessHealthServicesSDOH-EN.pdf). Accessed 2018 Nov 9.
- 704 31. Alasia A, Bedard F, Belanger J, Guimond E, Penney C. Measuring remoteness and  
705 accessibility: a set of indices for Canadian communities. Ottawa (ON): Statistics Canada;  
706 2017: <https://www150.statcan.gc.ca/n1/pub/18-001-x/18-001-x2017002-eng.htm>.  
707 Accessed 2018 Aug 2.
- 708 32. Goodwin AJ, Nadig NR, McElligott JT, Simpson KN, Ford DW. Where you live matters:  
709 the impact of place of residence on severe sepsis incidence and mortality. *Chest*.  
710 2016;150(4):829-836.
- 711 33. Poling J, Kelly L, Chan C, Fisman D, Ulanova M. Hospital admission for community-  
712 acquired pneumonia in a First Nations population. *Can J Rural Med*. 2014;19(4):135-141.
- 713 34. Loewen K, Bocking N, Matsumoto CL, Kirlew M, Kelly L. Epidemiologic features of  
714 invasive group A Streptococcus infection in a rural hospital: 6-year retrospective report  
715 and literature review. *Can J Rural Med*. 2017;22(4):131-138.



- 716 35. Kirlew M, Rea S, Schroeter A, et al. Invasive CA-MRSA in northwestern Ontario: a 2-  
717 year prospective study. *Can J Rural Med.* 2014;19(3):99-102.
- 718 36. Davis JS, Cheng AC, McMillan M, Humphrey AB, Stephens DP, Anstey NM. Sepsis in  
719 the tropical Top End of Australia's Northern Territory: disease burden and impact on  
720 Indigenous Australians. *Med J Aust.* 2011;194(10):519-524.
- 721 37. Curran J, Ritchie SD, Beardy J, et al. Conceptualizing and managing medical  
722 emergencies where no formal paramedical system exists: perspectives from a remote  
723 indigenous community in Canada. *Int J Environ Res Public Health.* 2018;15(2).
- 724 38. Chapter 6: Introduction to aboriginal health. In: 2014 community health assessment. .  
725 Selkirk (MB): Interlake-Eastern Regional Health Authority; 2015:  
726 <https://www.ierha.ca/default.aspx?cid=11205>. Accessed 2018 Oct 11.
- 727 39. Patterson M, Finn S, Barker K. Addressing tuberculosis among Inuit in Canada. *Can*  
728 *Commun Dis Rep.* 2018;44(3/4):82-85.
- 729 40. Access to health services for remote first nations communities: chapter 4. Ottawa (ON):  
730 Government of Canada; 2015:  
731 <http://www.ourcommons.ca/Content/Committee/412/PACP/Reports/RP8052165/pacprp2>  
732 [3/pacprp23-e.pdf](http://www.ourcommons.ca/Content/Committee/412/PACP/Reports/RP8052165/pacprp23-e.pdf). Accessed 2018 Sep 6.
- 733 41. Yukon health status report: focus on substance use, 2015. Whitehorse (YK): Yukon  
734 Health and Social Services; 2016:  
735 [http://www.yukoncmoh.ca/files/health\\_status\\_report\\_2015.pdf](http://www.yukoncmoh.ca/files/health_status_report_2015.pdf). Accessed 2018 Jul 23.
- 736 42. Health care services - Nunavut. Ottawa (ON): Office of the Auditor General of Canada;  
737 2017: [http://www.oag-bvg.gc.ca/internet/English/nun\\_201703\\_e\\_41998.html](http://www.oag-bvg.gc.ca/internet/English/nun_201703_e_41998.html). Accessed  
738 2018 Sep 7.
- 739 43. Kethireddy S, Light RB, Mirzanejad Y, et al. Mycobacterium tuberculosis septic shock.  
740 *Chest.* 2013;144(2):474-482.
- 741 44. Vachon J, Gallant V, Siu W. Tuberculosis in Canada, 2016. *CCDR.*44(3/4):75-81.
- 742 45. Kulig JC, Williams AM, eds. *Health in rural Canada.* Vancouver (BC): UBC Press; 2011.
- 743 46. Bosco C, Oandason I. Review of family medicine within rural and remote Canada:  
744 education, practice, and policy. *Background Paper.* Mississauga (ON): College of Family  
745 Physicians of Canada; 2016:  
746 [https://www.cfpc.ca/uploadedFiles/Publications/News\\_Releases/News\\_Items/ARFM\\_Ba](https://www.cfpc.ca/uploadedFiles/Publications/News_Releases/News_Items/ARFM_BackgroundPaper_Eng_WEB_FINAL.pdf)  
747 [ckgroundPaper\\_Eng\\_WEB\\_FINAL.pdf](https://www.cfpc.ca/uploadedFiles/Publications/News_Releases/News_Items/ARFM_BackgroundPaper_Eng_WEB_FINAL.pdf). Accessed 2018 Nov 7.
- 748 47. Orkin AM, VanderBurgh D, Ritchie SD, Curran JD, Beardy J. Community-based  
749 emergency care: a model for prehospital care in remote Canadian communities. *CJEM.*  
750 2016;18(5):385-388.
- 751 48. Nursing. Ottawa(ON): Health Canada; 2018: [https://www.canada.ca/en/indigenous-](https://www.canada.ca/en/indigenous-services-canada/services/first-nations-inuit-health/health-care-services/nursing.html)  
752 [services-canada/services/first-nations-inuit-health/health-care-services/nursing.html](https://www.canada.ca/en/indigenous-services-canada/services/first-nations-inuit-health/health-care-services/nursing.html).  
753 Accessed 2018 Nov 9.
- 754 49. Palmer K, Tepper J, Nolan M. Indigenous health services often hampered by legislative  
755 confusion. *Healthy Debate.* Sept 21, 2017:  
756 <http://healthydebate.ca/2017/09/topic/indigenous-health>. Accessed 2018 Sep 6.
- 757 50. Mew EJ, Ritchie SD, VanderBurgh D, et al. An environmental scan of emergency  
758 response systems and services in remote First Nations communities in Northern Ontario.  
759 *Int J Circumpolar Health.* 2017;76(1):1320208.
- 760 51. Young C, Grobelna A. Characteristics of remote and isolated health care facilities: an  
761 environmental scan. Ottawa(ON): CADTH; 2018: [https://www.cadth.ca/characteristics-](https://www.cadth.ca/characteristics-remote-and-isolated-managed-health-care-facilities-environmental-scan)  
762 [remote-and-isolated-managed-health-care-facilities-environmental-scan](https://www.cadth.ca/characteristics-remote-and-isolated-managed-health-care-facilities-environmental-scan). Accessed 2018  
763 Sep 28.
- 764 52. Wells C, Picheca L. Recognition and diagnosis of sepsis in adults: evidence-based  
765 guidelines. *CADTH Rapid Response Report: summary of abstracts.* Ottawa (ON):

- 766 CADTH; 2018: [https://www.cadth.ca/recognition-and-diagnosis-sepsis-adults-evidence-](https://www.cadth.ca/recognition-and-diagnosis-sepsis-adults-evidence-based-guidelines-0)  
 767 [based-guidelines-0](https://www.cadth.ca/recognition-and-diagnosis-sepsis-adults-evidence-based-guidelines-0). Accessed 2018 Aug 16.
- 768 53. Recognition and diagnosis of sepsis in rural or remote areas: a review of clinical and  
 769 cost-effectiveness and guidelines. *Rapid Response Report: summary with critical*  
 770 *appraisal*. Ottawa (ON): CADTH; 2016:  
 771 [https://www.cadth.ca/sites/default/files/pdf/htis/aug-](https://www.cadth.ca/sites/default/files/pdf/htis/aug-2016/RC0804%20Sepsis%20in%20Remote%20Areas%20Final.pdf)  
 772 [2016/RC0804%20Sepsis%20in%20Remote%20Areas%20Final.pdf](https://www.cadth.ca/sites/default/files/pdf/htis/aug-2016/RC0804%20Sepsis%20in%20Remote%20Areas%20Final.pdf). Accessed 2018  
 773 Sep 28.
- 774 54. Pejic W, Picheca L. Recognition and diagnosis of sepsis in rural or remote areas: clinical  
 775 and cost-effectiveness and guidelines. *Rapid Response Report: reference list*. Ottawa  
 776 (ON): CADTH; 2018: [https://www.cadth.ca/recognition-and-diagnosis-sepsis-rural-or-](https://www.cadth.ca/recognition-and-diagnosis-sepsis-rural-or-remote-areas-clinical-and-cost-effectiveness-and-0)  
 777 [remote-areas-clinical-and-cost-effectiveness-and-0](https://www.cadth.ca/recognition-and-diagnosis-sepsis-rural-or-remote-areas-clinical-and-cost-effectiveness-and-0). Accessed 2018 Sep 28.
- 778 55. Hosted in Canada Surveys. Ottawa (ON): MarketAccess.ca:  
 779 <https://www.hostedincanadasurveys.ca/>. Accessed 2018 Oct 30.
- 780 56. BC ED sepsis guidelines algorithm. Vancouver (BC): BC Patient Safety & Quality  
 781 Council / BC Sepsis Network; 2017: [https://bcpsqc.ca/resource/emergency-department-](https://bcpsqc.ca/resource/emergency-department-sepsis-resources-2/)  
 782 [sepsis-resources-2/](https://bcpsqc.ca/resource/emergency-department-sepsis-resources-2/). Accessed 2018 Sep 18.
- 783 57. Sepsis prevention, early identification and response: getting started kit. Edmonton (AB):  
 784 Canadian Patient Safety Institute; 2015:  
 785 [http://www.patientsafetyinstitute.ca/en/toolsResources/Sepsis-](http://www.patientsafetyinstitute.ca/en/toolsResources/Sepsis-GSK/Documents/Sepsis%20Getting%20Started%20Kit.pdf)  
 786 [GSK/Documents/Sepsis%20Getting%20Started%20Kit.pdf](http://www.patientsafetyinstitute.ca/en/toolsResources/Sepsis-GSK/Documents/Sepsis%20Getting%20Started%20Kit.pdf). Accessed 2018 Sep 18.
- 787 58. Could this pediatric patient be septic? Winnipeg (MB): TREKK (Translating Emergency  
 788 Knowledge for Kids); 2017:  
 789 [https://trekk.ca/documents/FINAL\\_Triage\\_Nurses\\_Poster\\_85x11.pdf](https://trekk.ca/documents/FINAL_Triage_Nurses_Poster_85x11.pdf). Accessed 2018  
 790 Sep 18.
- 791 59. Pediatric severe sepsis algorithm (for children >28 days of age). Winnipeg (MB): TREKK  
 792 (Translating Emergency Knowledge for Kids); 2018:  
 793 [https://trekk.ca/documents/Sepsis\\_Algorithm\\_July\\_2018-1a4e925d-49fe-43b2-8277-](https://trekk.ca/documents/Sepsis_Algorithm_July_2018-1a4e925d-49fe-43b2-8277-60a4d5bc890b.pdf)  
 794 [60a4d5bc890b.pdf](https://trekk.ca/documents/Sepsis_Algorithm_July_2018-1a4e925d-49fe-43b2-8277-60a4d5bc890b.pdf). Accessed 2018 Sep 18.
- 795 60. Schlesinger J. A Manitoba-based initiative is saving children's lives across the country.  
 796 *WAVE magazine Jan/Feb 2017*. Winnipeg (MB): Winnipeg Free Press:  
 797 [https://www.winnipegfreepress.com/arts-and-life/life/health/research-](https://www.winnipegfreepress.com/arts-and-life/life/health/research-innovation/411337815.html)  
 798 [innovation/411337815.html](https://www.winnipegfreepress.com/arts-and-life/life/health/research-innovation/411337815.html). Accessed 2018 Sep 18.
- 799 61. Levy MM, Evans LE, Rhodes A. The surviving sepsis campaign bundle: 2018 update.  
 800 *Intensive Care Med*. 2018;44(6):925-928.
- 801 62. Prehospital sepsis screening and action tool. Birmingham (UK): The UK Sepsis Trust;  
 802 2018: <https://sepsistrust.org/wp-content/uploads/2018/06/PH-adult-NICE-Final-2-1.pdf>.  
 803 Accessed 2018 Sep 21.
- 804 63. Meier B, Staton C. Sepsis resuscitation in resource-limited settings. *Emerg Med Clin*  
 805 *North Am*. 2017;35(1):159-173.
- 806 64. Clinical practice guidelines for nurses in primary care. Ottawa: Health Canada; 2015  
 807 [update in progress]: [https://www.canada.ca/en/indigenous-services-](https://www.canada.ca/en/indigenous-services-canada/services/first-nations-inuit-health/health-care-services/nursing/clinical-practice-guidelines-nurses-primary-care.html)  
 808 [canada/services/first-nations-inuit-health/health-care-services/nursing/clinical-practice-](https://www.canada.ca/en/indigenous-services-canada/services/first-nations-inuit-health/health-care-services/nursing/clinical-practice-guidelines-nurses-primary-care.html)  
 809 [guidelines-nurses-primary-care.html](https://www.canada.ca/en/indigenous-services-canada/services/first-nations-inuit-health/health-care-services/nursing/clinical-practice-guidelines-nurses-primary-care.html). Accessed 2018 Oct 11.
- 810 65. Fernando SM, Rochweg B, Seely AJE. Clinical implications of the Third International  
 811 Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *CMAJ*.  
 812 2018;190(36):e1058-e1059.
- 813 66. Jones J, Lawner BJ. Prehospital sepsis care. *Emerg Med Clin North Am*.  
 814 2017;35(1):175-183.
- 815 67. Cone DC. The prehospital sepsis screen: a test in search of an application? *Acad Emerg*  
 816 *Med*. 2015;22(7):845-846.

- 817 68. Alam N, Oskam E, Stassen PM, et al. Prehospital antibiotics in the ambulance for  
818 sepsis: a multicentre, open label, randomised trial. *Lancet Respir Med*. 2018;6(1):40-50.
- 819 69. Pomerantz WJ, Weiss SL. Systemic inflammatory response syndrome (sirs) and sepsis  
820 in children: definitions, epidemiology, clinical manifestations, and diagnosis. In: Post TW,  
821 ed. *UpToDate*. Waltham (MA): UpToDate; 2018: [www.uptodate.com](http://www.uptodate.com). Accessed 2018  
822 Nov 9.
- 823 70. Edwards MS. Clinical features, evaluation, and diagnosis of sepsis in term and late  
824 preterm infants. In: Post TW, ed. *UpToDate*. Waltham (MA): UpToDate; 2018:  
825 [www.uptodate.com](http://www.uptodate.com). Accessed 2018 Nov 9.
- 826 71. Sepsis screening. *Nurs Manage (London)*. 2014;21(7):15.
- 827 72. National early warning score & sepsis screening tool. Glasgow (UK): NHS Education for  
828 Scotland; 2018: [http://www.knowledge.scot.nhs.uk/home/portals-and-topics/sepsis-  
829 app.aspx](http://www.knowledge.scot.nhs.uk/home/portals-and-topics/sepsis-app.aspx). Accessed 2018 Nov 7.
- 830 73. Surviving sepsis app. Mount Prospect (IL): Society of Critical Care Medicine; 2018:  
831 <http://www.survivingsepsis.org/Resources/Pages/Surviving-Sepsis-App.aspx>. Accessed  
832 2018 Nov 7.
- 833 74. Maurer D. iMedicalApps: sepsis app a must-have for emergency medicine. New York  
834 (NY): MedPageToday.com; 2017:  
835 <https://www.medpagetoday.com/blogs/iltifathusain/69911>. Accessed 2018 Nov 7.
- 836 75. Becker JU, Theodosios C, Jacob ST, Wira CR, Groce NE. Surviving sepsis in low-income  
837 and middle-income countries: new directions for care and research. *Lancet Infect Dis*.  
838 2009;9(9):577-582.
- 839 76. Medical Devices Active Licence Listing (MDALL). Ottawa(ON): Health Canada:  
840 <https://health-products.canada.ca/mdall-limh/>. Accessed 2018 Oct 30.
- 841 77. Boland LL, Hokanson JS, Fernstrom KM, et al. Prehospital lactate measurement by  
842 emergency medical services in patients meeting sepsis criteria. *West J Emerg Med*.  
843 2016;17(5):648-655.
- 844 78. Guerra WF, Mayfield TR, Meyers MS, Clouatre AE, Riccio JC. Early detection and  
845 treatment of patients with severe sepsis by prehospital personnel. *J Emerg Med*.  
846 2013;44(6):1116-1125.
- 847 79. Nolan B, Ackery A, Mamakwa S, et al. Care of the injured patients at nursing stations  
848 and during air medical transport. *Air Med J*. 2018;37(3):161-164.
- 849 80. Papali A, McCurdy MT, Calvello EJ. A "three delays" model for severe sepsis in  
850 resource-limited countries. *J Crit Care*. 2015;30(4):861.e869-814.
- 851 81. Via G, Storti E, Spreafico A, Melniker L, Neri L. Point of care ultrasound for sepsis  
852 management in resource-limited settings: time for a new paradigm for global health care.  
853 *Intensive Care Med*. 2012;38(8):1405-1407; author reply 1408-1409.
- 854 82. Morris E, McCartney D, Lasserson D, Van den Bruel A, Fisher R, Hayward G. Point-of-  
855 care lactate testing for sepsis at presentation to health care: a systematic review of  
856 patient outcomes. *Br J Gen Pract*. 2017;67(665):e859-e870.
- 857 83. Baker SD. Improving sepsis recognition and utilization of early goal-directed therapy in  
858 the prehospital environment: a review of the literature. *J Emerg Nurs*. 2016;42(5):387-  
859 394.
- 860 84. Joynes EL, Martin J, Ross M. Management of septic shock in the remote prehospital  
861 setting. *Air Med J*. 2016;35(4):235-238.
- 862 85. Karlsen H, Dong T. Smartphone-based rapid screening of urinary biomarkers. *IEEE  
863 Trans Biomed Circuits Syst*. 2017;11(2):455-463.
- 864 86. Inui Health's smartphone device for urine testing gains approval. *FDAnews Device Daily  
865 Bulletin (Sept 21)*. Silver Spring (MD): US Food and Drug Administration (FDA); 2018:  
866 [https://www.fdanews.com/articles/188501-inui-healths-smartphone-device-for-urine-  
867 testing-gains-approval](https://www.fdanews.com/articles/188501-inui-healths-smartphone-device-for-urine-testing-gains-approval). Accessed 2018 Sep 21.

- 868 87. Barnes L, Heithoff DM, Mahan SP, et al. Smartphone-based pathogen diagnosis in  
869 urinary sepsis patients. *EBioMedicine*. 2018;36:73-82.
- 870 88. Cooper-Jones B, Farrah K. A rapid test for microbial identification in patients with  
871 suspected sepsis. *CADTH issues in emerging health technologies; issue 164*. Ottawa  
872 (ON): CADTH; 2016: [https://cadth.ca/dv/ieht/rapid-test-microbial-identification-patients-](https://cadth.ca/dv/ieht/rapid-test-microbial-identification-patients-suspected-sepsis)  
873 [suspected-sepsis](https://cadth.ca/dv/ieht/rapid-test-microbial-identification-patients-suspected-sepsis). Accessed 2018 Oct 30.
- 874 89. Bzdyl NM, Urosevic N, Payne B, et al. Field trials of blood culture identification FilmArray  
875 in regional Australian hospitals. *J Med Microbiol*. 2018.
- 876 90. Smyth MA, Brace-McDonnell SJ, Perkins GD. Identification of adults with sepsis in the  
877 prehospital environment: a systematic review. *BMJ Open*. 2016;6(8):e011218.
- 878 91. Stephenson E. Improving outcomes for patients with sepsis: a cross-system action plan.  
879 London: NHS England; 2015: [https://www.england.nhs.uk/wp-](https://www.england.nhs.uk/wp-content/uploads/2015/08/Sepsis-Action-Plan-23.12.15-v1.pdf)  
880 [content/uploads/2015/08/Sepsis-Action-Plan-23.12.15-v1.pdf](https://www.england.nhs.uk/wp-content/uploads/2015/08/Sepsis-Action-Plan-23.12.15-v1.pdf). Accessed 2018 Sep 21.
- 881 92. Moore C, Bulger J, Morgan M, et al. Prehospital recognition and antibiotics for 999  
882 patients with sepsis: protocol for a feasibility study. *Pilot Feasibility Stud*. 2018;4:64.
- 883 93. Vogel L. England, US report sepsis successes. *CMAJ*. 2017;189(43):E1348-e1349.
- 884 94. Sepsis and parents: are parents aware of sepsis? San Diego (CA): Radius Global  
885 Market Research for the Sepsis Alliance; 2017:  
886 [https://sepsis.org/downloads/2017\\_sepsis\\_parents.pdf](https://sepsis.org/downloads/2017_sepsis_parents.pdf). Accessed 2018 Sep 19.
- 887 95. Dugani S, Laxminarayan R, Kissoon N. The quadruple burden of sepsis. *CMAJ*.  
888 2017;189(36):e1128-e1129.
- 889 96. Schulte F, Lucas E, Mahr J. Avoidable sepsis infections send thousands of seniors to  
890 gruesome deaths. San Francisco (CA): Kaiser Family Foundation; 2018:  
891 [https://khn.org/news/avoidable-sepsis-infections-send-thousands-of-seniors-to-](https://khn.org/news/avoidable-sepsis-infections-send-thousands-of-seniors-to-gruesome-deaths/)  
892 [gruesome-deaths/](https://khn.org/news/avoidable-sepsis-infections-send-thousands-of-seniors-to-gruesome-deaths/). Accessed 2018 Sep 18.
- 893 97. Ansermino JM, Wiens MO, Kissoon N. We need smarter trigger tools for diagnosing  
894 sepsis in children in Canada. *CMAJ*. 2018;190(36):e1060-e1061.
- 895 98. Statement from Dr. Brian H. Rowe: World Sepsis Day. Ottawa (ON): Canadian Institutes  
896 of Health Research; 2018: <http://www.cihr-irsc.gc.ca/e/51143.html>. Accessed 2018 Oct  
897 16.
- 898 99. Davis AL, Carcillo JA, Aneja RK, et al. American College of Critical Care Medicine  
899 clinical practice parameters for hemodynamic support of pediatric and neonatal septic  
900 shock. *Crit Care Med*. 2017;45(6):1061-1093.
- 901
- 902

903 **Appendix 1:**  
904 **Environmental Scan Survey - Detection and Diagnosis of**  
905 **Sepsis in Remote and Rural Areas of Canada**

**A. Demographics and Clinical Setting**

- 906 1. For which province/territory do you work?  
907  Alberta  
908  British Columbia  
909  Manitoba  
910  New Brunswick  
911  Newfoundland and Labrador  
912  Northwest Territories  
913  Nova Scotia  
914  Nunavut  
915  Ontario  
916  Prince Edward Island  
917  Quebec  
918  Saskatchewan  
919  Yukon  
920  Federal Health Program (such as, Indigenous Services Canada, Canadian Armed Forces,  
921 Correctional Service Canada)  
922  Other (please specify) (free text)
- 923 2. What is your profession? The options below correspond to both care provided on-site and remotely.  
924 (Multiple Choice and Other)  
925  Director or manager of remote care facility  
926  Government decision-maker overseeing remote care provision  
927  Health care administrator, manager, or director within health authority overseeing remote care  
928 provision  
929  Physician overseeing remote care provision  
930  Registered nurse overseeing remote care provision  
931  Nurse practitioner overseeing remote care provision  
932  Other, please specify...(free text)



- 933  
934 3. Are you currently involved in any capacity with the early detection of patients with possible sepsis in  
935 or from rural or remote settings?  
936  Yes; if yes, please describe the nature of your involvement (free text)  
937  No; if no, please end the survey here
- 938  
939 4. Do you work in one or more of these geographical settings? (Please select all that apply.)  
940  Urban  
941  Rural  
942  Remote  
943 (Please self-identify based on your local understanding of the criteria for remote. As an  
944 example, [Health Canada](#) defines various levels of remote, ranging from *remote isolated* = no  
945 scheduled flights or road access and minimal telephone or radio service, through to *non-*  
946 *isolated remote* = road access and less than 90 km away from physician services.)  
947  Other (please specify) (free text)  
948
- 949 5. Do you work in one or more of these types of facilities or settings? (Please select all that apply.)  
950  Hospital  
951  Ambulatory (Outpatient) Care Clinic  
952  Community Care (e.g., public health clinic, family health centre, community outpost)  
953  Palliative (supportive) Care  
954  Home Care  
955  Public Health  
956  Physician's office  
957  Telehealth or Telepharmacy service  
958  Pre-hospital settings  
959  Health research or academic institute  
960  Government or Regional Health Authority  
961  Other (please specify) (free text)  
962

### B. Diagnostic Strategy

- 963 6. a. Does your organization have guidance for detecting or diagnosing sepsis (for example, clinical  
964 decision rules, protocols, guidelines, algorithms, or other clinical practice tools)?  
965  Yes  
966  No  
967 b. If yes, please specify the title, date, and name of the originating organization that publishes the  
968 document and if possible, please provide a link to the document or upload the document here —  
969 please note if the document is confidential: free text and link to upload)  
970
- 971 7. If your organization does not have specific internal guidance for detecting or diagnosing sepsis, are  
972 there other formal policies or guidelines that you use in your practice?  
973

- 974  Yes (please specify the title, date, and agency that publishes the document, and, if  
975 possible, a link to the document or upload the document here): free text and link to  
976 upload)  
977  No  
978
- 979 8. What additional diagnostic tools does your facility have available on-site for detecting, diagnosing, or  
980 initially treating patients with suspected sepsis?  
981
- 982  Protocols for referral of patients to other care settings  
983  Access to laboratory services for blood, wound, or respiratory culture, or measurement of  
984 sepsis-related markers (e.g., procalcitonin)  
985  Access to point-of-care tests for sepsis-related markers  
986  Urinalysis  
987  Imaging  
988  Specialist consultation via telemedicine  
989  Other (please specify) (free text)  
990
- 991 9. In your jurisdiction or facility, are there challenges with the storage and ready access to critical first-  
992 line antimicrobial agents for prompt and early treatment of suspected sepsis?  
993  Yes (if yes, please describe) (free text)  
994  No  
995
- 996 10. 10a. Do you feel there are barriers to the timely detection of sepsis in your organization or  
997 jurisdiction?  
998  Yes (if yes, please proceed to question 10b and check whichever categories apply, and add any  
999 additional barriers under the Other category)  
1000  No (if no, please skip to question 11)  
1001
- 1002 10b. Which of the following barriers to the timely detection of sepsis are experienced in your  
1003 organization or jurisdiction? (Please select all that apply.)  
1004  Patients and family or home caregivers are unaware of signs and risks of sepsis  
1005  Lack of local medical expertise or training in the initial detection and diagnosis of sepsis  
1006  Lack of guidelines for identifying and managing patients with potential sepsis  
1007  Appropriate rapid diagnostic tests are not available on-site  
1008  Appropriate treatments are not available on-site (for example, broad spectrum antibiotics)  
1009  Difficulty incorporating diagnostic or treatment options into care pathway (please specify reasons  
1010 why) (free text)  
1011  Lack of coordination of care by multiple providers  
1012  Geographical barriers to accessing services  
1013  Delays in transporting patients for specialist care (please specify reasons for these delays)  
1014  Other (Please specify) (free text)  
1015
- 1016 Please specify reasons: (free text)  
1017
- 1018 11. Have recent improvements or changes been made to help quickly detect and treat patients with  
1019 suspected sepsis in your facility?  
1020  Yes (if yes, please describe) (free text)  
1021  No

1022  
1023 **12.** Do you have any additional comments you would like to make regarding the detection or diagnosis of  
1024 sepsis in rural and remote areas of Canada? (free text)  
1025

1026

**C. Permission to Contact Regarding CADTH Environmental Scan Use**

1027  
1028 Please provide your contact information in case we need to clarify any responses or request  
1029 permission to cite information you have provided:

- 1030 Name:
- 1031 Title:
- 1032 Organization:
- 1033 City:
- 1034 Province:
- 1035 Email:
- 1036 Phone:

1037  
1038 Would you be willing to be consulted further on this topic, either through an informal phone call or  
1039 by email?

- 1040  Yes
- 1041  No

1042  
1043 Can you suggest any other individuals or organizations we should contact for more information or  
1044 to participate in this survey?

- 1045  Yes (please insert name, title, agency, and contact email)

1046  
1047 ***End of Survey — Thank you for your time.***

1048

1049 **Appendix 2: Information on Survey Respondents**

1050 **Table A1. Jurisdictions and Organizations of Survey Respondents**

National / Federal / Province / Territory	Organizations Represented by Survey Respondents <sup>a</sup>
National	Canadian Critical Care Society & Canadian Sepsis Foundation (n=1) Nurse Practitioner Association of Canada / Association des infirmiers praticiens du Canada (n=1)
Federal	Indigenous Services Canada (n=1)
British Columbia	University of British Columbia (n=1)
Alberta	Mount Royal University / Calgary Urban Project Society (n=1)
Saskatchewan	Saskatchewan Health Authority (n=2)
Manitoba	Winnipeg Regional Health Authority (n=1) Northern Health Region / Northern Regional Health Authority (n=4) Ongomiiwin Indigenous Institute of Health and Healing / Ongomwiizin Health Services, University of Manitoba (n=3) Interlake Eastern Regional Health Authority (n=1) Flin Flon General Hospital / Northern Health Region (n=1) University of Manitoba (n=1)
Ontario	-
Quebec	-
New Brunswick	-
Nova Scotia	Nova Scotia Health (n=2) Nova Scotia Health Authority (n=1)
Prince Edward Island	Health PEI (n=2)
Newfoundland and Labrador	Western Health (n=1) Eastern Health (n=1)
Nunavut	Government of Nunavut (n=2)
Northwest Territories	Northwest Territories Health and Social Services Authority (n=1)
Yukon	Community Nursing, Yukon Government (n=1)

1051 <sup>a</sup>Note that some respondents represented more than one organization or jurisdiction

1052 Table A2. Profession and Occupational Settings of Survey Respondents

Profession and Occupational Settings of Respondents	Number of respondents (% of 28) <sup>a</sup>
<b>Profession*</b>	
Director or manager of remote care facility	1 (4%)
Government decision-maker overseeing remote care provision	0 (0%)
Health care administrator, manager, or director within health authority overseeing remote care provision	4 (14%)
Physician overseeing remote care provision	14 (50%)
Registered nurse overseeing remote care provision	4 (14%)
Nurse practitioner overseeing remote care provision	0 (0%)
Other (included: physicians (in urban, rural and remote areas, involved in primary care, emergency and intensive care), nurses and nurse practitioners, and medical microbiology)	7 (25%)
<b>Occupational Setting</b>	
Hospital	20 (71%)
Ambulatory (outpatient) care clinic	6 (21%)
Community care (e.g., public health clinic, family health centre, community outpost)	6 (21%)
Palliative (supportive) care	1 (4%)
Home care	1 (4%)
Public health	0 (0%)
Physician's office	3 (11%)
Telehealth or telepharmacy service	8 (29%)
Pre-hospital settings	2 (7%)
Health research or academic institute	4 (14%)
Government or regional health authority	5 (18%)
Other (= emergency department, nursing station, rural health centre with no physician)	3 (11%)
<b>Geographical Setting</b>	
Urban	15 (54%)
Rural	15 (54%)
Remote	12 (43%)
Other (=support practice in remote locations, private clinic)	2 (7%)

1053 Note: some respondents identified as working in more than one geographical setting.



1054 **Appendix 3: Tools, Policies, Guidelines and Other**  
 1055 **References for Sepsis Detection Suggested by Survey**  
 1056 **Respondents**

1057 Please note that some of these documents are either not publicly available, or we were unable  
 1058 to identify a publicly available source based on the information provided. Two respondents  
 1059 noted they use UpToDate online for sepsis tools. These are available for individuals or  
 1060 organizations with a subscription to [UpToDate.com](http://UpToDate.com). This is not a comprehensive list of tools for  
 1061 detecting or diagnosing sepsis - many other agencies and associations have also developed  
 1062 such guidance.  
 1063

1064 **Pediatric**

- 1065 • [Clinical practice guidelines for nurses in primary care – pediatric and adolescent care](#)  
 1066 [update in progress]. Health Canada. First Nations and Inuit Health; 2012. \*Intended for use  
 1067 by community health nurses providing primary care in remote First Nations communities.  
 1068 Health Canada is also working on guidance for diagnosing sepsis, including laboratory work  
 1069 and protocols for patient referral and physician support. This is in draft form and expected to  
 1070 be released soon.
- 1071 • [Patient screening for sepsis](#). Child Health BC; 2015.
- 1072 • Could this pediatric patient have sepsis? 0 days of age – 17 years of age less 1 day  
 1073 (adapted from [TREKK](#)<sup>1</sup> PedsPac<sup>58</sup>). Child Health BC; 2017.
- 1074 • Pediatric septic shock algorithm: 0 days of age – 17 years less 1 day (adapted from [TREKK](#)<sup>\*</sup>  
 1075 PedsPac<sup>58</sup>). Child Health BC; 2017.
- 1076 • Pediatrics-initial management of pediatric septic shock in emergent/urgent care settings: 0  
 1077 days of age – 28 days of age. Child Health BC; [n.d.].
- 1078 • Pediatrics-initial management of pediatric septic shock in emergent/urgent care settings: 29  
 1079 days of age – 1 years of age less 1 day. Child Health BC; [n.d.].
- 1080 • Physician orders for pediatric severe sepsis, Interlake-Eastern Regional Health Authority;  
 1081 2017.
- 1082 • Pediatric sepsis assessment screening tool (age less than 17 years). Interlake-Eastern  
 1083 Regional Health Authority; 2017.
- 1084 • Pediatric sepsis assessment/screening tool. Northern Health Region, Manitoba; 2013.
- 1085 • [American College of Critical Care Medicine Clinical practice parameters for hemodynamic  
 1086 support of pediatric and neonatal septic shock](#) [PALS pediatric sepsis guidelines].<sup>99</sup>  
 1087

1088 **Adult**

- 1089 • [Adult care: Clinical practice guidelines for nurses in primary care](#) [update in progress].  
 1090 Health Canada, First Nations and Inuit Health; 2015. \*Intended for use by community health  
 1091 nurses providing primary care in remote First Nations communities. Health Canada is also  
 1092 working on guidance for diagnosing sepsis, including laboratory work and protocols for  
 1093 patient referral and physician support. This is in draft form and expected to be released soon.
- 1094 • Adult sepsis/severe sepsis medical directive – trigger tool. Saskatoon Health Region, [n.d.].
- 1095 • Physician’s order sheet orders for: adult severe sepsis and septic shock. Interlake-Eastern  
 1096 Regional Health Authority, Manitoba; 2014.

---

<sup>1</sup> TREKK = Translating Emergency Knowledge for Kids, based at the Children’s Hospital Research Institute of Manitoba. Their updated (September 26, 2018) Pediatric Severe Sepsis Algorithm (for children > 28 days of age) is available at: <https://trekk.ca/events/Updated-sepsis-algorithm><sup>59</sup>

- 1097 • Treatment of adult with suspected sepsis (age greater than 16 years). Interlake-Eastern  
1098 Regional Health Authority, Manitoba; 2017.
- 1099 • Adult diagnostics – bloodwork (age greater than 16 years). Interlake-Eastern Regional  
1100 Health Authority, Manitoba; 2017.
- 1101 • Sepsis protocol developed at the Queen Elizabeth Hospital [confidential documents],  
1102 Charlottetown, PEI; [n.d.].
- 1103 • Criteria for sepsis/septic shock. Health PEI; [n.d.].
- 1104 • [Provincial Antibiotic Advisory Team empiric antibiotic treatment guidelines for sepsis](#)  
1105 [syndromes in adults](#). Health PEI; 2014.
- 1106 • ER triage sheet [in progress, nearing completion – builds on the BC guidelines but geared to  
1107 community emergency practice].
- 1108 • Surviving Sepsis Campaign guidelines and updates.<sup>18,61</sup>

DRAFT