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Understanding Canadian Health Professionals' Knowledge, Attitudes, Opinions, and Perceptions Towards Zoonotic Infectious Diseases Survey and Interviews 2023-2024

Revised Report

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Understanding Canadian Health Professionals' Knowledge, Attitudes, Opinions, and Perceptions Towards Zoonotic Infectious Diseases: Survey and Interviews 2023-2024 – Final report

Prepared for Public Health Agency of Canada by Environics Research

March 2024

Revised November 2024 (Figure 9)

This public opinion research report presents the results of a quantitative and qualitative research study conducted by Environics Research on behalf of the Public Health Agency of Canada (PHAC). This study was reviewed and approved by the PHAC Research Ethics Board (Project File 2023-031P). The quantitative research consisted of an online survey of 1,023 Canadian health professionals in two groups: 526 physicians and 497 registered nurses/nurse practitioners. Participants were recruited through MDBriefCase, an organization providing accredited professional development education to medical professionals in Canada. This organization is in regular contact with more than 103,000 active health professionals. The survey was in field from December 5, 2023, to February 7, 2024. The qualitative research consisted of 38 interviews of 41 health professionals, conducted with 22 physicians and 19 nurses recruited from the same target population as the quantitative survey. 35 interviews were conducted individually while 3 interviews were conducted as diads with colleagues. 38 participants for interviews were recruited from the quantitative survey while 3 were referred by colleagues. The interviews were conducted from January 18 to February 6, 2024.

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Cette publication est aussi disponible en français sous le titre *Comprendre les connaissances, les attitudes, les opinions et les perceptions des professionnels et professionnelles de la santé au Canada relativement aux maladies infectieuses zoonotiques: Sondage et entrevues, 2023-2024.*

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Executive summary

A. Background and objectives

Zoonotic infectious diseases (ZIDs) include a wide range of illnesses that pose a significant threat to human health. Currently, about 60 percent of known infectious diseases in humans and 75 percent of all emerging infectious diseases are zoonotic.[1] Furthermore, climate change has increasingly been found to act as a driving force behind the emergence and re-emergence of ZIDs.[2] Zoonotic events such as the 2002-2004 SARS outbreak, 2009 H1N1 pandemic, and the 2022 mpox outbreak have shown how ZIDs can impact the health of Canadians, the healthcare system, and the economy.[3] It is therefore critical for health professionals to have the capacity to identify, prevent, manage, and respond to ZIDs, to ensure preparedness and a coordinated response to address the latest zoonotic threats to the health and safety of the Canadian population.

PHAC has recognized this need for capacity building related to ZIDs among health professionals. Results from an extensive literature review conducted by PHAC showed the existence of literature on the general knowledge needs of health professionals, including knowledge needs related to infectious diseases. However, the available literature did not address the capacity-building needs of health professionals related to ZIDs specifically, despite the growing and evolving threat of these diseases to the health and safety of the Canadian population. Without an understanding of the capacity-building requirements of health professionals, it is challenging to address these needs. Therefore, it is important to identify the gaps in ZID knowledge, attitudes, opinions, and perceptions among health professionals in Canada through public opinion research (POR). This public opinion research project being led by the Zoonoses Health Professionals Guidance Team is part of a broader zoonoses program being advanced by the Zoonoses Division at PHAC.

The purpose of this research was to identify the knowledge, attitudes, opinions, and perceptions of Canadian human health professionals in relation to ZIDs to better understand their current public health and clinical practices as well as their knowledge and resource needs relating to ZIDs. The objectives of this research were to understand the current landscape in terms of knowledge and experience with ZIDs, identify barriers in providing ZID care, and ascertain information needs and learning preferences among health professionals where ZIDs are concerned.

The results of this research will inform guidance development and dissemination priorities related to ZIDs, in order to inform public health and primary care practice of health professionals in Canada, with consideration for the specific needs of key groups of healthcare professionals. By addressing the guidance needs identified

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[1] Woodhouse and Gowtage-Sequeria, "Host Range and Emerging and Reemerging Pathogens," *Emerging Infectious Diseases*, no. 11(12)(2005): 1842–1847, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3367654/; Jones et al., "Global trends in emerging infectious diseases," *Nature*, no. 451 (2008): 990-993, https://www.nature.com/articles/nature06536.

[2] Bartlow et al., "Forecasting Zoonotic Infectious Disease Response to Climate Change: Mosquito Vectors and a Changing Environment," *Veterinary Sciences*, no. 6(2)(2019): 40, https://doi.org/10.3390/vetsci6020040.

[3] Canadian Medical Association and Deloitte, "A struggling system: understanding the health care impacts of the pandemic," CMA Digital Library, November 2021, https://digitallibrary.cma.ca/link/digitallibrary7; Balint et al., "Chapter 3: The 2003 SARS Outbreak in Canada: Legal and Ethical Lessons About the Use of Quarantine," *Ethics and Epidemics*, no. 9 (2006): 43-67, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7162264/; Hodge, "Canadian Healthcare Workers' experiences during pandemic H1N1 influenza: Lessons from Canada's response," National Collaborating Centre for Infectious Diseases, 2014, https://nccid.ca/publications/canadian-healthcare-workers-experiences-during-pandemic-h1n1-influenza/.

through this research, this work will aim to ensure that health professionals are equipped to address ZID threats, and protect the health and safety of Canadians.

B. Methodology

This research study consisted of two parts:

1. **Quantitative survey**: A 15-minute online survey with a representative sample of 1,023 Canadian health professionals who may encounter ZIDs in their practice in two groups: 526 physicians and 497 registered nurses and nurse practitioners. The survey was in field from December 5, 2023 to February 7, 2024.

2. **Qualitative interviews:** 35 IDIs (Individual interviews) and 3 diads were conducted with 38 survey participants and 3 participants who were referred by colleagues. A total of 38 interviews were conducted with 22 doctors and 19 nurses.

Quantitative survey

The survey sample came from MDBriefCase, an organization providing accredited professional development education to medical professionals in Canada. MDBriefCase's database provides access to more than 103,000 active health professionals. MDBriefCase was responsible for inviting and directing qualified respondents to the survey hosted by Environics. As this online survey used an opt-in list of health professionals, it is a non-probability survey. Thus, it cannot be assumed to be fully representative of the target population and no margin of sampling error is calculated. Results in this report are described as based on those responding and not representative of the population of doctors and nurses.

Environics achieved the following regional distribution among survey participants; final data were weighted to reflect regional distribution within each group based on Canadian Health Institute for Health Information (CIHI) data from 2020.[4]

Table 1 – Regional distribution of completed surveys

Occupation	Canada	Atlantic	Quebec	Ontario	MB/SK	Alberta	BC + Terr
Physicians/GPs	526	29	57	270	32	61	77
Nurses/nurse practitioners	497	58	44	171	77	85	62

Respondents were offered an incentive of $35 for their participation. MDBriefCase was responsible for providing incentives to their panellists through gift cards. Respondents had the choice to complete the survey in English or French; 953 surveys were completed in English and 70 in French.

[4] Canadian Institute for Health Information, "Health workforce in Canada: In focus (including nurses and physicians)," 2020, https://www.cihi.ca/en/health-workforce-in-canada-in-focus-including-nurses-and-physicians.

Qualitative interviews

The qualitative research is based on 38 semi-structured interviews with doctors, registered nurses, and nurse practitioners. Interviews were mainly conducted through a Canadian, privacy-authorized online web-based platform called Recollective, but some were conducted via Zoom or by telephone to accommodate participants who were not able to use Recollective.

Participants were recruited from the survey, which contained a short qualitative screener that asked respondents if they wished to opt-in for the qualitative research. Invitations were deployed to survey respondents from the opt-in list; to ensure a diverse mix of interview participants, some respondents in the list were prioritized for invitations based on location and specific practice experience. Participants were also given the option to invite colleagues with relevant expertise or delegated responsibilities; only 3 participants pursued this option, resulting in a total of 41 interview participants in 38 interviews.

Qualitative interview participants could choose to do their interview in English or French; 33 interviews were conducted in English and 5 in French. Participants comprised a mix of ages, gender, years of experience, clinical specialization, prior knowledge of zoonotic diseases, region, and experience with Indigenous populations. Interviews lasted 30 to 45 minutes. Participants were offered an incentive of $320 for their participation, paid by e-transfer from Environics Research.

Qualitative research provides insight into the range of opinions held within a population, rather than the weights of the opinions held, as measured in a quantitative survey. The results of the qualitative research should be viewed as indicative rather than projectable to the population.

C. Contract value

The contract value was $249,871.25 (including HST).

D. About the report

The report begins with an executive summary outlining key findings and conclusions, followed by a detailed analysis of the quantitative survey data and qualitative interviews.

Quantitative results were analyzed by sub-groups including practitioner type, practice area or specialty, practice setting, region, and other key demographic and experience metrics to illuminate the findings where relevant. Statistical differences between sub-groups are noted in the report where they are interpreted to be important and relevant to the analysis. Differences between gender groups were omitted, due to the distinct differences in gender composition between doctors (52% women, 44% men) and nurses (89% women, 9% men). Put another way, 84% of all men who completed the study are doctors, and 62% of all women who completed the study are nurses. This difference means that statistically significant relationships between men and women in the study are likely to be spurious, and better explained by looking at their professional characteristics. Provided under a separate cover is a detailed set of “banner tables” presenting the results for all questions in the quantitative survey by population segments as defined by region, demographics, and practice details.

The qualitative findings in the main report were written based on the structure of the interview guide, with additional sections for themes and findings that emerged from the research. These results were used to further complement the findings from the quantitative survey on the barriers to accessing information and the

information needs of physician and nurses in primary care and public health with respect to ZIDs. Quotations from the participants were included throughout the qualitative section to support the themes and findings.

Use of findings of the research. Data from this research will be used to identify and address the gaps in ZID knowledge, attitudes, opinions, and perceptions among health professionals in Canada for high priority diseases. This will aim to ensure health professionals have greater capacity to address zoonotic threats to the health and safety of the Canadian population.

E. Key findings

Key findings – Quantitative survey

Only 32% of health professionals report encountering zoonoses at least once a month among their patients, indicating that most do not encounter zoonoses frequently. When looking at specific diseases, Lyme disease is the disease encountered most by physicians and nurses in Canada; it is the only disease that was encountered by a majority of respondents. Other diseases among the list of 52 ZIDs included in the survey range from just 1% to 38% of health professionals saying they have encountered them in their practice. Diseases that are encountered more often tend to be those associated with well-known past outbreaks or epidemics (e.g., West Nile virus infection, rabies, Zika virus infection, mpox), common travel-related illnesses (e.g. chikungunya, cryptosporidiosis), and diseases that can be occupational hazards or risks for vulnerable patients (e.g., toxoplasmosis, bartonellosis, brucellosis). Most nurses and physicians did not mention other zoonoses of relevance to the scope of the zoonoses program work being led by the Zoonoses Health Professionals Guidance Team in the Zoonoses Division at PHAC.

The majority of doctors and nurses (89%) report having general, limited, or no knowledge on ZIDs. Very few rate their knowledge as expert or advanced (nurses 7%, physicians 15%). None of the nurses in the study rated their knowledge level as “expert.”

A bivariate analysis shows there is a clear and positive correlation between encountering a disease, and self-reported confidence in managing it. Lyme disease stands out from others for being encountered most often, and with the highest ratings for confidence. A multivariate regression analysis shows that even in combination with other variables, like self-rated knowledge and various disease characteristics, encountering a disease is the strongest driver of confidence in managing diseases. This finding was echoed in the qualitative research, where participants often noted that their lack of confidence about managing ZIDs was specifically due to the rarity of these diseases in everyday practice.

For diseases that are more well-known, self-rated knowledge is also a key driver of self-reported confidence. Based on the quantitative and qualitative research, education about ZIDs is quite limited for most health professionals. From qualitative interviews, it appears that self-rated knowledge of specific ZIDs is largely built on information from sources such as public health bulletins, experience with patient cases, and articles in journals or magazines. This could explain why knowledge is often a more important driver of confidence for the more frequently encountered diseases than it is for others.

Physicians are more satisfied (52%) with the formal ZID education provided in the context of their academic program (e.g., medical school, residency, nursing school) than nurses (31%). Nearly one-quarter of nurses (23%) say they did not receive any education on ZIDs during their formal healthcare training on ZIDs, which was substantially more than the amount of doctors (7%) who say they did not receive such training. Satisfaction with formal education on ZIDs is higher for those practicing family medicine, those who see ZIDs more frequently (i.e. daily, weekly, or monthly), and those with experience practicing outside of Canada. In the multivariate regression analysis, satisfaction with formal education on ZIDs was a significant, albeit smaller, driver of self-reported confidence in managing ZIDs.

Physicians and nurses are equally satisfied with continuing education on ZIDs, when they have received it. Nearly half (46%) of physicians who received continuing education on ZIDs are satisfied with this education, just slightly lower than the proportion of physicians satisfied with their formal education (52%). In contrast to formal education satisfaction, nurses show an equal level of satisfaction with continuing education (47%) when compared to physicians.

A minority of health professionals indicate they are confident in providing specific ZID information or services; overall self-reported confidence is highest for public health reporting and lowest for patient management. Practice area seems to play a role here; those specializing in public health or working in public health settings are more confident about public health reporting, infection control, and contact tracing, while those in emergency and critical care say they are most confident about patient assessment, diagnosis, and patient management.

Results of the quantitative research indicated that federal, provincial and territorial government health websites and digital clinical support tools are the resources used most; information from the qualitative interviews indicated that digital tools, especially the clinical decision support resource, UpToDate, are the most preferred. Given that health professionals indicated in the survey that the biggest barrier to caring for ZID patients is keeping up with the latest information, it is not surprising that they also expressed a strong preference for a tool that includes this concept in its branding.

Almost all health professionals surveyed are at least somewhat interested in receiving more professional education on ZIDs. They rank treatment, prevention, and diagnosis as the topics they would most like to learn about. In terms of formats, self-directed online learning, interactive online courses, webinars and fact sheets are the top formats preferred by health professionals. Format preferences differ by sub-group in some instances, for example, fact sheets are preferred more often by nurses and those practicing in rural areas, while physicians are more inclined to pursue continuing medical education (CME) and read journal articles.

K-means analysis was used to cluster respondents accordingly to similarities in the diseases they encountered; this analysis partitioned respondents into four discrete clusters. Cluster 1 is experienced and confident with a wide range of ZIDs including those that are extremely rare; most are physicians in urban hospitals. They encounter patients with ZIDs more often than health professionals in the other clusters. **Cluster 1** health professionals use a range of ZID resources often and are quite amenable to further training on the subject. **Cluster 2** is experienced with some specific diseases, particularly respiratory diseases associated with livestock and wildlife, and hantavirus diseases associated with crowded living conditions, likely because they work in front-line settings where they are more likely to encounter patients at risk of specific ZIDs due to occupational or lifestyle risks. **Cluster 2** health professionals have some interest in learning more about ZIDs, but time is a significant barrier and they are most interested in resources that are easy to use and available when they need them. Respondents in **Cluster 3** are more likely to work in family practices and community care, sometimes in rural settings, where they rarely or never see ZIDs in patients. Their experience, confidence, and knowledge about ZIDs is limited, but the nature of their practices means that learning more about ZIDs is not a priority for them. **Cluster 3** health professionals are most interested in resources that are short, easy to understand, and of demonstrable relevance to their practice. Health professionals in **Cluster 4** have higher levels of experience with some specific diseases, in particular West Nile virus infection, and are the most likely among the four clusters to work in a public health or travel clinic setting (although most work in hospitals or family practice). They tend to have knowledge of ZIDs in a direct patient care context where patients may be diagnosed with ZIDs while seeking care for other reasons. **Cluster 4** health professionals are more frequent users of ZID resources than Cluster 2, but like Cluster 2, time to look up symptoms for each patient is a critical barrier.

A principle components analysis was used to group the 52 diseases from the survey into groups (or factors) of diseases that tend to be seen by the same health professionals. Seven groups were defined by this analysis; additional research was used to identify shared characteristics of the diseases in each group. The seven

groups can be broadly described as: rarely encountered, common endemic and travel diseases, outdoor and agricultural occupational risks, rare emerging and travel-related diseases, diseases related to crowded living conditions, respiratory diseases from livestock and wildlife, and rare encephalitic diseases.

The seven disease groups were analyzed to see which clusters, identified by the K-means analysis, were most associated with each disease group; this analysis can be used to inform strategic resource development to target resources to those health professionals for whom they are most relevant in practice. Cluster 1 is experienced in all seven groups. Cluster 2 is strongly associated with the respiratory diseases from livestock and wildlife group, and is also fairly experienced with common endemic and travel diseases, some diseases associated with outdoor and agricultural occupational risks, and the diseases related to crowding living conditions group (especially the hantaviruses in this group). Cluster 4 has specific experience with Lyme disease, mpox, West Nile virus infection (from the common endemic and travel diseases group) and bartonellosis (outdoor and agricultural occupational risks).

Key findings – Qualitative

Primary care practitioners rarely identified ZID cases in their practices. Some said they provide counselling, vaccinations, or referrals for those with specific risk factors (animal exposure, recent travel, travel plans). In line with findings from the survey, **Lyme disease was the most common ZID encountered in everyday practice**, with health professionals across Canada often seeing patients with concerns about the risk. Participants located in Ontario, Quebec, and some parts of Atlantic Canada sometimes treated patients with Lyme disease, while those in other regions typically fielded questions about the disease but did not see active cases in patients.

Lack of experience with ZIDs drove low self-reported confidence in managing them. With most receiving limited training and continuing education on ZIDs, knowledge of specific diseases was very limited among physicians and nurses. Interview participants often pointed to this as a driver of low confidence in managing diseases. Additionally, due to the heavy demands of the job, **ZIDs were simply not seen as a priority for learning unless they were directly relevant to their practice**. Some health professionals had a higher degree of confidence in managing specific diseases like Lyme disease or rabies, but only when these were common in their practices.

UpToDate was the resource mentioned most often in interviews; PHAC and other Government of Canada resources were familiar, but generally not top-of-mind. UpToDate is a favourite resource for many nurses and physicians, who said it is easy to use, trustworthy, and up to date with recent research and recommendations. For infectious disease topics, the United States Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) were both frequently mentioned as good resources. Often, health professionals said they start with a Google search and look for reputable sources in the results, like Mayo Clinic and Johns Hopkins. Government of Canada resources were somewhat well-known, and many participants had used them intermittently, but they were often seen to be difficult to navigate, which limited their usefulness in situations where information was needed quickly.

An ideal resource would be a searchable web and app platform that is easy to use, with Canadian context. The relative rarity of most ZIDs in Canada meant they were not high on the priority list for deeper study or continuing education. Some interview participants pointed out that it was more important for them to know protocols for handling a potential case if it arises, rather than knowing specifics about individual diseases. Health professionals indicated that an ideal resource would be a user-friendly online database that they could access in an app or on a website, with different options for searching (e.g., by geography, symptom, patient risk factors, species involved, etc.). Canadian context was noted to be an important element, because different disease

factors like endemicity, diagnostic tools, and treatment options can differ from country to country, and regionally within a country. **Public health bulletins, infographics and articles were also seen as useful ways to drive familiarity with specific diseases, especially when there is imminent concern.**

Key Findings – Conclusion and Recommendations

Five broad considerations for future resource development and capacity building were drawn from the research findings:

1. Resources should be relevant and realistic:

    - Next steps should be grounded in the understanding that most health professionals do not realistically have the capacity for intensive study about ZIDs.

    - ZIDs are perceived as a low priority for learning among most health professionals because most do not encounter patient cases of ZIDs very often, and ZIDs are also easily conflated with other infectious diseases that are not zoonotic.

    - Education about specific ZIDs will be most effective when it is very strategic and geared for the right audiences.

    - Look for opportunities to ensure that more general information about ZIDs is integrated in resources about infectious diseases.

2. Resources are most useful if they are broad in scope, accessible, and easy to use:

    - The best resource for most health professionals is one that is easy to reach in a time of need, but that otherwise does not command much time or attention.

    - Since health professionals are not generally able to identify specific gaps in the resource landscape, it is therefore necessary to anticipate their needs to some extent by prioritizing what is most important for them to know.

    - It may be effective to enhance existing resources that health professionals already know about and reach for in everyday practice.

3. Health professionals know what resources have worked for them in the past:

    - Health professionals take it seriously when an infectious disease becomes a threat to the community. They will pay attention to information about outbreaks or diseases of concern, and they appreciate materials that help them to identify risk factors in their patients.

    - It may be useful to look at the resources and education approaches used for ZIDs where health professionals had higher levels of experience and self-reported confidence.

    - Physicians specifically will also take note of diseases they read about in journals and magazines.

4. Resources can be designed to be very strategic to increase their relevance and uptake:

- The multivariate analysis can be applied to more effectively target resources that are effective for specific settings or types of health professionals.

- The multivariate analysis could also inform communication about specific diseases to the audiences who need them most.

5. Collaboration and consultation with colleagues can grow capacity:

    - The single biggest influence on self-reported confidence in managing ZIDs is experience with specific diseases, which makes experienced colleagues a valuable resource.

    - Consider ways to encourage more health professionals to build knowledge and confidence with ZIDs at different stages of their career. Having even one colleague with more ZID experience can build capacity for an entire practice.

Political neutrality statement and contact information

I hereby certify as senior officer of Environics that the deliverables fully comply with the Government of Canada political neutrality requirements outlined in the Communications Policy of the Government of Canada, and Procedures for Planning and Contracting Public Opinion Research. Specifically, the deliverables do not include information on electoral voting intentions, political party preferences, standings with the electorate, or ratings of the performance of a political party or its leaders.

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Introduction

Zoonotic infectious diseases (ZIDs) include a wide range of illnesses that pose a significant threat to human health. Currently, about 60 percent of known infectious diseases in humans and 75 percent of all emerging infectious diseases are zoonotic.[5] Furthermore, climate change has increasingly been found to act as a driving force behind the emergence and re-emergence of ZIDs. Altering climate patterns and ecological shifts can disrupt natural habitats, leading to shifts in the distribution and behaviour of vectors and reservoir hosts, and thereby facilitating the transmission of pathogens to human populations.[6] Zoonotic events such as the 2002-2004 SARS outbreak, 2009 H1N1 pandemic, and the 2022 mpox outbreak have shown how ZIDs can impact the health of Canadians, the healthcare system, and the economy.[7] These threats demonstrated the crucial role health professionals play on the frontlines when encountering ZIDs. It is therefore critical for health professionals to have the capacity to identify, prevent, manage, and respond to ZIDs, to ensure preparedness and a coordinated response to address the latest zoonotic threats to the health and safety of the Canadian population. PHAC has recognized this need for capacity building related to ZIDs among health professionals. This public opinion research project is part of a broader zoonoses program being advanced by the Zoonoses Division at PHAC. The Zoonoses Health Professionals Guidance Team within the Zoonoses Division has been conducting this project as part of a larger prioritization project that aims to identify high priority ZIDs for guidance/resource development and dissemination activities.

PHAC conducted an examination of the literature to gauge the extent of research on health professional capacity-building needs for ZIDs. It was a comprehensive review of the available literature related to health professionals' capacity-building needs, including their need for knowledge resources. This review included searches in academic databases, relevant journals, and reports. The intention was to cast a wide net to capture any relevant information.

Results showed the existence of literature on the general knowledge needs of health professionals, including knowledge needs related to infectious diseases. However, the available literature did not address the capacity-building needs of health professionals related to ZIDs specifically, despite the growing and evolving threat of these diseases to the health and safety of the Canadian population. Without an understanding of the capacity-building requirements of health professionals, it is challenging to address these needs. Therefore, it is important to identify the gaps in ZID knowledge, attitudes, opinions, and perceptions among health professionals in Canada through public opinion research (POR).

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[5] Woodhouse and Gowtage-Sequeria, "Host Range and Emerging and Reemerging Pathogens," *Emerging Infectious Diseases*, no. 11(12)(2005): 1842–1847, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3367654/; Jones et al., "Global trends in emerging infectious diseases," *Nature*, no. 451 (2008): 990-993, https://www.nature.com/articles/nature06536.

[6] Bartlow et al., "Forecasting Zoonotic Infectious Disease Response to Climate Change: Mosquito Vectors and a Changing Environment," *Veterinary Sciences*, no. 6(2)(2019): 40, https://doi.org/10.3390/vetsci6020040.

[7] Canadian Medical Association and Deloitte, "A struggling system: understanding the health care impacts of the pandemic," CMA Digital Library, November 2021, https://digitallibrary.cma.ca/link/digitallibrary7; Balint et al., "Chapter 3: The 2003 SARS Outbreak in Canada: Legal and Ethical Lessons About the Use of Quarantine," *Ethics and Epidemics*, no. 9 (2006): 43-67, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7162264/; Hodge, "Canadian Healthcare Workers' experiences during pandemic H1N1 influenza: Lessons from Canada's response," National Collaborating Centre for Infectious Diseases, 2014, https://nccid.ca/publications/canadian-healthcare-workers-experiences-during-pandemic-h1n1-influenza/.

The purpose for this research was to identify the knowledge, attitudes, opinions, and perceptions of Canadian human health professionals in relation to ZIDs to better understand their current public health and clinical practices as well as their knowledge and resource needs relating to ZIDs. The objectives of this research were to:

Understand the current landscape:

- Determine the frequency of health professionals' encounters with ZIDs in their daily practice.
- Assess health professionals' level of self-reported confidence in their practice related to ZIDs.
- Assess health professionals' knowledge related to ZIDs and identify gaps in knowledge.
- Identify existing resources used by health professionals to inform their practice related to ZIDs and how health professionals access the resources (including mechanism and frequency).

Identify barriers in providing ZID care:

- Identify what barriers exist for health professionals in providing evidence-based ZID care.
- Identify what barriers exist for health professionals as it relates to acquiring information related to ZIDs.

Ascertain information needs and learning preferences:

- Identify the ZID topics (e.g., preventability, treatability, severity of illness) that are most relevant and useful for health professionals to leverage in their clinical and public health practices.
- Determine the gaps in the existing ZID educational resources or tools for health professionals.
- Identify trends in the preferred educational resources and learning formats for health professionals relating to ZID information among varied sub-groups of health professionals.

The results of this research will inform the guidance, development and dissemination priorities related to ZIDs, in order to inform public health and primary care practice of health professionals in Canada, with consideration for the specific needs of key groups of healthcare professionals. By addressing the guidance needs identified through this research, this work will aim to ensure that health professionals are equipped to address ZID threats, and protect the health and safety of Canadians.

About this report

This report begins with an executive summary outlining the key findings of the quantitative survey and qualitative interviews, followed by a detailed analysis and breakdown of the results. A detailed description of the survey methodology is presented in Appendix A and the qualitative methodology in Appendix B. The survey questionnaire is provided in Appendix C, the in-depth interview (IDI) discussion guide in Appendix D, and the screener is provided in Appendix E. As this online survey used an opt-in list of health professionals, it is a non-probability survey and cannot be assumed to be fully representative of the target population. Therefore, no margin of sampling error was calculated for this study.

Quantitative results are based on the entire sample and results are expressed as percentages unless otherwise noted. For results shown as graphs, results lower than 3% are not shown. Results may otherwise not add to 100% due to rounding (0.5 rounded up, <0.5 rounded down) or multiple responses. Provided under separate cover is a detailed set of "banner tables" presenting the results for all survey questions for the total and by sub-group segments. These tables are referenced by the survey question in the detailed analysis.

Differences between sub-groups are noted based on Z-test results at 95% probability for comparing proportions, and based on two-tailed T-test results at 95% probability for comparing means. Comparisons are based on differences between sub-groups, and not on differences compared to the total. In data charts in the report, bold and italicized text is used to note differences between sub-groups (i.e., higher results are bolded, lower are italicized). Note that sub-groups with less than 20 respondents (unweighted sample) are excluded from the analysis.

Differences between other sub-groups are called out where relevant. To ensure that differences noted in the report text are robust and meaningful to the analysis, when there are:

- Two comparison groups (e.g., nurses and doctors), any statistically significant difference between groups is called out.
- Three or four comparison groups (e.g., experience, ZID knowledge, practice setting), one group must have statistically significant differences with at least two other groups in the set.
- Five or more comparison groups (e.g. region, practice/specialty), one group must have statistically significant differences with at least three other groups in the set.

The following sub-groups were presented throughout this report:

- Profession
- Region
- Clinical specialty / Practice area
- Total years of experience
- Language of workplace
- Age
- Urban/rural
- Practice setting
- ZID patient encounters
- ZID knowledge level
- Experience outside Canada
- Indigenous experience
- Northern experience

- Satisfaction with formal training related to zoonoses
- Satisfaction with continuing education related to zoonoses

Glossary of terms used in this report:

Zoonoses, or ZIDs: Infectious diseases transmitted between animals and humans. Note that this project is focused on non-enteric zoonoses. The abbreviation ZIDs is used throughout the report.

Nurses: This group contains both registered nurses (RNs) and nurse practitioners (NPs). Mentions of nurses in this report refer to both RNs and NPs.

Northern experience: For the purposes of this project, health professionals with Northern experience were those with current or past experience practicing in any of the Canadian territories (i.e., Nunavut, Yukon, Northwest Territories).

Experience with Indigenous populations: For the purposes of this project, health professionals with experience with Indigenous populations were those who self-identified as having significant experience (at least one year) providing comprehensive health care services to Indigenous (First Nations, Inuit, Métis) populations in Canada.

Encounters: There was no specific definition of encountering in the questionnaire, which could result in a variety of interpretations.

Self-rated confidence in management: There was no specific definition of confidence in managing ZIDs in the questionnaire (i.e., respondents interpreted confidence in managing zoonoses in their own terms), which could extend to a variety of contexts such as feeling confident that they could provide care to a patient with a ZID, or that they could find the resources they need to manage a patient.

Statement of limitations:

When interpreting results, note that because this online survey used an opt-in panel, it is a non-probability survey and no margin of sampling error should be calculated. Reported percentages are not generalizable to any group other than the sample studied, and therefore no formal statistical inferences can be drawn between the sample results and the broader target population it may be intended to reflect.

Note that qualitative research provides insight into the range of opinions held within a population, rather than the weights of the opinions held, as measured in a quantitative survey. The results of the qualitative research should be viewed as indicative rather than projectable to the population.

I. Detailed findings – Quantitative

A. Current landscape

1. *Frequency of encountering patients with zoonotic infectious diseases*

Only 32% of health professionals report encountering zoonoses at least once a month among their patients, indicating that most do not encounter zoonoses frequently.

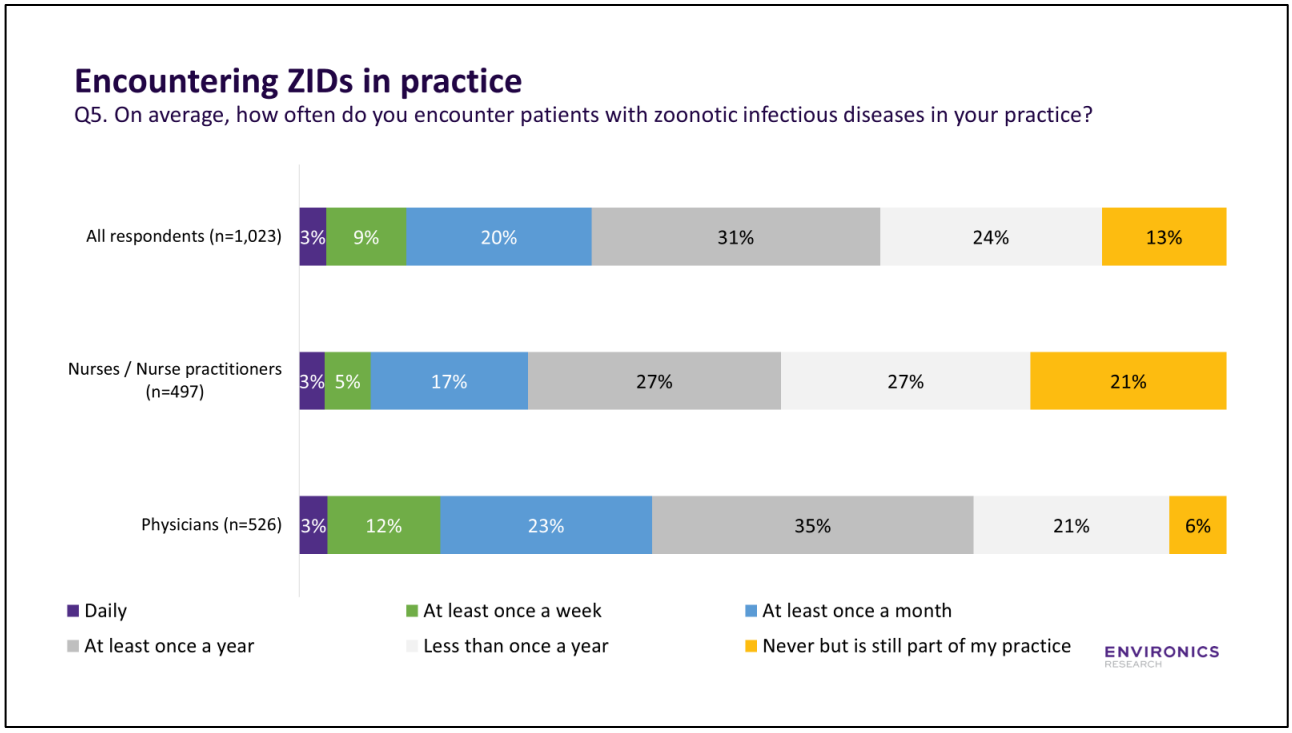

Figure 1 – Encountering ZIDs in practice

Only 32% of health professionals report encountering zoonoses at least once a month among their patients, indicating that most do not encounter zoonoses frequently; a small proportion see them on a frequent basis, i.e. daily or weekly (8% nurses, 15% physicians). One in five nurses (21%) and just 6% of physicians say that while they never encounter ZIDs, these diseases are still part of their practice – this could include health professionals who work in public health, counsel patients about risks, provide vaccines for at-risk groups and travellers, or prescribe other prophylactic measures.

Other sub-groups that are more likely to encounter ZIDs on a daily or weekly basis include:

- **ZID knowledge level:** Those who rate their ZIDs knowledge as expert or advanced (40%).
- **Experience outside Canada:** Those with experience practicing outside of Canada (17%).

Note, those who rate their ZIDs knowledge as limited or no knowledge are less likely to encounter ZIDs on a daily or weekly basis (3%).

2. *Level of knowledge regarding zoonotic infectious diseases*

A majority of doctors and nurses report general or limited knowledge about ZIDs.

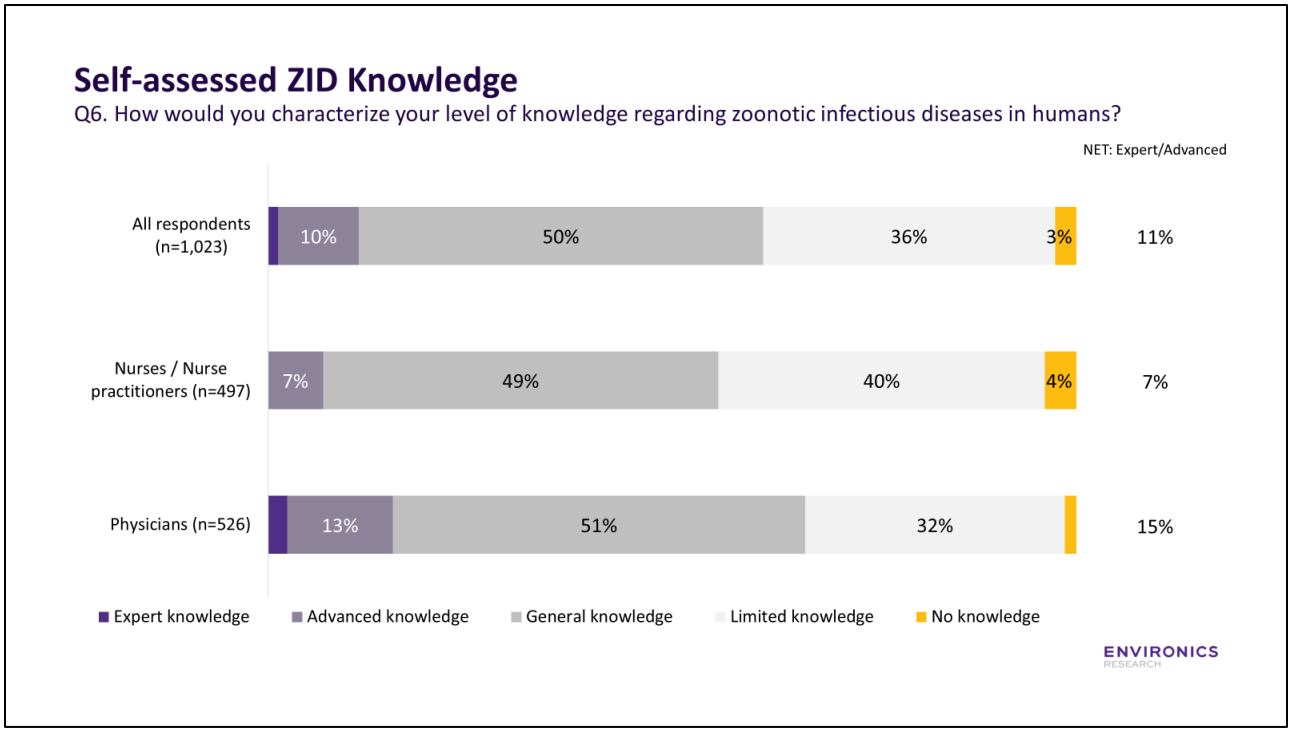

Figure 2 – Self-assessed ZID knowledge

When asked to rate their knowledge of ZIDs, a vast majority of nurses (89%) and physicians (83%) rate their knowledge as either general (nurses 49%, physicians 51%) or limited (40% nurses, 32% physicians). Very few rate their knowledge as expert or advanced (nurses 7%, physicians 15%) – in fact, none of the nurses in the study rated their knowledge as "expert."

Some sub-groups are more likely to rate their knowledge as expert or advanced:

- **Clinical specialty / Practice area:** Those with infectious disease as a specialty or practice area (36%), those who work in public health (19%), and those working in emergency and critical care (17%).
- **Practice setting:** Those who work in public health or travel settings (24%).
- **ZID patient encounters:** Those who encounter ZIDs on a daily/weekly (39%) or monthly (19%) basis.

One sub-group is notably less likely to rate their knowledge as expert or advanced:

- **Total years of experience:** Those with 5 years of experience or less (2%).

3. *Satisfaction with zoonotic infectious disease education during formal healthcare training*

Physicians are more satisfied than nurses with the ZID education they received. Nearly one-quarter of nurses say they did not receive any formal training on ZIDs.

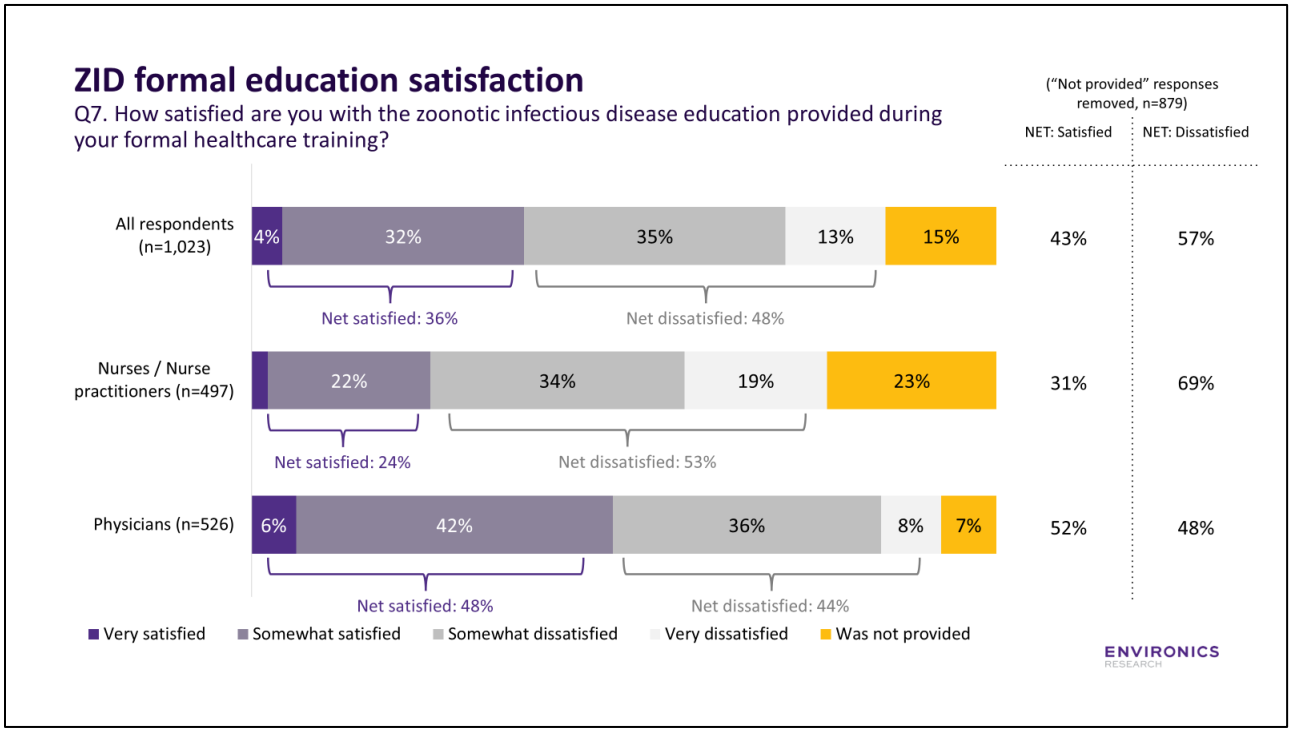

Figure 3 - ZID formal education satisfaction

Physicians are notably more satisfied with the formal education they received about ZIDs, compared to nurses; with "not provided" cases removed, half (52%) of physicians say they are very or somewhat satisfied, compared to just one in three (31%) nurses. Two in three (69%) nurses say they are unsatisfied with their education on this topic. Based on what was heard during the qualitative interviews, nurses and nurse practitioners generally reported receiving little, if any, specific training about ZIDs or infectious diseases in general during nursing school, while physicians in this interviews often recalled receiving training in the form of a formal class, a clinical rotation, or other experience with patient cases during residency.

Looking at satisfaction with responses removed who did not receive formal education on ZIDs, sub-groups more likely to be *satisfied* (NET: very / somewhat satisfied) with their formal education on ZIDs include:

- **Clinical specialty / Practice area:** Those practicing family medicine (44%).
- **ZID patient encounters:** Those who see ZID cases daily/weekly (58%) or monthly (50%).
- **Experience outside Canada:** Those with experience practicing outside of Canada (57%).

Sub-groups more likely to be *dissatisfied* (NET: very / somewhat dissatisfied) with their formal education on ZIDs include:

- **Clinical specialty / Practice area:** Those practicing in community medicine (70%).

- **Language of workplace:** Those who speak French in the workplace (66%).
- **ZID patient encounters:** Those who see ZID patients at least once a year (61%), less than once a year (61%), or never (69%).
- **ZID knowledge level:** Those who rate their knowledge of ZIDs as limited or no knowledge (75%).
- **Experience outside Canada:** Those with no experience practicing outside of Canada (62%).

4. Satisfaction with zoonotic infectious disease continuing professional education

Physicians and nurses are equally satisfied with continuing education on ZIDs, when they have received it.

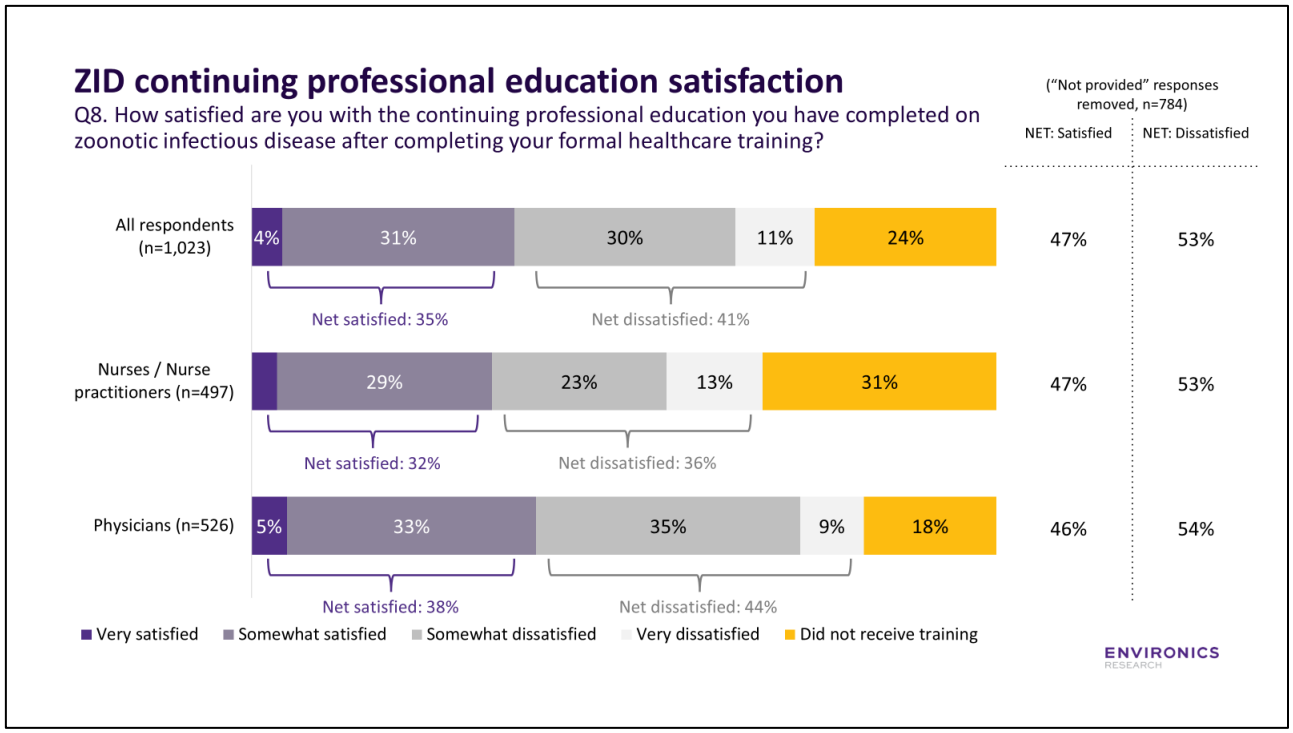

Figure 4 - ZID continuing professional education satisfaction

For physicians, when controlling for different uptakes in formal and continuing education, satisfaction levels for continuing education are similar to those for formal education. Excluding those who did not take any continuing professional education on ZIDs, 46% of physicians who received continuing education are satisfied. For continuing education, nurses show an equal level of satisfaction to physicians, in contrast to formal education, where their satisfaction is lower.

Sub-groups more likely to be *satisfied* (NET: very / somewhat satisfied) with continuing education include:

- **Clinical specialty / Practice area:** Those who practice or specialize in infectious diseases (69%)
- **ZID patient encounters:** Those who see ZIDs in practice on a daily or weekly basis (64%).
- **ZID knowledge level:** Those with expert or advanced knowledge (68%).

Sub-groups more likely to be *dissatisfied* (NET: very / somewhat dissatisfied) with continuing education include:

- **Language of workplace:** Those who speak another language in addition to English or French at work (73%).
- **ZID patient encounters:** Those who see ZIDs less than once a year (66%).
- **ZID knowledge level:** Those with limited or no knowledge related to ZIDs (75%).

B. Zoonotic infectious diseases in practice

1. Zoonotic infectious diseases encountered in practice

A vast majority of health professionals had encountered at least one disease from the list of 52 diseases presented in this survey. Lyme disease tops the list, encountered by three-quarters of nurses and almost nine in ten physicians.

Physicians and nurses were asked which of the 52 ZIDs they encountered in their practice. There was no specific definition of encountering in the questionnaire (i.e. respondents interpreted encountering in their own terms), which could extend to a variety of contexts. More precisely, participants in the qualitative interviews tended to refer to diagnosed cases, suspected cases, testing, differential considerations, patient questions, and public health alerts when recounting the ZIDs they had encountered in their practices.

Lyme disease stands alone as the only one that has been encountered by a majority; no other diseases come close. In total, 94% of survey respondents had encountered at least one disease from the list of 52. Shown in the table on the following page are the diseases encountered by 10% of respondents or more, broken down by practice setting. Looking at statistically significant differences between groups, several diseases are more common for health professionals in hospital settings, where patients may be coming in with acute symptoms, and those in public health settings.

Detailed topline results for this question can be found in Appendix K. The multivariate analysis, later in the report, contains extensive discussion of the relationships between different sub-groups and their likelihood of encountering diseases.

Table 2 - ZIDs most encountered by practice setting (10% or higher overall)

ZIDs encountered	Total (n=1,023)	Family / Walk-in / Urgent care / Long term care (n=466)	Hospital (n=263)	Community (n=126)	Public health / Travel (n=139)
NET: Any disease (of all 52)	*94%*	95%	96%	89%	92%
Lyme disease	80%	83%	81%	71%	75%
West Nile virus infection	38%	31%	**50%**	23%	**60%**
Rabies	37%	34%	33%	36%	**68%**
Toxoplasmosis	37%	35%	**48%**	29%	30%
Avian (zoonotic) influenza: H5N1	34%	33%	**44%**	24%	**37%**
Dengue	30%	31%	33%	24%	30%
Zika virus infection	30%	32%	35%	*10%*	38%
MERS-CoV infection	29%	*23%*	37%	29%	36%
Bartonellosis (cat scratch disease)	29%	31%	**36%**	23%	*13%*
Avian (zoonotic) influenza: H7N9	19%	15%	**28%**	14%	18%
Mpox (monkeypox)	18%	14%	17%	*10%*	**49%**
Chikungunya	17%	21%	15%	*6%*	21%
Tick-borne encephalitis	17%	*12%*	**25%**	13%	23%
Cryptosporidiosis	17%	15%	21%	*12%*	22%
Cutaneous larva migrans	15%	**21%**	13%	10%	*6%*
Rocky mountain spotted fever	15%	15%	20%	12%	13%
Yellow fever	13%	11%	16%	*4%*	**20%**
Q fever	11%	*7%*	15%	10%	18%
Brucellosis	11%	9%	**17%**	7%	13%
Bovine tuberculosis	10%	8%	12%	9%	**18%**
Leptospirosis	10%	9%	15%	8%	7%

Q10a/b. In the following grid, please indicate which diseases you have encountered in your practice, AND rate your level of confidence in managing each zoonotic infectious disease

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

2. Level of self-reported confidence in zoonotic infectious disease management

For nearly all ZIDs, physicians self-rate their confidence higher than nurses. Notable exceptions are MERS-CoV infection and Ebola disease; these diseases were also encountered more frequently among nurses.

Physicians and nurses were asked to rate their confidence in managing each ZID in a list of 52. The question was asked without a specific definition for confidence, therefore respondents interpreted this in their own terms. Differences in interpretation were noted during the qualitative interviews, when participants discussed their own self-reported confidence; for some this specifically meant their ability to manage a patient with a ZID, but for others, confidence meant knowing where to access protocols and resources.

Mean self-reported confidence scores are based on a 4-point scale where 1 = “Not at all confident” and 4 = “Very confident.” The mean ranges from 1 to 4 and includes all respondents, regardless of encounter. Shown on the following page are self-reported confidence scores for the top diseases with confidence ratings of 1.30 or higher. Complete results for this question can be found in Appendix K. A multivariate analysis discussed later in the report contains further discussion of the relationships between different sub-groups and their likelihood of encountering diseases.

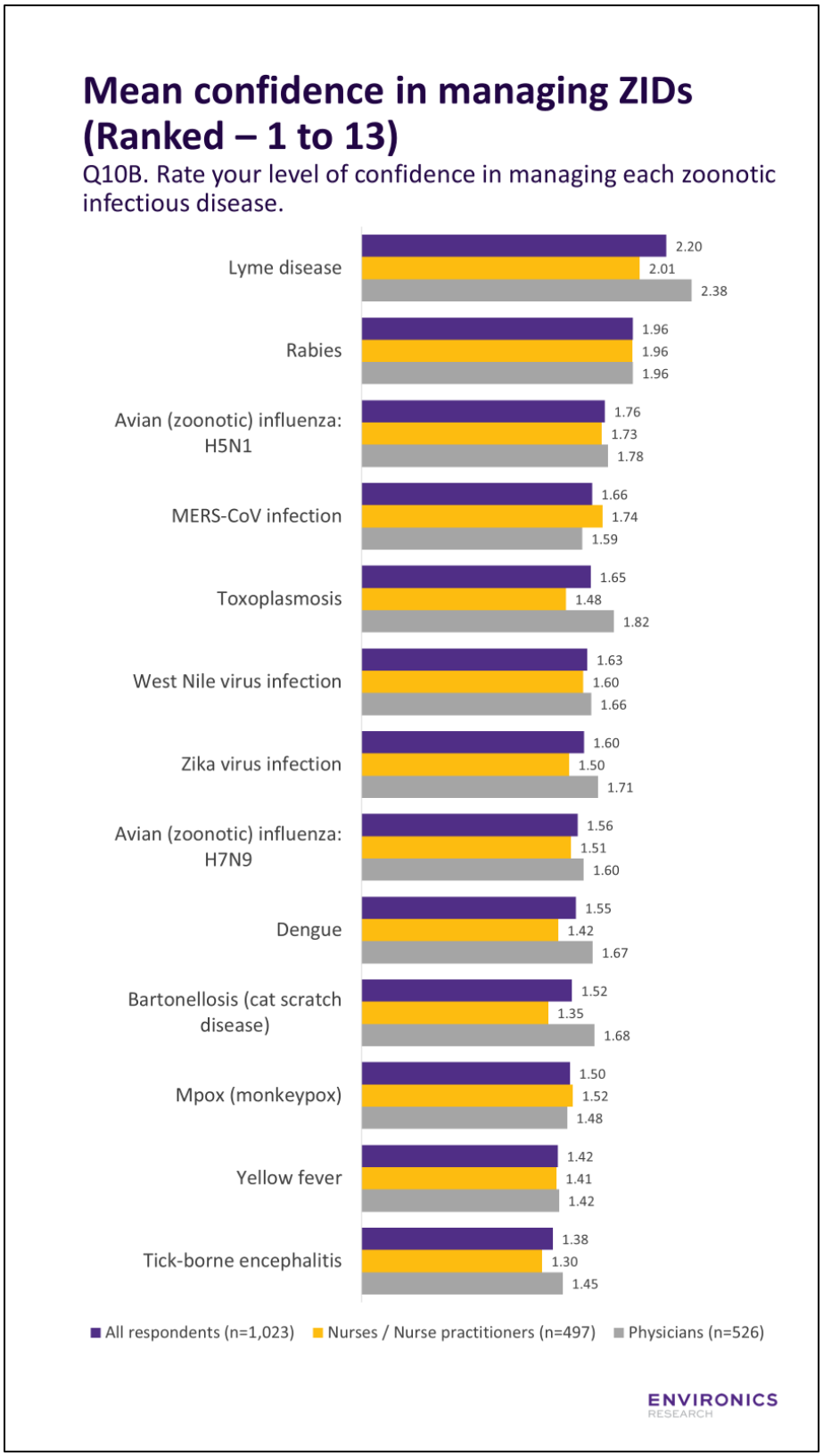

Figure 5 – Mean confidence in managing ZIDs (Ranked 1 to 13)

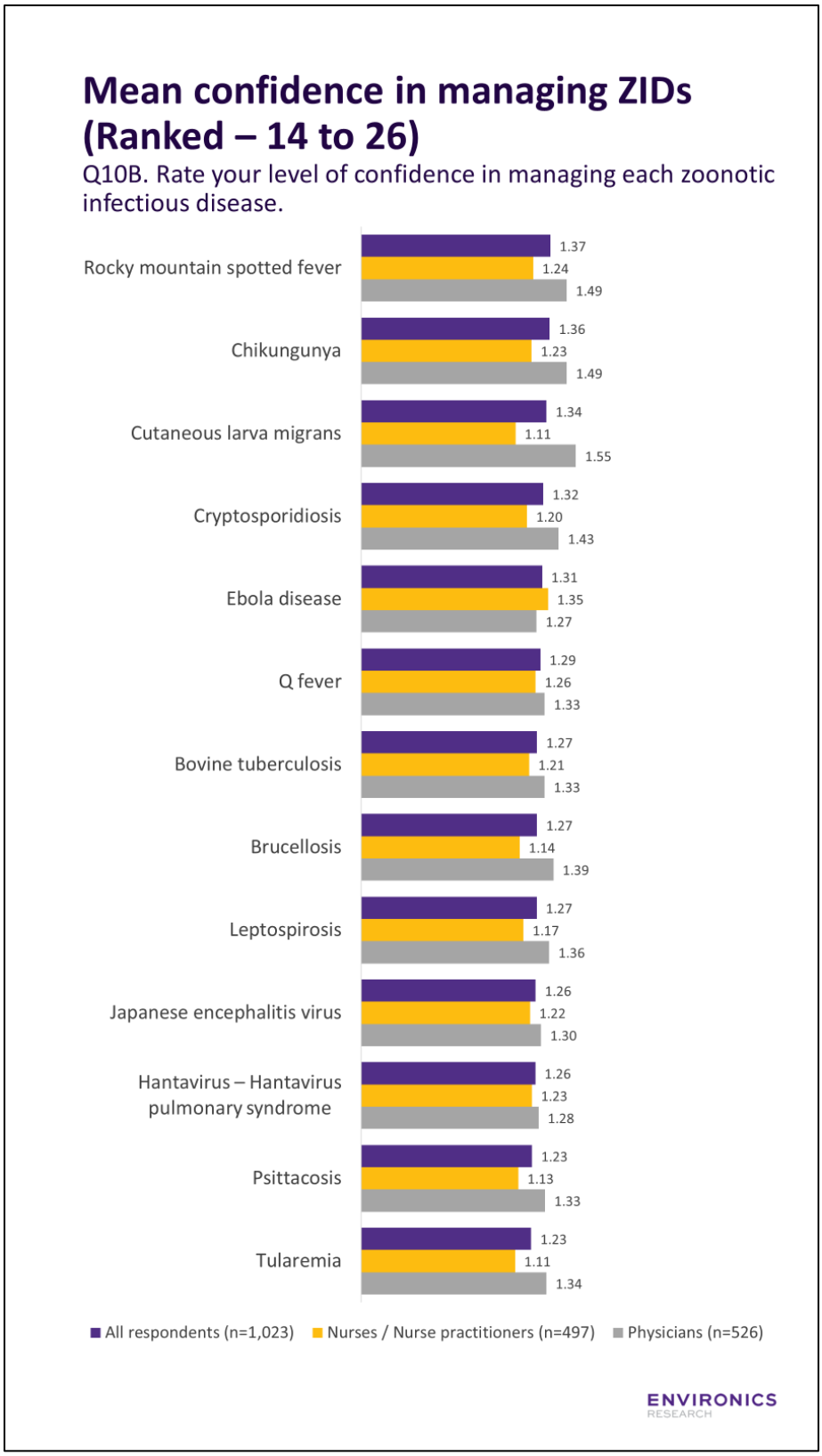

Figure 6 - Mean confidence in managing ZIDs (Ranked 14 to 26)

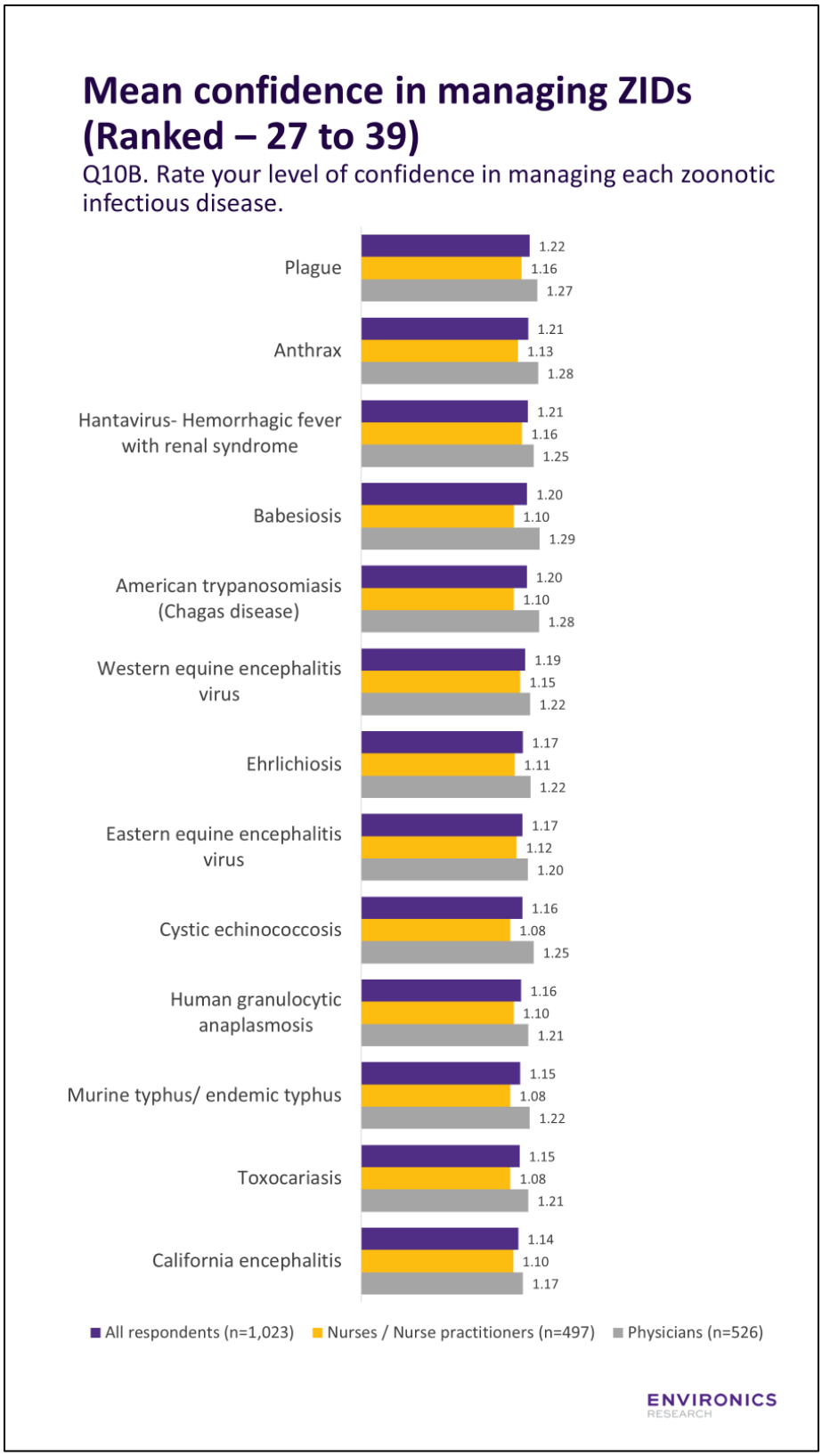

Figure 7 - Mean confidence in managing ZIDs (Ranked 27 to 39)

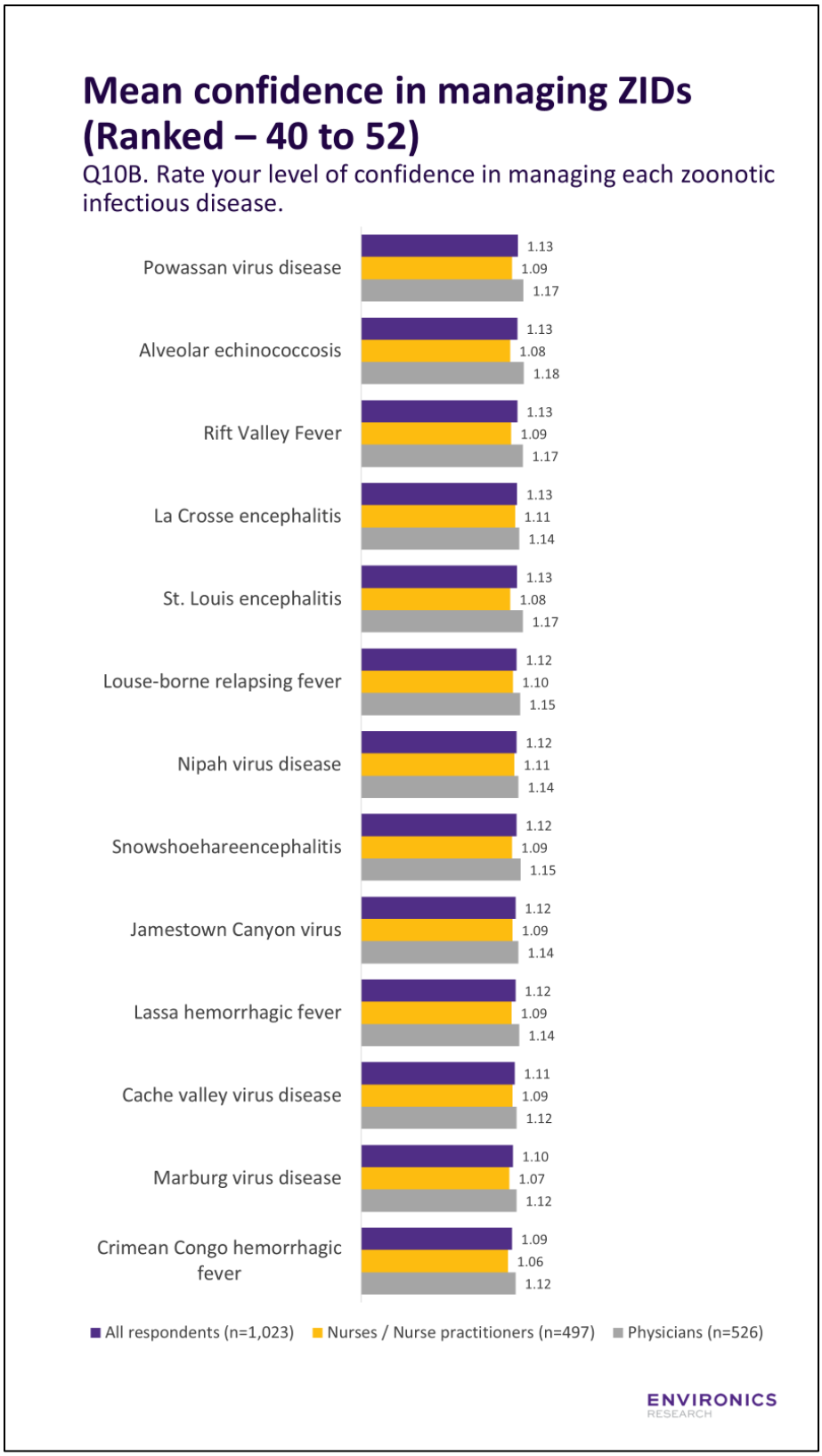

Figure 8 - Mean confidence in managing ZIDs (Ranked 40 to 52)

3. Zoonotic infectious diseases encountered in practice vs. self-rated level of confidence in management

ZIDs in Practice | Encountered / Self-rated confidence (All diseases)

There is a clear, positive correlation between encountering a disease, and confidence in managing it.

The following page contains a graph that plots each disease by the proportion of health professionals in the survey who encountered it (X-axis) and its mean self-reported confidence rating among all respondents (Y-axis). In this graph, it is evident that there is a clear correlation between encountering a disease, and feeling confident about managing it. Diseases are also organized by colour according to their factors from the PCA analysis, which is discussed later in section D (Multivariate analysis).

Most of the 52 ZIDs on the list are infrequently encountered and survey respondents have low self-reported confidence in managing them. Lyme disease is the only disease in the list that was encountered by a majority of health professionals (80%) and with a mean confidence rating above 2 (2.20). Confidence ratings range from a low of 1.09 (Crimean Congo hemorrhagic fever) to a high of 2.20 (Lyme disease). Note that because the data is so tightly clustered, the axes use logarithmic scales to better highlight differences between diseases.

When those who did not encounter a disease are excluded from the analysis, the confidence ratings for each disease are in a fairly narrow range (1.80 to 2.59). Complete encountered and confidence data for all diseases can be found in Appendix K.

The later report section with multivariate analysis discusses disease encounters and self-reported confidence in detail, in terms of their relationship to each other and other variables.

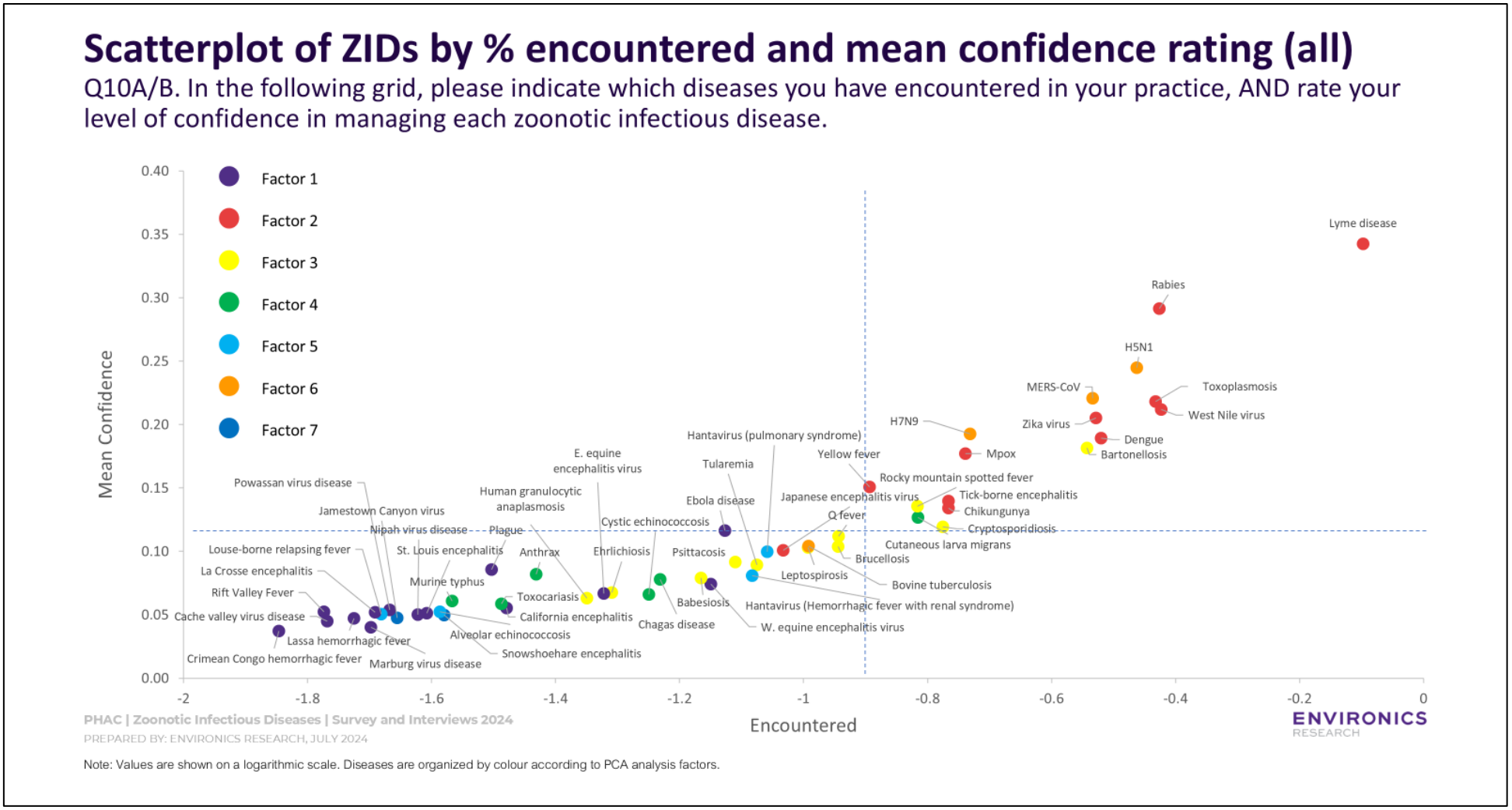

Figure 9 - Scatterplot of ZIDs by % encountered and mean confidence rating

4. Other zoonotic infectious diseases relevant for practice

Most nurses and physicians did not mention any other ZIDs of relevance to their practice.

After reviewing the 52 diseases in the survey list, respondents were asked to note any other zoonotic infectious diseases they felt were relevant in their practice. A large majority (88%) of health professionals indicated that they had nothing to add. Among those who responded to this open-ended question, some of the diseases mentioned were already in the main list, and most others did not meet the scope set out for this project. Parasitic diseases (4%) or bacterial infections (2%) were mentioned most often. Self-rated confidence in providing zoonotic infectious disease information or services.

A minority of health professionals are confident in providing specific ZID information or services; self-reported confidence is highest for public health reporting and lowest for patient management.

Rating their confidence on seven aspects of ZID management, nurses and physicians are most confident about public health reporting, with four in ten saying they are confident or very confident (41% nurses, 38% physicians). While both groups share similar levels of self-reported confidence around patient assessment, patient education, and patient management, nurses are more confident about infection prevention and control (nurses 35%, physician 23%) and contact tracing (nurses 23%, physicians 14%), whereas physicians are more confident about diagnosis (nurses 18%, physicians 25%).

Table 3 – Very confident / confident in providing ZID information or services

NET: Very confident/confident in providing ZIDs information or services	**Total (n=1,023)**	**Nurses/NP (n=497)**	**Physicians (n=526)**
Public Health Reporting: Reporting cases to local public health authorities per your jurisdictional requirements	40%	41%	38%
Infection prevention and control measures: Implementing infection control protocols to prevent healthcare-associated transmission, as appropriate.	29%	**35%**	23%
Patient assessment: Risk factors and physical assessment	26%	25%	26%
Patient education: Educating patients and their families about zoonotic diseases such as transmission, and preventive measures.	22%	24%	21%
Diagnosis: taking patient history, assessing patient's clinical presentation, ensuring appropriate tests are ordered, interpretation of results for laboratory diagnosis, understanding differential diagnoses	22%	18%	**25%**
Contact tracing: Identifying and monitoring individuals who may have been exposed to the ZID-infected patient.	18%	**23%**	14%
Patient management: Selecting the appropriate treatment plan and follow-up.	15%	13%	17%

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Looking at results by practice setting, there are some differences in confidence on the aspects of management.

Table 4 – Self-rated confidence in public health reporting by practice setting

Confidence rating	Total (n=1,023)	Family / Walk-in / Urgent care / Long term care (n=466)	Hospital (n=263)	Community (n=126)	Public health / Travel (n=139)
NET: Very confident / Confident	40%	39%	34%	34%	**61%**
Very confident	12%	10%	10%	10%	**25%**
Confident	28%	29%	24%	24%	35%
Somewhat confident	38%	39%	37%	47%	*26%*
Not at all confident	20%	20%	25%	17%	*8%*
Not applicable	3%	2%	4%	2%	5%

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

Sub-groups more likely to be *confident* (NET: very confident/confident) about *public health reporting* include:

- **Region:** Those in Atlantic Canada (62%).
- **Clinical specialty / Practice area:** Those with the following practice areas or specialties: infectious disease (66%) and public health or preventative medicine (56%).
- **Language of workplace:** Those who speak French in the workplace (50%).
- **Practice setting:** Those working in public health or travel settings (61%) (shown in table).
- **ZID patient encounters:** Those who encounter ZIDs daily/weekly (51%) or monthly (46%).
- **ZID knowledge level:** Those who rate their ZID knowledge as expert or advanced (69%).
- **Indigenous experience:** Those with experience with Indigenous populations (47%).

Table 5 – Self-rated confidence in infection prevention and control by practice setting

Confidence rating	Total (n=1,023)	Family / Walk-in / Urgent care / Long term care (n=466)	Hospital (n=263)	Community (n=126)	Public health / Travel (n=139)
NET: Very confident / Confident	29%	23%	**34%**	19%	**50%**
Very confident	7%	*4%*	9%	6%	**14%**
Confident	22%	19%	25%	*14%*	**36%**
Somewhat confident	44%	44%	44%	51%	37%
Not at all confident	25%	**30%**	21%	30%	*11%*
Not applicable	2%	2%	1%	0%	2%

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

Sub-groups more *confident* (NET: very confident/confident) about *infection prevention and control* include:

- **Clinical specialty / Practice area:** Those with the following practice areas or specialties: infectious disease (48%), public health or preventative medicine (44%).
- **Practice setting:** Those working in public health or travel settings (50%) and hospitals (34%).
- **ZID patient encounters:** Those who encounter ZIDs daily/weekly (42%) or monthly (37%).
- **ZID knowledge level:** Those who rate their ZID knowledge as expert or advanced (60%).

Table 6 – Self-rated confidence in patient assessment by practice setting

Confidence rating	Total (n=1,023)	Family / Walk-in / Urgent care / Long term care (n=466)	Hospital (n=263)	Community (n=126)	Public health / Travel (n=139)
NET: Very confident / Confident	26%	25%	29%	17%	34%
Very confident	5%	4%	8%	3%	4%
Confident	21%	21%	22%	13%	30%
Somewhat confident	48%	47%	45%	**61%**	43%
Not at all confident	24%	27%	25%	21%	*14%*
Not applicable	2%	1%	1%	1%	**9%**

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

Sub-groups more *confident* (NET: very confident/confident) about *patient assessment* include:

- **Region:** Those in Atlantic Canada (36%).
- **Clinical specialty / Practice area:** Those with the following practice areas or specialties: infectious disease (53%), emergency and critical care (39%).
- **Language of workplace:** Those who speak French (32%) or English (26%) in the workplace (as opposed those who speak any other languages in addition to French and English).
- **ZID patient encounters:** Those who encounter ZIDs daily/weekly (48%) or monthly (32%).
- **ZID knowledge level:** Those who rate their ZID knowledge as expert or advanced (64%).

Table 7 – Self-rated confidence in patient education by practice setting

Confidence rating	Total (n=1,023)	Family / Walk-in / Urgent care / Long term care (n=466)	Hospital (n=263)	Community (n=126)	Public health / Travel (n=139)
NET: Very confident / Confident	22%	18%	23%	16%	**47%**
Very confident	4%	3%	3%	4%	**13%**
Confident	18%	16%	20%	*12%*	**34%**
Somewhat confident	47%	49%	42%	**60%**	*35%*
Not at all confident	29%	31%	33%	25%	*16%*
Not applicable	2%	1%	2%	0%	2%

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

Sub-groups more *confident* (NET: very confident/confident) about *patient education* include:

- **Region:** Those in Manitoba and Saskatchewan (35%).
- **Clinical specialty / Practice area:** Those with the following practice areas or specialties: infectious disease (49%), public health or preventative medicine (39%).
- **Language of workplace:** Those who speak French (27%) or English (22%) in the workplace (as opposed to other languages).
- **Practice setting:** Those working in public health or travel settings (47%).
- **ZID patient encounters:** Those who encounter ZIDs daily/weekly (40%) or monthly (31%).
- **ZID knowledge level:** Those who rate their ZID knowledge as expert or advanced (65%).

Table 8 – Self-rated confidence in diagnosis by practice setting

Confidence rating	Total (n=1,023)	Family / Walk-in / Urgent care / Long term care (n=466)	Hospital (n=263)	Community (n=126)	Public health / Travel (n=139)
NET: Very confident / Confident	22%	22%	23%	*9%*	31%
Very confident	4%	5%	5%	2%	5%
Confident	17%	18%	18%	*7%*	26%
Somewhat confident	42%	43%	44%	52%	*27%*
Not at all confident	31%	33%	27%	33%	26%
Not applicable	5%	2%	6%	6%	**16%**

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

Sub-groups more *confident* (NET: very confident / confident) about *diagnosis* include:

- **Clinical specialty / Practice area:** Those who specialize or practice in infectious disease (44%).
- **ZID patient encounters:** Those who encounter ZIDs daily/weekly (33%) or monthly (31%).
- **ZID knowledge level:** Those who rate their ZID knowledge as expert or advanced (57%).
- **Experience outside Canada:** Those with experience outside of Canada (27%).

Table 9 – Self-rated confidence in contact tracing by practice setting

Confidence rating	Total (n=1,023)	Family / Walk-in / Urgent care / Long term care (n=466)	Hospital (n=263)	Community (n=126)	Public health / Travel (n=139)
NET: Very confident / Confident	18%	14%	16%	14%	**49%**
Very confident	5%	3%	2%	2%	**21%**
Confident	14%	11%	14%	11%	**28%**
Somewhat confident	37%	36%	36%	**48%**	33%
Not at all confident	40%	**46%**	42%	34%	*13%*
Not applicable	5%	4%	7%	4%	5%

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

Sub-groups more *confident* (NET: very confident / confident) about *contact tracing* include:

- **Region:** Those in Manitoba and Saskatchewan (30%).
- **Clinical specialty / Practice area:** Those with the following practice areas or specialties: infectious disease (44%), public health or preventative (39%).
- **Practice setting:** Those working in public health or travel settings (49%).
- **ZID patient encounters:** Those who encounter ZIDs daily/weekly (33%).
- **ZID knowledge level:** Those who rate their ZID knowledge as expert or advanced (46%).
- **Indigenous experience:** Those experienced with Indigenous populations (27%).
- **Northern experience:** Those with experience in the North (32%).

Table 10 – Self-rated confidence in patient management by practice setting

Confidence rating	Total (n=1,023)	Family / Walk-in / Urgent care / Long term care (n=466)	Hospital (n=263)	Community (n=126)	Public health / Travel (n=139)
NET: Very confident / Confident	15%	15%	15%	13%	18%
Very confident	2%	2%	3%	1%	2%
Confident	13%	13%	13%	12%	16%
Somewhat confident	39%	40%	39%	40%	37%
Not at all confident	40%	43%	39%	42%	*27%*
Not applicable	6%	*2%*	6%	5%	**19%**

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

Sub-groups more *confident* (NET: very confident / confident) about *patient management* include:

- **Clinical specialty / Practice area:** Those specializing or practicing in infectious diseases (39%).
- **ZID patient encounters:** Those who encounter ZIDs daily/weekly (29%) or monthly (21%).
- **ZID knowledge level:** Those who rate their ZID knowledge as expert or advanced (47%).

C. Barriers, information needs and learning preferences

1. Resources used regarding zoonotic infectious diseases

Federal/provincial government health websites and digital clinical support tools are the resources used most.

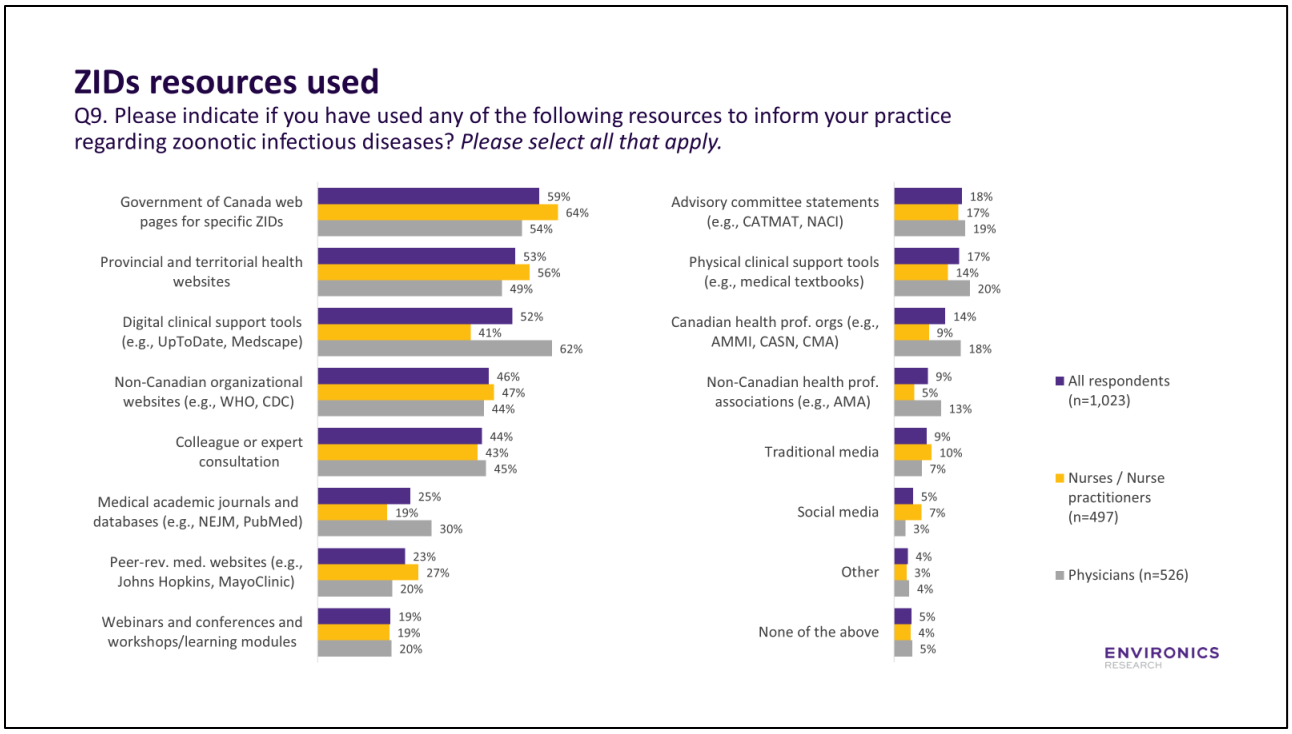

Figure 10 - ZID resources used

The survey responses demonstrated some differences in terms of the resources that nurses and physicians have used where ZIDs are concerned. While both groups share the same top five resources overall, physicians most often use digital clinical support tools like UpToDate or Medscape (62%), while nurses most often use Government of Canada web pages for specific diseases (64%). Physicians are more likely to use academic journals (30%, compared to 19% of nurses) while nurses are more likely to access medical websites such as those offered by Johns Hopkins and the Mayo Clinic (27%, compared to 20% of physicians).

The qualitative interviews were generally well aligned with the quantitative results here, with some distinctions. UpToDate was the single resource mentioned most often in interviews, particularly among physicians. While most interview participants had some recall of Government of Canada resources, they were more of a secondary consideration after more popular resources like UpToDate and the CDC.

Looking at the top three sources, there were some sub-group differences.

For *Government of Canada web pages*, the following sub-groups were more likely to indicate they had used them:

- **Region:** Those based in the territories (86%) or Saskatchewan and Manitoba (76%).
- **Northern experience:** Those with northern experience (82%).

- **Clinical specialty / Practice area:** Those practicing or specializing in infectious diseases (77%) and public health and preventative care (76%).
- **Practice setting:** Those in public health or travel settings (77%).
- **Frequency of ZID encounters:** Those who encounter ZIDs daily/weekly (70%).

Those with 5 years of experience or less are less likely to use Government of Canada web pages (49%) compared to those with more experience.

For *provincial and territorial health websites*, the following sub-groups were more likely to indicate they had used them:

- **Region:** Those based in British Columbia (74%), and the territories (93%).
- **Northern experience:** Those with northern experience (72%).
- **Clinical specialty / Practice area:** Those practicing or specializing in public health and preventative care (71%).
- **Practice setting:** Those in public health or travel settings (78%).
- **Frequency of ZID encounters:** Those who encounter ZIDs daily/weekly (66%) or monthly (66%).
- **ZID knowledge level:** Those who rate their ZID knowledge as expert or advanced (73%).

For *digital clinical support tools, including UpToDate*, the following sub-groups were more likely to indicate they had used them:

- **Clinical specialty / Practice area:** Those practicing or specializing in emergency and critical medicine (65%) or family medicine (61%).
- **Language of workplace:** Those who speak a language other than English or French in the workplace (72%).
- **Frequency of ZID encounters:** Those who encounter ZIDs at least once a year (63%).

Those in public health or travel settings are *less* likely to use these tools compared to all other practice settings (33%). Additionally, those who rate their ZID knowledge as limited or no knowledge are also less likely to use these tools (42%) than those with more experience.

2. *Most significant information/resource barriers to providing care to zoonotic infectious disease patients*

Staying current with the latest information about diseases is the most common barrier to caring for ZIDs patients, mentioned by seven in ten health professionals.

From a provided list of possible barriers, a majority of nurses (70%) and physicians (71%) say that staying current with the latest information is a significant barrier to providing ZID care to their patients. The second biggest barrier, selected by 43 percent of nurses and physicians, is that information is not always relevant to their specific context (e.g., specialty, geographic region). Time is also a major barrier, particularly for physicians (37%). Most barriers are named by similar proportions of nurses and physicians; nurses are more likely to say that information is conflicting (nurses 15%, physicians 9%).

This topic was discussed in the qualitative interviews, where participants often explained that medical research and recommendations frequently evolve, and with heavy workloads it is difficult to find time for study and research, which leads them to prioritize the topics that are most pressing in their day-to-day practice. For most, ZIDs are perceived as an infrequent concern for patients, so the topic just does not rise to the top of the priority list.

Table 11 – Most significant information/resource-related barriers to providing ZID care to patients

Most significant information/resource-related barriers	Total (n=1,023)	Nurses/NP (n=497)	Physicians (n=526)
It is difficult to stay up-to-date on the latest information about a disease	70%	70%	71%
Information is not relevant to my specific context (e.g., specialty, geographic region)	43%	43%	43%
It takes too much time to look up specific symptoms for each patient	32%	26%	**37%**
It's too difficult to find relevant information	23%	22%	24%
There aren't enough trusted medical sources for information on zoonotic infectious diseases	21%	21%	22%
Information changes too frequently	21%	23%	19%
Information is not easy to access online	20%	21%	20%
Trusted sources are costly to access	14%	16%	12%
Available information is conflicting	12%	**15%**	9%

*Q13. From the following list, select the **three most significant information/resource-related barriers** when it comes to **providing care for patients** with zoonotic infectious diseases in your own practice.*

Looking at sub-group differences, there are some distinctions where barriers are concerned:

- *Information not being relevant to their context* is more likely to be a barrier for physicians practicing in rural areas (54%), those who see ZIDs at least once a year (51%), those who rate their knowledge below expert/advanced (45%), and those without experience practicing outside of Canada (45%).

- *It takes too much time to look up specific symptoms for each patient* is more likely to be named as a barrier for those who see ZIDs monthly (41%), those in Ontario (39%), those practicing / specializing in family medicine (36%), and emergency and critical care (36%).
- *Difficulty finding relevant information* is more likely to be a barrier for those with 6 to 10 years of practice (30%), those with experience outside of Canada (29%), and those practicing in urban areas (23%).
- *Frequently changing information* is more likely to be a barrier for those practicing in Manitoba and Saskatchewan (29%).
- *Trusted resources being costly to access* is more likely to be a barrier for those with experience outside of Canada (20%).
- *Conflicting information* is more likely to be a barrier for those with five years of experience or less (23%), those who see ZIDs daily/weekly (19%), and those who rate their ZIDs knowledge as advanced / expert (19%) or general (13%).

3. Important zoonotic infectious disease topics

Clinical manifestations and treatments are the most important ZIDs-related topic for health professionals practicing in Canada.

From a list of topics related to public health and clinical practice, the topic of clinical manifestations is the most important for both nurses (54%) and physicians (61%). For physicians, the second most important is diagnostics (58%), followed by treatment (57%). For nurses, prevention is second (51%), followed by treatment (46%). Differences between groups in terms of the relative importance of these topics is likely related to differences in their respective practice settings, and specific roles at work.

Clinical manifestations also seemed to be a high priority when discussing ZID topics in the qualitative interviews. Several qualitative interview participants felt that more guidance on symptoms and risk factors would help them to overcome their lack of awareness and self-reported confidence about managing most of the diseases on the survey list. They sometimes related recent examples of public health bulletins, posters, and information campaigns around diseases like Lyme disease and mpox. These types of resources were useful at equipping them to answer patient questions and recognize symptoms of these illnesses in patients.

Table 12 - Most important ZID related topics for health professionals in Canada

Most important topics in relation to ZIDs	Total (n=1,023)	Nurses/NP (n=497)	Physicians (n=526)
Clinical manifestations	57%	54%	**61%**
Treatment	52%	46%	**57%**
Diagnostics	46%	33%	**58%**
Prevention	36%	**51%**	23%
Incidence in Canada	33%	30%	36%
Human to human transmission	22%	**27%**	17%
Zoonotic (animal to human, including via vector) transmission	19%	21%	18%
Disease trend	14%	14%	14%
Risk perception	7%	9%	6%
Current environmental climate	6%	6%	6%
Case fatality rate	3%	3%	3%

*Q13B. From the following list, select **up to three topics that are most important** for you as a Canadian health professional to be informed on in relation to zoonotic infectious diseases?*

Clinical manifestations were mentioned more often by respondents in the follow sub-groups:

- **Region:** Those based in the territories (79%).
- **Practice setting:** Those working in family practices, walk-in settings, or long-term care (65%).
- **Clinical specialty / Practice area:** Those practicing or specializing in family medicine (64%).

Clinical manifestations were mentioned less often by those working in public health and preventative medicine specialties (41%), those with 20 years of experience or more (53%), those working in public health or travel clinic settings (38%), and those with expert or advanced ZID knowledge (45%). This may reflect different roles within health care, with these types of health professionals less likely to see patients who are initially presenting with symptoms.

Treatment was mentioned more often by those in the following sub-groups:

- **Clinical specialty / Practice area:** Those practicing or specializing in emergency or critical care (63%) and family medicine (56%).
- **Total years of experience:** Those with five years of experience or less (68%).
- **Language of workplace:** Those speaking a language other than English or French at work (69%).

Treatment was mentioned less often by those working in public health and preventative medicine (32%), those working in community settings (36%) and public health or travel clinic settings (32%), and those who never encounter ZIDs in patients (41%).

Diagnostics were mentioned as a priority topic more often by those in the following sub-groups:

- **Clinical specialty / Practice area:** Those practicing or specializing in family medicine (57%) and emergency or critical care (57%).
- **Language of workplace:** Those speaking a language other than English or French at work (62%).
- **Practice setting:** Those working in family practices, walk-in clinics, urgent, or long-term care settings (59%).

Diagnostics were mentioned less often by those working in public health and preventative medicine (24%) and public health or travel clinic settings (17%).

Prevention was mentioned as a priority topic more often by those in the following sub-groups:

- **Region:** Those in Atlantic Canada (51%).
- **Clinical specialty / Practice area:** Those practicing or specializing in public health and preventative medicine (63%), community medicine (52%), and infectious diseases (49%).
- **Practice setting:** Those working in public health or travel clinic settings (65%).
- **Frequency of ZID encounters:** Those who never see ZIDs in patients (51%).

Prevention was mentioned less often by those working in family practices, walk-in clinics, urgent, or long-term care settings (27%), and those who see ZIDs monthly (27%).

Sub-groups were fairly uniform where *incidence in Canada* is concerned, with a couple of exceptions where interest was lower:

- **Years of experience:** Those with five years of experience or less (21%).
- **Language of workplace:** Those speaking a language other than English or French at work (17%).

Human-to-human transmission was selected more often by:

- **Clinical specialty / Practice area:** Those practicing or specializing in public health (31%) and community medicine (30%).
- **Frequency of ZID encounters:** Those who state that they never encounter ZIDs in patients although ZIDs are still part of their practice (34%).

Human-to-human transmission was selected less often as a priority topic by those working in family practices, walk-in clinics, urgent, or long-term care settings (15%).

Zoonotic transmission was statistically uniform across sub-groups.

Interest in *disease trend* was similar across most sub-groups except:

- **Practice setting:** It was lower among those working in family practices, walk-in clinics, urgent, or long-term care settings (10%).
- **ZID knowledge level:** It was higher among those with expert or advanced knowledge of ZIDs (24%).

Risk perception is also relatively unvarying, but higher for those working in public health or travel clinic settings (16%).

Interest in *current environmental climate* and *case fatality rate* were similarly low across all sub-groups.

4. Interest in additional professional education on zoonotic infectious diseases

Almost all health professionals are at least somewhat interested in receiving more professional education on ZIDs.

Although the two groups differ in their background education on ZIDs, their experience with ZIDs in practice, and the resources they access to learn about ZIDs, nurses and physicians are equally interested in receiving additional education about ZIDs. About four in ten health professionals say they are very interested (nurses 38%, physicians 38%), and just over half say they are somewhat interested (nurses 56%, physicians 55%).

In the qualitative interviews, participants frequently said they wished they knew more about ZIDs or regretted not learning about them during their training, while readily admitting that it was difficult to find time to make this topic a priority. This duality of high interest, but lack of time, underscores the importance of accessible resources that meet health professionals where they are.

Table 13 – Interest in additional professional education on ZIDs

Interest in receiving more ZIDs professional education	Total (n=1,023)	Nurses/NP (n=497)	Physicians (n=526)
NET: Very/somewhat interested	93%	94%	92%
Very interested	38%	38%	38%
Somewhat interested	55%	56%	55%
Not interested	7%	6%	8%

Q14. How interested are you in receiving additional professional education on zoonotic infectious diseases?

Net interest was high across most sub-groups, but looking specifically at those who said they were *very interested*, there are some groups who are particularly keen to learn more:

- **Clinical specialty / Practice area:** Those practicing or specializing in infectious diseases (52%).
- **Urban/rural:** Those practicing in rural areas (44%).
- **Frequency of ZID encounters:** Those who encounter ZIDs on a daily or weekly basis (63%).
- **ZID knowledge level:** Those with advanced or expert knowledge (64%).
- **Experience outside Canada:** Those with experience outside of Canada (50%).
- **Northern experience:** Those with northern experience (59%).

Some groups were less likely to be *very interested*:

- **Region:** Health professionals based in British Columbia (26%).
- **Clinical specialty / Practice area:** Those specializing in internal medicine or surgery (22%).
- **Frequency of ZID encounters:** Those who see ZIDs in patients less than once a year (25%).

5. Topics of interest for continuing education on zoonotic infectious diseases

Health professionals rank treatment, prevention, and diagnosis as the topics they would most like to learn about.

In an open-ended question to those interested in ZID education (n=947) about which specific topics they would like to learn about, the top topic overall is treatment (48%) followed by prevention (40%), however, nurses and physicians were different somewhat in their top choices. For physicians, treatment is the top topic (48%) followed by diagnosis (38%). For nurses, prevention comes out on top (53%) followed by treatment (47%). This likely reflects differing roles in patient care, as well as practice setting, between these two groups.

Table 14 – Specific ZID topics of interest (mentioned by 3% or higher)

ZIDs Topics of Interest	Interested in receiving ZIDs education (n=947)	Family / Walk-in / Urgent care / Long term care (n=440)	Hospital (n=236)	Community (n=117)	Public health / Travel (n=129)
Treatment and management (NET)	50%	52%	56%	43%	36%
Prevention	40%	32%	37%	54%	54%
Epidemiology (NET)	33%	34%	34%	26%	39%
Diagnosis (NET)	30%	35%	34%	23%	13%
Clinical manifestations	15%	15%	16%	20%	4%
Interest in specific diseases	6%	5%	7%	7%	7%
Transmission (NET)	5%	4%	5%	12%	8%
Assessment/Risk Assessment	5%	4%	5%	6%	8%
Resources/information/updates	5%	5%	5%	4%	3%
Risk Perception	5%	6%	4%	6%	2%

Q15. If you were to learn more about zoonotic infectious diseases, what would you be interested in learning about?

Note: Results for "Other" practice settings not shown due to small sample size (n=18). Some respondents did not provide their practice setting.

Focusing on the top four topics mentioned most often by respondents, there are some notable differences between sub-groups:

Topics related to *treatment and management* are mentioned more often by:

- **Clinical specialty/Practice area:** Those who specialize in internal medicine or surgery (62%).

Topics related to treatment and management are mentioned less often by:

- **Clinical specialty/Practice area:** Those who work in public health and preventative medicine (35%).

Prevention is mentioned more often as a topic of interest to:

- **Clinical specialty/Practice area:** Those who specialize in public health and preventative medicine (59%) and community medicine (56%).
- **Frequency of ZID encounters:** Those who never see ZIDs in patients but it is still part of their practice (54%).
- **Age:** Those aged 18 to 34 (52%).

Prevention is mentioned less often as a topic of interest to:

- **Practice setting:** those working in hospitals (37%), family practices, walk-in clinics, urgent, or long-term care settings (32%).
- **Clinical specialty/Practice area:** Those specializing in emergency or critical care (27%).

Epidemiology topics are mentioned by similar proportions across all sub-groups of interest.

Diagnosis as a topic is of higher interest to:

- **Clinical specialty/Practice area:** Those practicing emergency and critical care (37%) or family medicine (34%).

Diagnosis as a topic is mentioned less by:

- **Practice setting:** Those working in community (23%) and public health or travel medicine settings (13%).
- **Frequency of ZID encounters:** Those who report never encountering ZIDs in patients but ZIDs are still part of their practice (20%).

6. *Preferred formats for continuing education on zoonotic infectious diseases*

Self-directed online learning, interactive online courses, webinars and fact sheets are the top formats preferred by health professionals for additional ZID education.

Health professionals were shown a list of possible formats for additional professional education and resources on ZIDs and asked which they prefer. Self-directed online learning (54%) and interactive online courses (54%) are mentioned by a majority of health professionals, followed closely by webinars (47%) and fact sheets (45%). Online learning options and fact sheets were also highly preferred by participants in the qualitative interviews.

Table 15 – Preferred formats for continuing professional education and resources on ZIDs

Preferred formats for additional ZIDs professional education and resources	**Total (n=1,023)**	**Family / Walk-in / Urgent care / LTC (n=466)**	**Hospital (n=263)**	**Community (n=126)**	**Public health / Travel (n=139)**
Self-directed learning online	54%	*49%*	55%	63%	**66%**
Interactive online courses	54%	*47%*	58%	64%	64%
Webinars	47%	*41%*	47%	56%	**63%**
Fact sheets	45%	40%	42%	**54%**	**65%**
Decisional algorithms	38%	37%	36%	43%	32%
Continued Medical Education programs in Canada	35%	**42%**	35%	30%	*20%*
Lecture based online courses	31%	31%	27%	36%	36%
Advisory pubs., e.g. Committee to Advise on Tropical Medicine and Travel (CATMAT) or CDC recs.	30%	30%	28%	32%	**39%**
Mobile applications (apps)	30%	29%	**36%**	25%	22%
Conferences	30%	33%	*24%*	35%	29%
Toolkits	22%	23%	*14%*	28%	29%
Workshop sessions	19%	*15%*	23%	18%	**31%**
Infographics	17%	16%	17%	13%	**27%**
Evidence briefs	17%	14%	19%	21%	18%
Interactive classroom courses	12%	14%	12%	10%	12%
Lecture based classroom courses	9%	11%	8%	6%	6%
Self-directed learning with physical resources (e.g., textbooks)	8%	7%	10%	8%	9%
Onsite educational outreach	6%	7%	4%	7%	9%
Postgraduate courses	4%	4%	2%	4%	5%
Other	<1%	<1%	1%	<1%	1%

Q16. If you were to receive additional professional education and resources on zoonotic infectious diseases, in which formats would you prefer to receive the information?

Note: Results for "Other" practice settings not shown due to small sample size (n=18). Some respondents did not provide their practice setting.

In general, across sub-groups, the top four formats are highly ranked, though some sub-groups are more likely to prefer certain formats than others:

Self-directed learning online is preferred more by:

- **Practice setting:** Those practicing in public health or travel medicine settings (66%).

Self-directed online learning was preferred less by:

- **Clinical specialty/Practice area**: Those specializing in family medicine (52%) and internal medicine or surgery (46%).

Interactive online courses are preferred less by:

- **Clinical specialty/Practice area**: Those in family medicine (50%) and internal medicine or surgery (50%).
- **Practice setting:** Those working in family practices, walk-in clinics, urgent, or long-term care settings (47%).
- **Years of experience:** Those with 20 years of experience or more (47%).
- **Language of workplace:** Those who speak languages other than English or French at work (36%).

Webinars are preferred more by:

- **Clinical specialty/Practice area:** Those practicing or specializing in public health and preventative (65%) or community medicine (56%).
- **Frequency of ZID encounters:** Those who never see ZIDs in patients (61%).
- **Language of workplace:** Those who speak French at work (57%).
- **International experience:** Those with no experience outside of Canada (51%).

Webinars are preferred less by:

- **Practice setting:** Those working in family practices, walk-in clinics, urgent, or long-term care settings (41%).
- **Region**: Health professionals based in Ontario (40%) and British Columbia (34%).

Fact sheets are preferred more by:

- **Region:** Health professionals based in Saskatchewan and Manitoba (58%).
- **Urban vs rural:** Those practicing in rural areas (56%).
- **Indigenous experience:** Those with experience working with Indigenous populations (53%).
- **International experience:** Those with no experience outside of Canada (50%).

Fact sheets are preferred less by:

- **Clinical specialty/Practice area:** Those specializing in family medicine (42%) and internal medicine or surgery (40%).
- **Practice setting:** Those working in hospitals (42%) or family practices, walk-in clinics, urgent, or long-term care settings (40%).

D. Multivariate analysis

1. Key drivers of self-rated confidence – Shapley Value Regression analysis

Overall, 42% of the variance in self-reported confidence (for all diseases) is explained by the independent variables included in the Shapley Value Regression analysis.

A multivariate analysis, using Shapley Value Regression, was conducted to better understand the key drivers of self-reported confidence in managing zoonotic infectious diseases overall. In addition to data from the survey, external data provided by PHAC was included in the analysis. Details on how this external data was coded for analysis are included in Appendix I. The analysis was conducted using tools created in R, a free software environment for statistical computing and graphics.

The Shapley Value Regression is an analysis that quantifies the relative impact of each independent variable in a linear regression. This type of analytical technique is used to resolve a common weakness of linear regression for explanatory purpose, which is that it is not reliable when independent predictors are moderately to highly correlated (as is the case, for example, with encountering a disease and confidence in managing it).

The Shapley Value Regression consists of running multiple regression models with all possible combinations of independent variables being included or excluded out of the model, and then averaging the standardized beta scores of each independent variable across the models on which it is included. This computationally expansive technique then allows for a relative comparison across the independent variables, all while moderating the concern of multicollinearity.

This analysis was run across the 52 ZIDs listed in the survey as one “block” of data. The output of the analysis includes two main components:

- An adjusted R-squared value which indicates the amount of variance in the dependent variable explained by the independent variables. The R-squared value explains the proportion of change in a dependent variable that can be accounted for by all of the independent variables together. The adjusted R-squared value is a value between 0 and 1, or a percentage between 0-100.

- A separate share of impact for each independent variable based on the average of its standardized beta scores in every combination where it is included in the calculation. The share of impact for each independent variable is also expressed as a value between 0 and 1, or a percentage between 0-100. The sum of this for all the independent variables is 1, or 100%.

The analysis included the following variables:

Dependent variables: Self-rated confidence in managing each disease (Q10B series)

Independent variables from survey:

- Encountered disease (Q10A)
- Self-reported knowledge of zoonotic infectious diseases (Q6)
- Satisfaction with zoonotic infectious disease formal healthcare training (Q7)
- Self-reported confidence with elements of disease management (Q12 series)
- Province or territory (Q1B)
- Urban or rural primary setting (variable derived from postal codes)
- Profession type, i.e. nurse or physician (Q2)
- Specialty or practice area (Q4)
- Practice setting (Q22)
- Years of practice (Q17A)
- Years of practice internationally (Q17C)
- Northern experience (variable derived from Q20 and Q1B)
- Indigenous experience (Q26)

Independent variables based on criteria provided by PHAC (see Appendix F):

- Incidence in Canada
- Disease trend in Canada
- Case fatality rate
- Severity of illness and long-term sequelae
- Treatability
- Capacity to detect and diagnose
- Preventability
- Mode of transmission: animal-to-human
- Mode of transmission: human-to-human
- Current environment climate
- Risk perception

Looking at the overall key drivers of confidence for all 52 diseases in the survey, the results from this analysis show that these variables have an adjusted R-squared value of 0.42, indicating that 42% of the variance in confidence (across all diseases) is explained by the independent variables included in the analysis.

The relative share of impact for the dependent variables shows that above all else, encountering a disease in practice is the most important driver of self-reported confidence in managing that disease, with a 68% share of impact. The second biggest driver is self-reported knowledge of ZIDs in general, at 12%. Years of practice internationally and the level of risk related to the ZIDs as perceived by the general public in Canada are tied for third place with a 3% share of impact. All other variables account for 2% or less each.

Table 16 - Share of impact in Shapley Value Regression Model

Variable	Share of impact (%)
Encountered disease (Survey Q10A)	68%
Self-reported knowledge of zoonotic infectious diseases (Survey Q6)	12%
Years of practice internationally (Q17C)	3%
Risk perception (External data)	3%
Infectious disease specialty / practice area (Q4)	2%
Mode of transmission: animal-to-human (External data)	2%
Incidence (External data)	2%
Satisfaction with education received during formal healthcare training (Q7)	1%
Province or territory (Q1B)	1%
Profession type (Q2)	1%
Preventability (External data)	1%
Treatability (External data)	1%
Severity of illness (External data)	1%
All other independent variables from external data	1%
All other independent variables from survey	1%

2. Key Drivers for Individual Diseases – Shapley Value Regression analysis

At the disease level, encountering disease is still the most important driver of self-reported confidence for most diseases. For Lyme disease, self-reported knowledge is a bigger driver than encountering the disease.

A simplified Shapley Value Regression analysis was conducted at the individual disease level to identify key drivers of self-reported confidence in managing specific diseases. Because this analysis was conducted at the individual disease level rather than comparing across all diseases, the disease-specific external data was not applicable.

Dependent Variables: Self-rated confidence in managing each disease (Q10B series)

Independent Variables from Survey:

- Encountered disease (Q10A)
- Self-reported knowledge of zoonotic infectious diseases (Q6)
- Satisfaction with zoonotic infectious disease education (Q7)
- Self-reported confidence with elements of disease management (Q12 series)
- Province or territory (Q1B)
- Urban or rural primary setting (Variable derived from postal codes)
- Profession type, i.e. nurse or physician (Q2)
- Specialty or practice area (Q4)
- Practice setting (Q22)
- Years of practice (Q17A)

- Years of practice internationally (Q17C)
- Northern experience (Variable derived from Q20 and Q1B)
- Indigenous experience (Q26)

The adjusted R-squared values for all 52 diseases ranged from 21% (Plague) to 54% (Q Fever), with a mean of 36%. Complete results for all 52 diseases are provided in Appendix I. Results for the top five diseases (i.e. those encountered most often in Q10A) are shown below.

Table 17 – Shapley Value Regression R-squared for top five diseases (encountered)

	Lyme disease	West Nile virus	Rabies	Toxoplasmosis	H5N1
Adjusted R-squared	32%	39%	32%	36%	43%

Table 18 – Share of impact in Shapley Value Regression Model (1 of 2)

Variable share of impact	Lyme disease	West Nile virus	Rabies	Toxoplasmosis	H5N1
Encountered disease (Survey Q10A)	24%	56%	49%	51%	76%
Self-reported knowledge of zoonotic infectious diseases (Survey Q6)	32%	20%	18%	22%	10%
Region (Q1B)	11%	6%	3%	4%	1%
Profession (Q2)	6%	0%	1%	5%	0%
Family medicine specialty / practice area (Q4)	2%	0%	0%	0%	0%
Satisfaction with education (Q7)	3%	2%	2%	2%	1%
Community health specialty / practice area (Q4)	2%	1%	1%	1%	0%
Family medicine practice setting (Q22)	2%	1%	1%	0%	0%
Years of practice (Q17A)	2%	0%	1%	0%	0%
Years of practice internationally (Q17C)	2%	0%	2%	4%	0%
Infectious disease specialty / practice area (Q4)	1%	3%	1%	1%	2%
Public health and preventive medicine specialty / practice area (Q4)	1%	1%	4%	1%	0%
Obstetrics/Gynecology specialty / practice area (Q4)	1%	2%	1%	0%	0%

Table 19 – Share of impact in Shapley Value Regression Model (2 of 2)

Variable share of impact	Lyme disease	West Nile virus	Rabies	Toxoplasmosis	H5N1
Emergency medicine/critical care specialty / practice area (Q4)	1%	1%	3%	0%	3%
Internal medicine specialty / practice area (Q4)	1%	1%	2%	0%	0%
Surgery specialty / practice area (Q4)	1%	0%	1%	0%	0%
Hospital practice setting (Q22)	1%	1%	0%	2%	2%
Community health centre practice setting (Q22)	1%	0%	0%	0%	0%
Public health clinic practice setting (Q22)	1%	1%	5%	0%	0%
Confidence in patient assessment (Q12)	0%	0%	0%	0%	0%
Confidence in diagnosis (Q12)	0%	0%	0%	0%	0%
Confidence in infection prevention and control measures (Q12)	0%	1%	2%	0%	0%
Confidence in patient management (Q12)	0%	0%	0%	0%	0%
Confidence in patient education (Q12)	0%	0%	0%	0%	0%
Confidence in contact tracing (Q12)	0%	0%	0%	0%	0%
Confidence in public health reporting (Q12)	0%	0%	0%	0%	1%
Urban vs Rural setting	0%	1%	0%	0%	0%
Pediatrics specialty / practice area (Q4)	0%	0%	0%	0%	0%
Walk-in clinic or urgent care practice setting (Q22)	0%	0%	0%	0%	0%
Specialized travel health centre/clinic practice setting (Q22)	0%	0%	0%	0%	0%
Long-term care residence practice setting (Q22)	0%	0%	0%	0%	0%
Northern experience (Q1B and Q20)	0%	0%	1%	1%	0%
Indigenous experience (Q26)	0%	1%	1%	2%	0%

Lyme disease

As discussed previously, Lyme disease is the disease encountered most often and with the highest self-rated confidence ratings. In this analysis, its below-average adjusted R-squared value of 32% indicates that variance in confidence is less influenced by the independent variables in the model, than it is for most other diseases. This means there are other factors influencing confidence that are not accounted for in this set of independent variables.

Looking at the share of impact for the independent variables, Lyme disease is the only of the top five (and in fact, one of only three) diseases from the full list of 52 where self-reported knowledge has a higher share of impact than encountering the disease. Lyme disease is the disease most influenced by region (11%), with health professionals in eastern provinces where the disease is more prevalent[8] (i.e. Ontario, Quebec, Atlantic) showing higher levels of confidence about the disease. Confidence in managing Lyme disease is also influenced by being a physician (6%) and working in family medicine (5%); this lines up with other findings from the quantitative and qualitative research indicating that family physicians field many patient inquiries about this disease.

Confidence in managing Lyme disease may be increased by other factors not measured in the survey such as exposure to general information about the diseases, discussion with colleagues, and questions from patients. Based on what was heard during the qualitative interviews, information specific to Lyme disease accounts for a large proportion of the information health professionals receive about ZIDs from public health bulletins, continuing education opportunities, and patient cases and queries. This means that relative to the other diseases, health professionals are more likely to be educated about Lyme disease even if they have not encountered it with a patient, and this likely makes them feel more confident about managing it.

West Nile virus infection

The adjusted R-squared value for West Nile virus is above average at 39%, meaning the variables in the regression account for more of the variance in confidence, compared to most other diseases in the survey list. Encountering the disease has an above-average share of impact of 56%, with self-reported knowledge close to the average at 20%. Region also has a notable influence at 6%.

Findings from the qualitative research suggest that health professionals do not usually look for West Nile virus (or any other specific diseases) in patients with mild flu-like symptoms. Though they do receive public health bulletins about its presence in the community, they do not receive much information about managing patients with the virus unless they have a seriously ill patient who tests positive. The share of impact results also suggest that while knowledge plays a role in confidence, encounters with the disease is a stronger element.

Rabies

Over one in three survey respondents say they have encountered rabies in practice, and it is the disease with the second highest self-reported confidence rating, after Lyme disease. Similar to Lyme disease, its low adjusted R-squared value of 32% indicates that variance in confidence is less influenced by the independent variables in the model.

[8] Public Health Agency of Canada, "Lyme Disease Surveillance in Canada: Annual Edition, 2019," Library and Archives Canada, August 2023, https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/diseases-conditions/lyme-disease-surveillance-report-2019/LD-REPORT2019-ENG-Final.pdf.

Unlike Lyme, however, encountering the disease has a higher share of impact at 49%, with self-reported knowledge at 18%. This means that encountering the disease is a stronger influence on confidence in managing rabies, than self-reported knowledge. These values are close to the average across all 52 diseases. Working in a public health setting (5%) or having public health as a specialty (4%) are also notably important for rabies in comparison with other diseases. Having an emergency medicine specialty also has a notable influence at 3%.

In the qualitative research, health professionals with rabies experience typically gained it as a matter of course while working with a patient base at risk for the disease, but also received bulletins about rabies and had access to public health resources when needed.

Toxoplasmosis

The adjusted R-squared value for toxoplasmosis is 36%, which is about average among the 52 diseases from the survey. Encountering toxoplasmosis has a share of impact at 51%, and self-reported knowledge at 22%; these values are also close to average for the 52 survey diseases. Other variables that have a notable influence on confidence in managing this disease are profession (5%), region (4%), and years of practice internationally (4%).

Relative to most diseases in the list, toxoplasmosis was mentioned somewhat often by participants in the qualitative interviews, who usually noted it as a disease of concern for pregnant patients. Knowledge beyond simple awareness of the disease and the risk profile seemed to be limited.

Avian influenza A(H5N1)

The adjusted R-squared value for avian influenza A(H5N1) is 43%, which is quite high relative to most diseases in the survey. Encountering the disease has a very high share of impact at 76%, while the share for self-reported knowledge is 10% and having an emergency medicine specialty is also notable at 3%. This suggests that encountering avian influenza A(H5N1) in practice is an even more important component in self-reported confidence for this disease than it is for most of the others.

3. Segmenting Health Professionals – K-Means Cluster Analysis

Respondents were segmented into four broad groups based on the diseases they encountered; the analysis shows four distinct groups of health professionals with different degrees of ZID experience and expertise closely linked to practice setting.

Assigning the segments

A segmentation analysis was applied to all respondents in the study, based on K-Means analysis of diseases encountered; data for all 52 diseases was included in the segmentation. This analysis looks at similarities between respondents based on the inputs used (in this case, diseases encountered) and groups similar respondents into discrete categories (i.e., segments or clusters).

Segmentation can be applied using any variables in a dataset; often segmentation is done using demographic variables, to group respondents with shared characteristics. For this analysis, segmentation was applied using the diseases encountered variables, for several reasons:

- The bivariate analysis already shows meaningful and explainable differences between groups such as nurses and physicians, practice settings, specialties, and region.

- When analyzing the top-line results, most of the diseases in the survey list are very similar to each other in terms of low % encountered and mean confidence. Grouping respondents who have encountered similar sets of diseases helps us to understand both the health professionals and the diseases better.

- Different approaches to segmentation were assessed before this solution was selected for inclusion in the report. Segmenting by other survey questions and demographics characteristics resulted in groupings that were very similar. Grouping by this set of variables (diseases encountered) means that the demographic characteristics of the segments are descriptive, rather than definitive.

For this analysis, four different solutions, arriving at three to six clusters, were initially analyzed to determine which solution was most useful for the study objectives. After comparing the different cluster solutions, by looking at the profile of respondents in each cluster including their demographics, practice setting, specialization, and experience, the four-cluster solution was selected for discussion in the report, illustrated below. Complete results for the four clusters are provided under separate cover with the banner tables for the study.

As a starting point to understand the clusters, the table below shows the proportion of respondents in each cluster who had encountered a selection of key diseases from the list. Looking at the proportions within each cluster who had encountered these diseases, the four clusters have some different characteristics:

- Within cluster 1, the proportion of respondents who has encountered each disease is high. On average, respondents in cluster 1 report encountering 24 diseases from the list.
- Cluster 2 also has fairly high proportions encountering each disease, sometimes exceeding cluster 1; on average, respondents in this cluster recall encountering ten diseases.
- Respondents in cluster 3 are below average for encountering all diseases; this is the only cluster with some respondents who do not recall encountering any. On average they report encountering less than three diseases.
- Cluster 4 is a mix, with some diseases encountered by a high proportion, and others at a low proportion. On average they recall encountering about six diseases.

Table 20 – Essential characteristics of four clusters (% encountered)

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
% encountered any disease	100%	100%	*88%*	100%	94%
Mean # diseases encountered	24.5	9.9	2.6	6.3	6.5
Lyme disease	100%	95%	*65%*	94%	80%
West Nile Virus	**90%**	54%	*1%*	**96%**	38%
Rabies	**75%**	**62%**	*20%*	41%	37%
MERS-CoV	**47%**	**69%**	18%	*7%*	29%
Bartonellosis	**77%**	34%	*18%*	33%	29%
Bovine tuberculosis	**46%**	**16%**	4%	6%	10%
Chagas disease	**51%**	6%	*1%*	2%	6%
Crimean Congo hemorrhagic fever	**13%**	2%	0%	1%	1%

Q10a/b. In the following grid, please indicate which diseases you have encountered in your practice, AND rate your level of confidence in managing each zoonotic infectious disease

The next table shows the mean self-reported confidence for the same set of diseases, by cluster. Cluster 1 exhibits significantly higher levels of confidence for each disease, while cluster 3 has lower confidence across the board. Cluster 2 has notably higher confidence about some specific diseases, while cluster 4 is specifically more confident about West Nile virus.

Table 21 - Essential characteristics of four clusters (mean confidence)

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
Mean confidence (all diseases)	**2.04**	1.35	*1.20*	1.28	1.31
Lyme disease	**2.89**	2.32	*2.03*	2.27	2.20
West Nile virus	**2.53**	1.80	*1.31*	**1.94**	1.63
Rabies	**2.54**	**2.17**	*1.78*	1.98	1.96
MERS-CoV	**2.30**	**2.10**	*1.48*	1.43	1.66
Bartonellosis	**2.44**	1.53	*1.40*	1.50	1.52
Bovine tuberculosis	**2.07**	**1.31**	*1.17*	1.20	1.27
Chagas disease	**2.02**	1.15	*1.13*	1.13	1.20
Crimean Congo hemorrhagic fever	**1.52**	1.07	*1.04*	1.08	1.09

Q10a/b. In the following grid, please indicate which diseases you have encountered in your practice, AND rate your level of confidence in managing each zoonotic infectious disease

The diseases encountered by each cluster are discussed in more detail in the later section on Principal Components (PCA) factor analysis.

Practice settings by cluster

Looking at results by practice setting highlights some key differences between the clusters.

- Cluster 1 contains a higher proportion of respondents working in hospital settings.
- Cluster 2 is very similar to the total, where practice settings are concerned.
- In cluster 3, there is a higher proportion of respondents working in family practice, walk-in, urgent care, or LTC settings, and in community settings.
- In cluster 4, the proportion of respondents working in public health settings is somewhat higher, directionally, than other groups, but due to sample sizes this difference is not statistically significant. However, for the purposes of describing the clusters, it is worth noting.

Table 22 - Practice setting by cluster

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
Family practice / walk-in / urgent / LTC	37%	44%	**51%**	39%	46%
Hospital	**44%**	32%	*19%*	30%	26%
Community	8%	7%	**18%**	7%	11%
Public health / Travel	11%	13%	7%	18%	11%
Other	0%	2%	<1%	2%	1%

Q22. What type of setting describes your Practice setting?

Experience and knowledge

Looking at overall experience with ZIDs, self-rated knowledge, and satisfaction with education, the segments differ again. Cluster 1 members see ZIDs in practice often, with more than half seeing them daily or weekly. They rate themselves to be very knowledgeable about ZIDs, and are highly satisfied with the education they have received about this subject matter. The other clusters are generally similar to the total average for these characteristics, except that cluster 3 has a higher proportion who never encounter ZIDs in patients, despite indicating that they are part of their practice, and are less likely to rate their knowledge as advanced or expert.

Table 23 – ZID experience and knowledge

\	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
% encounter ZIDs daily or weekly	**51%**	13%	7%	8%	12%
% encounter ZIDs never	2%	11%	**18%**	8%	13%
% expert or advanced knowledge	**59%**	10%	*5%*	12%	11%
% satisfied with formal ZIDs education*	**61%**	38%	44%	39%	43%
% satisfied with continuing education on ZIDs	**64%**	43%	45%	48%	47%
% encountered any disease from list	100%	100%	*88%*	100%	94%
Mean confidence (all diseases in list)	**2.04**	1.35	*1.2*	1.28	1.31

**Excludes those who said they did not receive such education.*

Self-rated confidence in ZID management

The segments also differ by their confidence in providing various types of information or services related to ZIDs, with cluster 1 notably more confident and cluster 3 less confident than other segments.

Table 24 – Very/somewhat confident in providing ZID information or services

NET: Very/somewhat confident in providing ZID information or services	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
Public health reporting	**57%**	41%	*34%*	45%	40%
Infection prevention and control measures	**50%**	32%	*20%*	38%	29%
Patient assessment	**60%**	30%	*19%*	28%	26%
Patient education	**54%**	24%	*14%*	30%	22%
Diagnosis	**55%**	24%	*15%*	24%	22%
Contact tracing	**37%**	24%	*11%*	23%	18%
Patient management	**46%**	15%	*12%*	15%	15%

Q12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

Other characteristics of segments

The segments also show some differences in demographic and experience characteristics.

- Cluster 1 respondents are predominantly physicians. Respondents in this cluster have an average of 24 years of experience in health care, and many of them have experience practicing outside of Canada or experience working with Indigenous populations. They are highly urban.
- Cluster 2 resembles the average for these characteristics, with an even split of nurses and physicians.
- Cluster 3 has an even split of nurses and physicians. Their mean experience, in years, is lower than other clusters and they are less likely to practice in an urban area.
- Much like cluster 2, cluster 4 is unremarkable in terms of demographics.

Table 25 – Other cluster characteristics

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
% Nurse / Nurse practitioner	*15%*	50%	51%	51%	49%
% Physician	**85%**	50%	49%	49%	51%
Mean years practicing	**24.05**	19.83	*19.51*	21.70	20.32
% with experience outside Canada	**44%**	21%	17%	21%	21%
% with urban primary practice	**94%**	87%	*80%*	84%	83%
Indigenous experience	**35%**	20%	18%	19%	20%

Summary of segment characteristics

Cluster 1 contains health professionals who have a high degree of ZID expertise relative to other health professionals. They are experienced with a wide range of ZIDs including those that are rarely encountered by most, knowledgeable about the subject overall, and confident about their ability to manage these diseases when they come up in practice, even when the disease is very rare. Most, but not all, are physicians in urban settings.

Cluster 2 comprises health professionals with a solid working knowledge of some ZIDs. In many ways they are average, in terms of their responses to survey questions, but they have experience with some specific diseases, particularly respiratory diseases associated with livestock and wildlife, and the hantavirus diseases. This is discussed in more detail in the following section describing results from the PCA factor analysis.

Health professionals in **cluster 3** are less experienced with ZIDs, and have lower self-reported confidence about managing them. They are more likely to work in family practices and community care, sometimes in rural settings, where they may rarely or never see ZIDs in patients. This cluster also contains health professionals with fewer years of experience on average, so they may not have had exposure to a broad range of patient cases at this stage in their career.

Overall, **cluster 4** is similar to cluster 2, with differences in the diseases they have encountered. They tend to work in settings where they are likely to encounter patients with suspected or confirmed cases of ZIDs that require management. Directionally, they are more likely to work in a public health or hospital setting, and are somewhat more confident about public health reporting and infection control.

Information sources and barriers

Respondents in cluster 1 are more likely to report using provincial or territorial websites, non-Canadian sites (e.g. WHO or CDC), medical journals, advisory committee statements, and Canadian health professional organizations. Directionally, their information barriers look somewhat different than other clusters; they are most likely to say there aren't enough trusted medical sources for information on ZIDs, that information changes too frequently, it's not easy to access online, trusted sources are costly to access, or that available information is conflicting. Since this group generally has more expertise about ZIDs, they are likely more familiar with a range of resources and have more to critique.

Cluster 2 is similar to the average in terms of the information sources they recall using for ZIDs. When it comes to barriers, cluster 2 respondents say they find it more difficult to stay up to date, and that looking up symptoms for each patient is time-consuming. This is in keeping with other cluster characteristics since cluster 2 largely comprises nurses and physicians in busy, front-line settings where they see ZIDs on an occasional basis, meaning that they do not prioritize learning about the topic.

Compared to the other clusters, those in cluster 3 are significantly or directionally less likely to use any of the listed resources (except for traditional media). Cluster 3 is the least experienced and engaged with ZIDs overall, so it follows that their use of resources is more limited. Where barriers to information are concerned, cluster 3 is similar to the average, perhaps reflecting a lack of specific experience with the topic in general.

Cluster 4 is directionally above average for their use of most resources. Where barriers are concerned, they are more likely to find that it takes too much time to look up symptoms for each patient, but less likely to have difficulty finding relevant information. While not as well-versed in ZIDs as cluster 1, cluster 4 does exhibit a

degree of ZIDs experience and expertise in a public health context, which likely influences them to use resources they use.

Table 26 - ZID resources used (by cluster)

ZID resources used	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
Government of Canada (canada.ca) web pages for specific ZIDs	75%	64%	*51%*	68%	59%
Provincial and territorial health websites	**67%**	53%	*48%*	59%	53%
Digital clinical support tools (e.g., UpToDate, Medscape, etc.)	56%	56%	48%	56%	52%
Non-Canadian organizational websites (e.g., WHO, CDC)	**61%**	47%	41%	49%	46%
Colleague or expert consultation	55%	46%	*39%*	50%	44%
Medical academic journals and databases (e.g., NEJM, PubMed)	**60%**	30%	*18%*	25%	25%
Peer-reviewed medical websites (e.g., Johns Hopkins, MayoClinic)	34%	23%	*19%*	31%	23%
Webinars and conferences and workshops/learning modules	31%	19%	*15%*	26%	19%
Advisory committee statements (e.g., CATMAT, NACI)	**39%**	16%	13%	**26%**	18%
Physical clinical support tools (e.g., medical textbooks)	29%	17%	15%	21%	17%
Canadian health professional organizations (e.g., AMMI, CASN, CMA)	**38%**	13%	*9%*	17%	14%
Non-Canadian health professional associations (e.g., AMA)	17%	10%	6%	12%	9%
Traditional media	10%	*4%*	10%	10%	9%
Social media	8%	6%	4%	6%	5%
Other	9%	4%	4%	*1%*	4%
None of the above	3%	2%	6%	4%	5%

Q9. Please indicate if you have used any of the following resources to inform your practice regarding zoonotic infectious diseases.

Table 27 – Most significant information/resource-related barriers to providing ZID care to patients (by cluster)

Barriers to resources	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
It is difficult to stay up-to-date on the latest information about a disease	*56%*	**77%**	69%	72%	70%
Information is not relevant to my specific context (e.g., specialty, geographic region)	32%	40%	45%	44%	43%
It takes too much time to look up specific symptoms for each patient	25%	**38%**	28%	**37%**	32%
It's too difficult to find relevant information	27%	26%	25%	*14%*	23%
There aren't enough trusted medical sources for information on zoonotic infectious diseases	28%	22%	20%	21%	21%
Information changes too frequently	24%	21%	18%	26%	21%
Information is not easy to access online	20%	17%	21%	23%	20%
Trusted sources are costly to access	20%	14%	13%	15%	14%
Available information is conflicting	16%	11%	12%	11%	12%
Other	10%	5%	8%	4%	6%

Q13. From the following list, select the three most significant information/resource-related barriers when it comes to providing care for patients with zoonotic infectious diseases in your own practice.

Interest in receiving professional education and topics of interest

Where information and education are concerned, cluster 1 is most likely to be *very interested* in receiving additional professional education. This aligns with other findings that suggest health professionals prioritize topics that are relevant to their practice.

The segments are similar in their specific topics of interest, except that cluster 3 is more interested in prevention and clinical manifestations. This likely relates to their practice settings (see Table 22 above), where they may be counselling patients on risks rather than identifying active disease.

There were few notable differences between segments as far as preferred formats were concerned. Cluster 1 members were far more interested in CMEs, advisory publications, evidence briefs, and interactive classroom courses compared to the other clusters. This points to a more academic style of learning as far as ZIDs are concerned, that is in line with the general composition of the cluster; that is to say, these health professionals encounter ZIDs regularly, and are thus more likely to devote time to learning about them in depth.

Table 28 - Interest in additional professional education on ZIDs

Interest in receiving more ZIDs professional education	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
NET: Very/somewhat interested	96%	94%	93%	92%	93%
Very interested	**65%**	41%	*33%*	39%	38%
Somewhat interested	*31%*	53%	60%	54%	55%
Not interested	4%	6%	7%	8%	7%

Q14. How interested are you in receiving additional professional education on zoonotic infectious diseases?

Table 29 – ZID topics of interest (Top 5 topics)

Interest in receiving more ZIDs professional education	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total (Interested in additional education)
Cluster size (unweighted N)	N=74	N=213	N=458	N=202	N = 947
Treatment	55%	50%	45%	47%	48%
Prevention	26%	37%	**45%**	35%	40%
Diagnosis	30%	32%	28%	35%	30%
Outbreaks	25%	25%	23%	27%	25%
Clinical manifestations	8%	12%	**18%**	11%	15%

Q15. If you were to learn more about zoonotic infectious diseases, what would you be interested in learning about?

Table 30 – Preferred information formats (by cluster)

Interest in receiving more ZIDs professional education	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Cluster size (unweighted N)	N=76	N=227	N=499	N=221	N = 1,023
Self-directed learning online	48%	56%	53%	56%	54%
Interactive online courses	60%	52%	52%	59%	54%
Webinars	42%	45%	47%	52%	47%
Fact sheets	36%	45%	44%	51%	45%
Decisional algorithms	38%	*30%*	39%	43%	38%
Continued Medical Education programs in Canada	**58%**	31%	32%	40%	35%
Lecture based online courses	23%	27%	32%	34%	31%
Advisory publications such as CATMAT or CDC recommendations	**44%**	27%	27%	**37%**	30%
Mobile applications (apps)	27%	37%	27%	31%	30%
Conferences	33%	27%	30%	32%	30%
Toolkits	22%	19%	23%	24%	22%
Workshop sessions	19%	21%	15%	24%	19%
Infographics	18%	21%	16%	17%	17%
Evidence briefs	**29%**	16%	15%	18%	17%
Interactive classroom courses	**23%**	10%	11%	14%	12%
Lecture based classroom courses	18%	7%	9%	7%	9%
Self-directed learning with physical resources (e.g., textbooks)	8%	7%	8%	10%	8%
Onsite educational outreach	13%	7%	5%	5%	6%
Postgraduate courses	6%	3%	4%	3%	4%
Other	3%	<1%	<1%	<1%	<1%

Q16. If you were to receive additional professional education and resources on zoonotic infectious diseases, in which formats would you prefer to receive the information?

Applying the cluster analysis to communication

Cluster analysis groups respondents who are similar to each other in the way they respond to survey questions. The cluster analysis shows that some clusters are associated with certain types of professionals, areas of specialty, and practice settings. Looking at the composition of other sub-groups by cluster can therefore be useful for application.

Shown below are clusters by practice setting. For family practice and community settings, a majority of health professionals land in cluster 3; knowing that cluster 3 is less experienced with ZIDs and not likely to prioritize learning about them, resources directed to these settings should be developed with these characteristics in

mind. While this cluster reports high interest in all of the top four resource formats in question 16, resources they can access quickly, like fact sheets, or education that requires little commitment, like short webinars, will likely be more effective than longer courses.

In hospital and public health settings, there is a higher concentration of cluster 2 and cluster 4 health professionals than in other settings. Therefore, these are the best settings to prioritize for communication towards cluster 2 and cluster 4 with more strategic resources that suit their relatively higher levels of expertise with ZIDs.

Cluster 1 is most prevalent in hospitals. Understanding that these health professionals are primarily physicians and they have more experience with ZIDs than other clusters, CMEs, academic resources and detailed clinical information about rarer diseases will find more of an audience in the hospital setting, particularly if it is aimed at those with specialties and practice areas that are more engaged with ZIDs patients. It cannot be understated, however, that cluster 1 also had the same general preference for the top four information formats as all other clusters.

Table 31 – Clusters by practice setting

Clusters	**Total (n=1,023)**	**Family / Walk-in / Urgent care / LTC (n=466)**	**Hospital (n=263)**	**Community (n=126)**	**Public health / Travel (n=139)**
Cluster 1	7%	6%	12%	4%	7%
Cluster 2	22%	21%	27%	*11%*	27%
Cluster 3	51%	**57%**	38%	**69%**	33%
Cluster 4	20%	17%	23%	16%	**32%**

Note: Results for "Other" practice settings not shown due to small sample size (n=19). Some respondents did not provide their practice setting.

The following section discusses the findings from a PCA analysis that provides more insight into the specific diseases and disease types that are most relevant to the different clusters.

4. ZIDs Communication Themes – Principal Components Analysis (PCA)

A principal components analysis was used to group diseases into seven categories, or factors: rarely encountered, common endemic and travel diseases, outdoor and agricultural occupational risks, rarer emerging and travel-related diseases, diseases related to crowded living conditions, respiratory diseases from livestock and wildlife, and rare encephalitic diseases.

To better understand how ZIDs coalesce on the incidence of health professionals encountering the diseases, a Principal Components Analysis (PCA) was applied on Q10A. This analysis provides the opportunity to explore whether there are any themes that emerge across groups of ZIDs, i.e., to identify groups of ZIDs that are seen more frequently by similar groups of survey respondents.

What this means is that diseases within each group tend to be encountered by the same health professionals, which is a reflection of the patient population or community being served by those health professionals. These are largely discrete groups; some diseases were strongly associated with more than one group, in these cases they were assigned to their strongest group, and noted in their second strongest group in the analysis with an asterisk.

It is also important to note that there was no specific definition of encounter in the questionnaire, i.e. respondents interpreted encounter in their own terms, which could extend to a variety of contexts such as diagnosed cases, suspected cases, testing, differential considerations, patient questions, and public health alerts.

Seven factors emerged using the “elbow” method in the scree plot – that is, the visible break at which an additional factor component explains a notably lower amount to the variability in the data than the previous factor component. Note that one of the groups simply consists of the diseases that were most commonly encountered in the survey, and another group consists of those least encountered, while the other five groups appear to share more specific characteristics in terms of the populations at risk.

In application, these broad groups of diseases could be considered as higher priorities for communication among the health professionals who would be serving patients at higher risk for them. In some cases it may be appropriate to strategize about resource development at a group level.

The seven factors, or disease groups, can be broadly defined as follows:

- Factor 1 – Rarely encountered
- Factor 2 – Common endemic and travel diseases
- Factor 3 – Outdoor and agricultural occupational risks
- Factor 4 – Rarer emerging and travel-related diseases
- Factor 5 – Diseases related to crowded living conditions
- Factor 6 – Respiratory diseases from livestock and wildlife
- Factor 7 – Rare encephalitic diseases

Complete numerical outputs for the PCA analysis are appended to the report in Appendix G.

The seven factors, or groups of diseases, are described in more detail below. Diseases are assigned to the factor for which they have the highest weight. In some instances, diseases are included in a second group where they also had a high weight; these diseases are noted in their second-highest factor in italics with an asterisk.

Table 32 – Factor 1 – Rarely encountered

Disease	Factor weight
Rift Valley Fever	0.656
Marburg virus disease	0.650
La Crosse encephalitis	0.643
Lassa hemorrhagic fever	0.600
Plague	0.581
California encephalitis	0.557
St. Louis encephalitis	0.524
Nipah virus disease	0.478
Powassan virus disease	0.459
Crimean Congo hemorrhagic fever	0.452
Ebola disease	0.391
Western equine encephalitis virus	0.373
Eastern equine encephalitis virus	0.370
Cache valley virus disease	0.310
*Ehrlichiosis**	*0.346*
*Bovine tuberculosis**	*0.277*

Factor 1 is the largest factor. Looking at the characteristics of the diseases in this list, the trait they really have in common are that they are rarely encountered – most are near the bottom of the list in terms of the proportion of participants who said they had encountered them in practice. In application, these diseases can be considered a **low priority** for communication among most health professionals, as they are likely only encountered by those with a specific specialty or interest in rare diseases.

Despite being rarely encountered overall, they tend to be familiar to those in cluster 1. Ebola disease specifically is familiar to cluster 2.

Table 33 – Factor 2 – Common endemic and travel diseases

Disease	Factor weight
Dengue	0.634
Zika virus infection	0.628
West Nile virus infection	0.558
Chikungunya	0.547
Yellow fever	0.508
Rabies	0.475
Japanese encephalitis virus	0.427
Lyme disease	0.426
Toxoplasmosis	0.423
Tickborne encephalitis	0.412
Mpox (monkeypox)	0.372
*Rocky mountain spotted fever**	*0.400*
*Ebola disease**	*0.298*
*Leptospirosis**	*0.262*
*Q fever**	*0.234*

In contrast to Factor 1, the diseases in Factor 2 are encountered frequently relative to other diseases in the survey list. These diseases tend to reside near the top of the list by proportion of respondents who encountered them. Also, most of the diseases that were mentioned often in qualitative interviews are in this group. It contains a mix of diseases that are well-known endemic risks in Canada, diseases that are common concerns for travellers, and diseases that have been in the public eye due to outbreaks and epidemics. These are the ZIDs that would come up most often in general family practices, emergency rooms, urgent care, and community clinics, and they should be considered a **high priority** for communication among most health professionals seeing patients in any primary care setting.

These diseases are highly familiar to those in cluster 1 and cluster 2. Lyme disease, mpox, and West Nile virus are specifically encountered frequently by cluster 4 as well.

Table 34 – Factor 3 – Outdoor and agricultural occupational risks

Disease	Factor weight
Babesiosis	0.605
Brucellosis	0.522
Cryptosporidiosis	0.511
Human granulocytic anaplasmosis	0.471
Tularemia	0.463
Psittacosis	0.447
Rocky mountain spotted fever	0.411
Ehrlichiosis	0.382
Bartonellosis (cat scratch disease)	0.367
Leptospirosis	0.347
Q fever	0.289
*Toxoplasmosis**	*0.402*
*Cystic echinococcosis**	*0.380*
*Western equine encephalitis virus**	*0.327*
*Bovine tuberculosis**	*0.245*

Factor 3 diseases are a mix of diseases that are mainly bacterial. Several are transmitted by ticks, and some are transmitted by close contact with affected species. Many of the diseases in this list would be most familiar to physicians or nurses working in rural or remote areas with patients who spend a lot of time outdoors or who work with animals. Resources for managing these diseases should be communicated to health professionals who serve rural and remote areas.

All of the diseases in factor 3 are known to those in cluster 1, and some are known to cluster 2, namely bartonellosis, Q fever, and Rocky Mountain spotted fever. Bartonellosis is specifically encountered frequently by cluster 4.

Table 35 – Factor 4 – Rare emerging and travel-related diseases

Disease	Factor weight
American trypanosomiasis (Chagas disease)	0.558
Murine typhus / endemic typhus	0.529
Anthrax	0.494
Cystic echinococcosis	0.470
Cutaneous larva migrans	0.453
Toxocariasis	0.446
*Alveolar echinococcosis**	*0.368*
*Eastern equine encephalitis virus**	*0.341*

Factor 4 diseases are rare emerging and travel-related diseases. In general, most of these diseases are contracted by travellers and possibly newcomers to Canada from further south in the Americas, including southern portions of the United States. Many of these diseases also have relevant vectors, hosts, and reservoirs already established in Canada, with some diseases, such as echinococcosis, emerging in the country. Communication strategies about Factor 4 diseases should be aimed at health professionals with highly travelled patient bases, mainly those in urban settings and affluent areas, those who serve significant newcomer populations. Cluster 1 respondents are familiar with this group.

Table 36 – Factor 5 – Diseases related to crowded living conditions

Disease	Factor weight
Hantavirus – Hemorrhagic fever with renal syndrome	0.583
Hantavirus – Hantavirus pulmonary syndrome	0.525
Alveolar echinococcosis	0.455
Louse-borne relapsing fever	0.452

The four diseases in factor 5 are often associated with crowded living conditions. Some of these diseases tend to be found in patients who are new immigrants or refugees from impoverished regions and places affected by conflict.[9] Hantavirus pulmonary syndrome and alveolar echinococcosis can occur in Canada, and may impact those living in crowded conditions with prolonged close contact with animals such as rodents and dogs, and can be a public health concern specifically in remote Indigenous communities. Resources for managing these diseases should be communicated specifically to those working with these highly vulnerable populations. These diseases are familiar to cluster 1; the two hantavirus diseases are also somewhat familiar to those in cluster 2.

Table 37 – Factor 6 – Respiratory diseases affecting livestock and wildlife

Disease	Factor weight
Avian (zoonotic) influenza H7N9	0.726
Avian (zoonotic) influenza H5N1	0.703
MERS-CoV infection	0.552
Bovine tuberculosis	0.286

The diseases in factor 6 are respiratory diseases associated with livestock and wildlife, and usually initially present with generalized respiratory symptoms in humans. These diseases would likely be diagnosed only in patients with more serious symptoms, presenting with a risk profile that leads to specific testing that would detect them. Communication about this group of diseases should be aimed at health professionals in agricultural communities, especially those who employ temporary foreign workers as well as health professionals with significant newcomer populations in general. These diseases, like all the others, are familiar to cluster 1, but are even more familiar to those in cluster 2.

[9] Tariq M, Kim DM. "Hemorrhagic Fever with Renal Syndrome: Literature Review, Epidemiology, Clinical Picture and Pathogenesis," Infection and Chemotherapy, 54(1):1-19, Mar 2022, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8987181; Warrell, DA, "Louse-borne relapsing fever (Borrelia recurrentis infection)," Epidemiology and Infection, 147:e106, Jan 2019, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6518520.

Table 38 – Factor 7 – Rare encephalitic diseases

Disease	Factor weight
Jamestown Canyon virus	0.743
Snowshoe hare encephalitis	0.737
*Nipah virus disease**	*0.422*
*Cache Valley virus disease**	*0.285*

Factor 7 is the smallest group, with two main diseases that belong to the same serogroup of viruses, and are often conflated with each other: Jamestown Canyon virus and snowshoe hare encephalitis. Nipah virus and Cache Valley virus, both part of factor 1, are marginal for factor 7. The trait these four diseases have in common is that they can all cause encephalitis. This suggests that the physicians and nurses who have experience with this group of diseases likely work with encephalitis patients, and these diseases come up during investigation and diagnosis. These diseases are most familiar to those in cluster 1.

Applying the factor analysis to communication

The research findings indicate that health professionals generally do not prioritize learning about ZIDs unless they are specifically relevant to their practice. The factor analysis can be applied to strategic resource development and dissemination that targets health professionals with resources about the ZIDs that are most likely to apply to their practices. These groupings need not be considered concrete; it can be used as a starting point for making this large list of diseases more digestible for health professionals. For example, a resource aimed at those serving agricultural communities could provide information about diseases from group 3 and group 6, along with select other diseases from other factors that are also thematically, if not mathematically, related.

E. Demographic description of participants

The following table shows the profile of participants in the study (data are weighted).

Table 39 – Respondent profile (1 of 3)

Characteristic	**Total (n = 1,023)**	**Nurses/NP (n = 497)**	**Physicians (n = 526)**
Primary profession			
Registered Nurse or Nurse Practitioner	49%	100%	-
Physician/Resident	51%	-	100%
Area of practice			
Family medicine	54%	37%	70%
Community health and palliative care/pain management	18%	33%	3%
Public health	15%	26%	5%
Emergency medicine/critical care, urgent care/acute care	12%	12%	11%
Internal medicine and mental health/psychiatry/psychology/addiction	8%	8%	7%
Other	5%	6%	3%
Practice setting			
Family medicine clinic/ private practice/ specialist clinic	46%	26%	65%
Hospital setting	26%	29%	23%
Community health centre and home or community setting/palliative care and mental health and addictions	13%	21%	6%
Public health clinic/setting	10%	17%	3%
Specialized travel health centre/clinic	1%	1%	1%
Other	2%	4%	1%
Indigenous health experience			
Yes	20%	25%	15%
No	74%	70%	77%
Not sure	4%	4%	5%

Table 40 – Respondent profile (2 of 3)

Northern health experience			
Yes	6%	7%	5%
No	94%	93%	95%
Years of experience in Canada			
5 years or less	8%	7%	9%
6 to 10 years	17%	18%	17%
11 to 20 years	36%	43%	29%
>20 years	37%	31%	42%
Practice outside Canada			
Yes	21%	13%	28%
No	75%	84%	66%
Prefer not to answer	4%	3%	6%
Regions practiced in (of those who practiced outside Canada)			
United States	24%	31%	21%
Europe	21%	23%	20%
Africa	18%	12%	20%
Asia	17%	21%	16%
Middle East	10%	7%	12%
Australia or New Zealand	10%	6%	12%
South America or Central America	5%	7%	5%
Caribbean/Mexico	4%	4%	4%

Table 41 – Respondent profile (3 of 3)

Age			
Under 35	11%	17%	5%
35-44	31%	36%	26%
45-54	25%	24%	26%
55-64	20%	17%	23%
65+	10%	4%	16%
Gender			
Woman	70%	89%	52%
Man	27%	9%	44%
Gender diverse/other	<1%	<1%	0%
Prefer not to say	3%	1%	4%
Region			
British Columbia	12%	10%	14%
Alberta	12%	12%	12%
Saskatchewan	3%	3%	3%
Manitoba	4%	5%	3%
Ontario	37%	36%	37%
Quebec	24%	23%	24%
Atlantic	8%	8%	7%
Territories	1%	3%	<1%
Community size			
Urban	83%	78%	88%
Rural primary	9%	14%	5%
Rural any	11%	16%	6%
None of the above	7%	7%	7%

II. Detailed Findings – Qualitative in-depth interviews (IDIs)

A. Practice setting, patients, and zoonotic disease cases in practice

In total, 41 health professionals participated in interviews for this study. The most common practice settings for interview participants were family medicine or walk-in clinics in large or medium cities. Other settings included hospitals (large cities and smaller towns), virtual care, public health clinics, and specialist practices.

Most participants had some experience with ZIDs, but on a very infrequent basis. The specific diseases they had experience with depended on the nature of their practice, but Lyme disease, rabies, and travel-acquired illnesses in general were mentioned most often.

When asked to discuss their practices and what experiences they had with ZIDs at work, many health professionals talked about the characteristics of their patients and the communities they serve, though they were not asked about this directly. The patient base served by interview participants also varied and largely mirrored the quantitative survey sample characteristics; most were in general practice with patients who reflected the population in the community they served. For those in urban centres, newcomers to Canada and travellers were a notable proportion of their patient population that they perceived to be at a higher risk for zoonotic infections. Zika virus infection and toxoplasmosis counselling was often mentioned by those serving patients who were pregnant, or planning to become pregnant.

Health professionals in cities tended to refer ZID cases to the emergency room, infectious disease specialists, or public health units, depending on the severity of the patient's symptoms and the suspected cause. The main exceptions to this were those working in practices that specifically offered travel health services, like vaccination, travel consultation, and travel-related disease testing and treatment.

> *"Most often it's malaria and Zika virus, we do counselling on. We have a lot of people going to Eastern Europe, so we do vaccines for tick-borne encephalitis. We screen for dengue, depending on where our patients came from."*
>
> *"Most of the time, it's like someone came back from a trip somewhere … They're suddenly unwell, and we're just trying to figure out if they caught something from another country ... It's mostly just a workup for it."*
>
> *"I would say almost all the time that there's a potential zoonotic infection, the patient gets referred to infectious diseases."*

Those working in smaller towns and rural areas noted that their patients who were most at risk for ZIDs were those involved in agriculture (e.g., farmers, veterinarians), those who worked outdoors, and those with outdoor recreational pursuits (e.g., hunting, hiking). These participants often saw patients at a heightened risk of rabies exposure from incidents like dog bites or wildlife encounters, though no interview participants noted seeing a lab-confirmed rabies diagnosis in Canada, where prevention measures for rabies are highly available. Health professionals in smaller communities also tended to be more aware of livestock and wildlife-related illnesses like avian influenza, brucellosis and bovine tuberculosis. Small community participants were often more involved with investigation, diagnosis, and treatment, since they and their patients had limited access to amenities like specialists and testing facilities.

Participants with experience working in extremely remote or far northern communities noted some specific risk factors that were fairly unique to this community type, including a much higher likelihood of contact with wildlife or feral domestic animals, and a general lack of precautions during outdoor activities. In addition to rabies, hantavirus and tick-borne diseases were issues of heightened concern for these health professionals though these diseases were rarely seen in patients.

Several interview participants were nurses and nurse practitioners with public health experience. There were also some physicians who had worked in or received training in public health. Those working directly in public health often had experience following up with patients with potential rabies exposure, or confirmed cases of Lyme disease. Nurses and physicians with public health experience or education tended to demonstrate more knowledge of ZIDs in general, and had higher awareness of specific diseases like Lyme disease, rabies, Zika virus infection, mpox, West Nile virus infection, and avian influenza.

> *"Even with something like Lyme disease it's unusual enough that the average doc doesn't know much about guidelines. I know a little more because my public health involvement and it was a public health issue across Canada."*

For physicians and nurses working in urgent care or emergency room settings, containment and PPE were high priorities; several interview participants noted that they were concerned about infections spreading within the workplace and to staff households. For those in urgent or emergency care, a typical approach was to focus on stabilizing the patient before referring them to an infectious disease specialist, a public health unit, or a family doctor for further investigation and follow-up care. Whether or not an infectious disease was specifically zoonotic was not a major concern in this type of setting, where there are standard policies and protocols to follow for patients with infectious diseases in general.

B. ZID knowledge and perceptions

For most doctors and nurses who participated in interviews, knowledge of the ZIDs on the list (52 key diseases from survey) was limited. Interview participants often recalled feeling surprised or overwhelmed by the number of zoonotic diseases that were unfamiliar to them. Another common impression of the list overall was that many of the diseases were rare or foreign (i.e. not endemic to their region, or to Canada overall).

> *"This is a very extensive list of infectious diseases; I think a lot of primary care providers are probably not very well versed."*
>
> *"There's a lot of concern about zoonotic disease… we do see waves of patient concern, but we really haven't seen waves of disease."*

Even when referring directly to the list (which was offered to participants as a downloadable PDF file), most interview participants had only passing familiarity with a few diseases on the list. A handful of diseases were mentioned somewhat more often.

Lyme disease

Lyme disease was mentioned most often in interviews as a disease that was relevant to participants' practice. This aligns with findings from the survey research, where Lyme disease is the disease encountered most, and with the highest ratings for self-reported confidence among survey respondents. Physicians and nurses in areas where Lyme is more common (Ontario, Quebec, Atlantic provinces) generally had some experience diagnosing and treating it, and frequently encountered patients who were concerned about contracting it. Elsewhere in Canada, most doctors and nurses had some experience discussing it with patients, but usually they had not seen any confirmed cases. Several interview participants commented on the increasing prevalence of Lyme disease in some regions of Canada in recent years, and some had received some form of public health communication or continuing education about it.

> *"Living here in Alberta I guess the main zoonotic thing that I would be asked about in my day-to-day work was always Lyme. That's the main thing that people worry about."*
>
> *"I have certainly a lot of people who come in wanting screening for Lyme disease or have a tick that had to be removed or other stuff, and some who actually test Lyme positive and require treatment."*

Rabies

Rabies was mentioned often in interviews as an endemic disease posing a risk to particular populations. Several doctors and nurses, mostly in rural areas, had managed cases where rabies exposure was a risk (i.e., animal bites, picking up dead animals, wildlife encounters, etc.) but nobody recalled a positive case in a patient, or a positive test result from an animal in Canada. Some interview participants, especially those in rural settings and those working in public health, had experience administering rabies vaccines and prophylactic immunoglobulin treatments to at-risk individuals. In urban areas, these patients were usually referred to public health. One doctor had seen fatal cases of rabies in two patients while working abroad.

Rural health professionals also counselled high risk patients, such as veterinarians, farmers, and outdoor enthusiasts, on risk reduction and procedures to follow for suspected exposure (e.g., seek treatment immediately, if possible try to contain the animal without killing it so it can be observed).

> *"Rabies is a big one … in the isolated communities, there are no veterinarian services. So, we have a lot of dogs that are unimmunized ... There's a lot of fear around it with clients."*
>
> *"I've never had an actual rabies case, but I've worked in places where people have been bitten by dogs or wild animals. It's something that we keep aware of and treat seriously."*

Mpox

Many interview participants recalled seeing public health alerts about mpox in the past couple of years, but very few had seen confirmed or suspected cases. Some physicians and nurses working in urban settings had referred patients for vaccines based on their risk profile. Those who had seen mpox cases noted that the materials they received, like public health bulletins and information posters, helped them to recognize the disease in patients.

West Nile virus infection

West Nile virus infection was mentioned frequently as a disease that participants were generally aware of, but few had any detailed understanding of its current status in Canada. Some recalled instances of confirmed infections in patients who had severe symptoms, but in general, it was viewed as a disease that is known to be endemic but is rarely a consideration for testing in patients.

> *"West Nile virus… I don't hear so much about that right now, but it is still very present in the community."*

Avian influenza (H5N1, H7N9)

Several participants were aware of these specific strains of influenza, and some physicians recalled requisitioning tests that covered them (along with other viruses). However, most interview participants who mentioned these diseases said they generally did not differentiate between different strains of influenza and typically treated patients for flu-like symptoms unless there was a more severe illness requiring further investigation.

Zika virus infection

Zika virus infection was mentioned several times as a topic discussed with pregnant patients. Several interview participants recalled hearing about Zika virus during the outbreak in 2015 and 2016, and there were some mentions of positive Zika virus cases in travellers.

> *"I do see some pregnant women as well. So especially those who travel to tropical climates, there are concerns there, in particular for Zika virus and prevention and travel advice."*

Other diseases

There were limited mentions of some other diseases from the list:

- A nurse in a northern community had a young patient who became very ill, and eventually tested positive for Snowshoe hare encephalitis after a lengthy investigation.
- Japanese encephalitis was mentioned as a common consideration for those with patients who travel to Asia.
- Powassan virus disease and Rocky Mountain spotted fever were mentioned by name several times in discussion of tick-related risks, but nobody had seen an actual case of either.
- Chikungunya was noted by several doctors and nurses with experience practicing outside of Canada. Some health professionals included it in testing for symptomatic patients with a history of travel to regions where it is endemic.
- Ebola disease was mentioned in passing as an example of a serious disease they had heard of but had not seen in practice.
- Toxoplasmosis and bartonellosis were both mentioned as differential considerations for patients who were cat owners. Toxoplasmosis was also noted several times as a potential risk for pregnant patients.
- Cutaneous larva migrans, Chagas disease, dengue, and yellow fever were mentioned in discussions around travel illnesses. Cutaneous larva migrans was a disease that some interview participants had diagnosed in patients.

- Hantaviruses in general came up in interviews with participants who had experience serving remote and/or Indigenous communities.
- Several diseases were mentioned in one particular interview with a nurse in a remote area. This participant noted that bovine tuberculosis, brucellosis, and anthrax were potential risks within wildlife and livestock in their region, though she had not seen or heard of cases crossing to humans in practice.

> *"Oftentimes they're like mosquito-borne ones (in the emergency room). That's pretty typical from where people are returning back from, especially if they have fevers… Chikungunya is something they look at."*

> *"We don't actually see a lot of tick-related diseases… we do talk about it in training and whatnot. We've always talked about Rocky Mountain spotted fever, Lyme disease and things like that, but haven't actually seen those."*

Most of the other diseases on the list were unfamiliar or unknown to the vast majority of interview participants. While discussing their experiences with specific ZIDs, some participants mentioned diseases that were not part of the survey list; often, the diseases mentioned were vector-borne or mainly human-to-human diseases that are sometimes associated with animals. Malaria, salmonella, giardia, ringworm, and COVID-19 are examples of diseases that were mentioned repeatedly, but were not part of the survey list.

Low confidence

Participants were told that survey results showed very low confidence among health professionals when it comes to managing the diseases on the list. None of the participants were surprised to hear this, and they almost unanimously rated their own confidence at managing ZIDs as low. A few participants, who had some experience with ZIDs in their practices, suggested they were somewhat more confident at managing the diseases that were familiar.

> *"Pretty low confidence. Because even though we deal with it at least a few times a week, we don't deal with it a few times a day… that's where I feel like you really kind of solidify your knowledge."*

Physicians and nurses alike attributed low confidence among health professionals to a lack of direct experience, and a lack of education about individual diseases or infectious diseases in general. Very few had taken anything more than a single, general course on infectious diseases during their medical training, and continuing education on any topics related to ZIDs was very rare. For those participants who had encountered any of the diseases on the list, experience with confirmed cases was often limited to one or two across an entire career.

> *"Lack of education in the area and the infrequency of how often we see these types of infections come up in BC are the drivers of low confidence."*

> *"My own differential diagnosis is still very limited about the things I could only possibly see here in Canada … there's so much overlap in some of the symptoms. I might have even seen some of these conditions but not identified them as such because they are so rare and so infrequent."*

C. Resources on zoonotic diseases

When discussing resources, it is important to note that most health professionals interviewed did not strongly differentiate between ZIDs, and infectious diseases in general. With little experience, they often spoke more in hypothetical terms about the resources they would consult. Real experience with these resources was usually in the context of other diseases not mentioned in the survey list.

A few key resources were mentioned frequently:

UpToDate

This popular online resource was mentioned by nearly all physicians interviewed, and many nurses as well. One key advantage of this resource, as the name suggests, is that it is up to date with current research. It was also seen as trustworthy, easy to use, and relevant, with information presented in a useful format. This resource was popular both among participants who liked looking up information on a phone, and those who preferred to use a computer. The only significant drawback for UpToDate was that it is not a Canadian resource, therefore tests and treatments discussed may not be relevant for Canadian practices. As a subscription service, the fees have potential to be a barrier, but most participants had their subscriptions paid for by their employers.

> *"There are different things like calculators, drug interactions, but there's a search bar within UpToDate which can tell you what to do when you look up certain infections… I can look up zoonoses for cats and then it can talk about some of the different infections."*

CDC

The CDC was seen as a trustworthy source of information about diseases in general, and was mentioned frequently in interviews. Occasionally, it was mentioned in contrast to Government of Canada resources, with interview participants suggesting that the CDC's website was easier and more effective for them to use when researching a disease. Like UpToDate, the lack of Canadian-specific context was a potential drawback.

WHO

The WHO was also mentioned as a trustworthy source of information about medical topics in general, and as a potential source of information about the diseases on the list, particularly those of concern for travellers and immigrants. Again, not reflecting Canadian-specific context was a minor limitation.

Provincial health resources

Health professionals often mentioned resources from their own province or territory, or other Canadian provinces. BCCDC resources were mentioned by health professionals located in BC and other western provinces as a reliable resource for ZIDs, infectious diseases in general, and other public health topics. This provincial government resource was seen as well researched, and the Canadian context was helpful. It was also noted to be easy to use, and often preferred over resources from other provinces. Quebec resources like those produced by the Institut national de santé publique du Québec (INSPQ) and Institut national d'excellence en santé et services sociaux (INESSS) were well-regarded by Quebec-based health professionals, but were not mentioned by participants outside of Quebec.

Government of Canada resources

Spontaneous mentions of Government of Canada resources were not uncommon among participants, but were rarely noted as major resources. Most often, Government of Canada information was noted to be useful in the context of travel advisories, or the risk of diseases endemic in other countries. When asked directly about Government of Canada resources, most observed that while they felt government resources were thorough and trustworthy, website navigation was difficult due to the number of links they would have to click through to reach relevant web pages, and inconsistent formatting across different pages and resources. These issues meant that Government of Canada resources were not viewed as a streamlined reference to be accessed in a hurry, because it took too much reading to find clinically relevant information. Some indicated that Government of Canada resources could be worthwhile when there was time for a deeper read. In some instances, interview participants did not differentiate between provincial government resources and those offered by the Government of Canada.

> *"I also get asked questions from patients asking what kind of vaccines to get, what to avoid. I often direct them to the government travel advisory website."*
>
> *"I find it is very hard to navigate. You search for a specific topic, and you get tons of links that often are not relevant… Going through all this information to find what you need is very laborious."*

Other resources

Several interview participants talked about popular reference books for their fields, such as the American Academy of Pediatrics (AAP) "Red Book" for pediatric cases, the U.S. Food and Drug Administration (FDA) "Orange Book" on medications, and the CDC's "Yellow Book" for travel health concerns. In discussion, some interview participants suggested that resources like these were expensive, became quickly outdated, and also lacked Canadian context.

Other health professionals were seen as an important source of information and guidance in both informal and formal contexts. Many interview participants said that when faced with a difficult case or an unfamiliar disease, they would consult colleagues with different experience or training backgrounds. Local health units and local specialists were a good option, where these were accessible. E-consultation services, providing access to specialists, were also popular; interestingly, both urban and rural participants mentioned using e-consultation. Some participants also mentioned that after referring patients to an infectious disease specialist, reading the specialist's report about the case was an excellent way to enhance their knowledge.

> *"I use the e-consult service a lot, because it's all covered under OHIP, and I can get a response usually right away."*
>
> *"Because most of my experiences in Quebec have been up north ... I just call the MUHC, and I see who's on call for infectious diseases."*

When health professionals are looking for information on ZIDs, they often start with a simple Google search, and from the results, look for information from reputable sources like universities, the CDC, Mayo Clinic, or Johns Hopkins. Some noted that it was important to be aware of what their patients might also be seeing in general internet searches, so they could be better equipped to have productive conversations about patient concerns.

D. Resource gaps and suggestions

Knowledge gaps

Most interview participants agreed that there are knowledge gaps within their field when it comes to ZIDs in general. Though they struggled to come up with concrete reasons for this knowledge gap, a few themes emerged:

Rarity

Most zoonotic diseases, including those on the survey list, are seen as rare or foreign. In the context of primary care, this means that actual patient cases are limited or non-existent in regular practice. Because they are so rare, most of these diseases are not even considered by physicians in their differential diagnoses.

Related to this is that the symptoms of many ZIDs are similar to more common illnesses; health professionals will consider many other conditions first in a patient presenting with signs and symptoms like fever, headache, and diarrhea. Several participants related the medical adage "When you hear hoofbeats, think of horses, not zebras" in describing this perspective. Ultimately, the importance of maintaining knowledge about ZIDs is simply dwarfed by the necessity of knowing about more common conditions that affect their patients, like diabetes, heart disease, and cancer.

> *"If you don't see them often, then you don't end up being able to treat them, and you don't know how to treat them."*
>
> *"If you look at the symptom constellation for things like Lyme disease or West Nile, they tend to blend into other things that we see commonly … for every person who has Lyme disease, I'm probably going to see a few hundred with flu so it's a bit of a needle in a haystack."*
>
> *"[Mpox] is not such an exotic infection… there was a big, a large campaign of awareness from the local public health, the provincial public health and federally as well, on understanding the signs, symptoms, risk factors, et cetera, for that illness. So, a little bit more confidence in that."*
>
> *"When you see it recurrently, you get your comfort level there. You can go through training in specific infectious diseases or conditions, but then if you don't see them frequently enough, you forget."*
>
> *"It's very hard to keep up with things you're not really seeing."*

Not covered in formal medical education

Most interview participants noted that infectious diseases in general, and ZIDs more specifically, were not a main focus during their formal education in medical or nursing school. Physicians could usually recall being taught about infectious diseases at a high level during medical school, and some had seen patient cases during their residencies. Most nurses in the interviews did not recall receiving any specific formal education about ZIDs. Beyond that, very few health professionals had attended continuing education courses or conferences that touched on ZIDs (or infectious diseases in general).

When choosing CMEs and other training options, participants often said they typically pursued topics that were more immediately relevant to their daily practice. Some mentioned that they could not recall seeing many opportunities to receive continuing education about ZIDs, or infectious diseases in general. Another factor was that pharmaceutical companies often drive awareness of medical topics; some interview participants suggested that there is little pharmaceutical industry attention given to infectious diseases and related topics.

> *"Unless you're working in a like a health authority funded position where this was the specialty clinic, and they were willing to train an NP on that. That's the only way you're going to get the education. Even self-study is hard because where do we even start that? We can go and review resources, but there isn't really a great program or course that's really tailored to zoonotic infections and primary care."*
>
> *"I think there's not very much ongoing training on these illnesses, unlike many other topics of clinical interest... There's not very much pharmaceutical industry sponsorship of those kinds of infectious diseases."*

Information overload

Interview participants did not generally perceive there to be a lack of adequate resources about ZIDs available to them. However, this perception should be interpreted with the understanding that most health professionals had low overall awareness and few encounters with the 52 ZIDs in the study list, and therefore little experience trying to find resources or information about them. The challenge they perceived with resources was more a matter of information overload where all medical topics are concerned, which makes it difficult to focus on a given topic, or to stay abreast of new developments. This poses a risk where resources that are too specific have the potential to be overlooked.

> *"There're all these different electronic medical records all over the place… all these different access points. How many pages do I need to have open on a given day to provide the care that I need to provide at this moment in time?"*
>
> *"There's constant reminders of things coming at you. So, it's this bleep and that bleep and your email, your phone is on, and you've got all this stuff."*
>
> *"I don't think there's any lack of resources... The problem is that there are almost too many resources now and you're often left not knowing which ones to trust."*

Perceived as low priority

While most health professionals interviewed agreed that there was a knowledge gap about ZIDs among their industry colleagues, this was not necessarily seen as an issue requiring their immediate action. Many participants felt that in a high information environment where health professionals must maintain knowledge on many complex topics, the relative infrequency of ZIDs (as discussed earlier) means they are not high on their priority list for learning. Most were confident that they do have ready access to support resources and infectious disease specialists when a case comes up. Some practitioners also indicated that detailed knowledge about specific diseases is not necessary even when they encounter a case – it's more critical to know where to find information such as:

- How to handle patients with infectious disease symptoms (i.e. isolation, PPE, etc.).

- Contact details for appropriate specialists and/or public health.
- How to manage confirmed cases, if they are sent back for follow-up care.
- For those in more remote settings, what to look for during patient assessment, what tests to order, and what prophylaxis may be relevant.

> *"As a busy family physician, most of the things we do are on the go… we have a case, we learn, we study, we consult, but not necessarily specifically for zoonotics."*

> *"Especially as a family physician, there's a lot of breadth of things we need to know but we definitely do not know the nitty gritty details of this zoonotic disease and I will never pretend I do … it's not uncommon for us to actually pick up the phone and call our infectious disease colleagues for advice on testing, on treatment because it's not that straightforward."*

> *"It would be nice to know what the risks are ... I know a lot of my colleagues are quite concerned about taking it home to their children or just taking it home to any potentially immunocompromised people."*

> *"I don't know when in my day I would ever find time to sit down and just think about something that I don't see a lot of, but I'm interested to learn… I think that's how everybody in health care feels right now."*

Suggestions

Staying current with medical knowledge in general is a major challenge for health professionals, who frequently mentioned how much effort it takes for them to be up to date on research, practice methods, medications, and emerging threats. Many health professionals talked about how they try to prioritize what they spend time on, and what forms of information tend to get their attention. Where ZIDs are concerned, there were some information sources that seemed to break through better than others.

In general, health professionals take public health issues very seriously, so public health bulletins or alerts are effective. Most interview participants could recall seeing public health information about specific diseases (e.g., mpox, avian influenza, West Nile virus infection). This puts a specific disease on their radar, so to speak, which seems to boost their confidence about counselling at-risk patients or spotting symptoms, and helps them know where to look if they need more information.

> *"If you think of mpox, for instance, we'll be getting a lot more sort of information from public health… I think that has been helpful, but I don't see the same kind of information uploads for other conditions."*

> *"I get updates constantly from Ottawa Public Health… that's where I usually get the information from, because public health will send reminders and bulletins about what's out there."*

Articles and columns about emerging trends or diseases of concern in Canada are effective for some. Physicians in particular often indicated that they browse industry-specific magazines and journals. While they may not have time to read complete peer-reviewed studies about all topics, shorter articles that summarize key information are useful for introducing a topic and generating a baseline level of awareness about a specific disease.

> *"Every month when I get these journals, I do actually try my best to go through the interesting cases, especially for topics I don't know about or don't see very often."*

Ideal resource

When asked to describe an ideal resource for learning about ZIDs, physicians and nurses provided a variety of suggestions. There was a broad appetite among participants to have access to a web-based resource with the following characteristics:

- It should be offered as both a website and an app. Health professionals tend to prefer one or the other, or have different use cases for both.
- Online resources should be attractive and easy to use. This ties back to a key criticism of Government of Canada resources from the interviews, which was that they lack visual appeal and navigability.
- There should be information for health professionals and patients. Physicians and nurses want access to detailed information to help them understand more, but they also want accessible summaries of key points that they can share with patients.
- It should be searchable by different variables or aspects of diseases, like geography, symptoms, patient characteristics, risk factors, and the specific species that could be involved.
- It needs to be easy to drill down to the relevant details needed in the moment, such as assessment, diagnosis, treatment, and epidemiology.
- The resource needs to highlight key details that are specific to the Canadian context, like what tests and treatments are standard and accepted in Canada, what diseases are actually relevant for a differential diagnosis of a patient in Canada, and if there have been recent concerns or outbreaks in Canada.
- Many participants felt this sort of resource would work best if it was included in a broader resource, rather than a separate, stand-alone piece.

> *"Dovetailing it into an app instead of us having to pay for these infectious disease apps."*
>
> *"Why reinvent the wheel? Like, the Canadian STI guideline, it's a great resource. It's easy to access… why couldn't there be a resource like that? Like, the Canadian Zoonotic Infectious Diseases Guidelines and set up in a very similar way."*
>
> *"Maybe a website that's password protected, with our license number, for example. Then we log in and we type in the condition. For example, yellow fever, and it would pop up with the signs and symptoms and the diagnostic test required was the latest up -to-date treatment that's evidence -based."*
>
> *"The ideal format would be a website… with up-to-date factual information, including clinical presentations, diagnosis, management, treatment, and emerging epidemiology of the different diseases."*
>
> *"It would be something that was good for both diagnosis and management… how the disease is going to present, which countries are more likely to have that type of infection, what tests to do to diagnose it and what the management would be."*
>
> *"A Canadian lens would be more helpful, because a lot of the information is American. Whether the values are different for labs or the medications aren't available in Canada, it can sometimes be frustrating."*

In addition to a comprehensive web-based resource, participants mentioned a variety of other types of resources they would find helpful. Some common themes for other resources included:

- Infographics or one-page summaries of key information, shared by email or fax.
- Online courses, webinars, and CMEs.

> *"What I could use is almost like a triage thing. Family doctors are very practical, so walking me through the steps of what should be done would be very helpful."*
>
> *"I wish they had maybe an online course … like yearly refreshers on what's new and in travel medicine."*
>
> *"I kind of like a one pager of what should be done about it, how it can be maybe prevented, and then maybe what could be the treatment for it, or where to go for more information."*
>
> *"I think if you're a subspecialist… the opportunities for CME are quite abundant… I could understand how a general practitioner or somebody specializing in another area would not necessarily get exposure to that type of CME."*

When it comes to the authors or distributors of information on ZIDs, interview participants were generally agnostic about resources as long as they come from organizations who are trustworthy, current, and evidence-based. When asked to specify who they saw as trustworthy, health professionals named a wide variety of entities and organizations, such as provincial health ministries, local public health units, infectious disease specialists, CDC, WHO, and reputable universities (in Canada or elsewhere). The Government of Canada was widely seen as trustworthy overall, but many health professionals expect to receive information from the provinces, rather than the federal government. Some participants also referred back to the sources they had discussed earlier in the interview, reiterating that trust was a reason they relied on online resources like UpToDate and MayoClinic. Several doctors specifically mentioned being somewhat wary of resources provided by or funded by pharmaceutical companies, not because they believe the information is incorrect, but because they expect it to serve a commercial agenda that may not align with patient needs.

> *"Something coming from a … large Canadian University that would be trustworthy because I know it's not going to be biased through pharmaceutical companies. Things that are paid and sponsored through pharmaceuticals even though they mean well, they often will distort the information."*

Conclusions and recommendations

The quantitative and qualitative results of this research point to several key findings that could inform future efforts to develop resources and build capacity where ZIDs expertise is concerned:

- While most physicians (73%) and nurses (52%) say they encounter zoonotic infectious diseases (ZIDs) in their practice at least once a year, the majority of doctors and nurses claim to have only general or limited knowledge about ZIDs.

- Diseases that are encountered more often tend to be those associated with well-known past outbreaks or epidemics (e.g., Lyme disease, West Nile virus infection, rabies, Zika virus infection, mpox), common travel-related illnesses (e.g. chikungunya, cryptosporidiosis,), and diseases that can be occupational hazards or risks for vulnerable patients (e.g., toxoplasmosis, bartonellosis, brucellosis).

- There is a positive correlation between encountering a disease, and self-reported confidence in managing it. Lyme disease stands out from others for being encountered most often, and with the highest ratings for confidence. Even in combination with other variables, like self-rated knowledge and various diseases characteristics, encountering a disease is the strongest driver of confidence.

- Physicians are more satisfied (52%) with the formal ZID education they received than nurses (31%). One-quarter of nurses (23%) say they did not receive any formal training on ZIDs, triple the proportion of doctors (7%) who say they did not receive such training. Physicians and nurses are equally satisfied with continuing education on ZIDs, when they have received it. Nearly half (46%) of physicians who received continuing education on ZIDs are satisfied with this education, just slightly lower than the proportion of physicians satisfied with their formal education (52%). In contrast to formal education satisfaction, nurses show an equal level of satisfaction with continuing education (47%) when compared to physicians.

- Results of the quantitative research indicated that federal/provincial and territorial government health websites and digital clinical support tools are the resources used most; information from the qualitative interviews indicated that digital tools, especially UpToDate, are the most preferred.

- Almost all health professionals surveyed are at least somewhat interested in receiving more professional education on ZIDs. They rank treatment, prevention, and diagnosis as the topics they would most like to learn about. In terms of formats, self-directed online learning, interactive online courses, webinars and fact sheets are the top formats preferred by health professionals.

- Health professionals indicated that an ideal resource would be a searchable web and app platform with Canadian context. Because of knowledge and time demands inherent to health care work, understanding protocols and knowing where to look for information was often seen to be more important than knowing specific details about individual diseases.

The executive summary at the beginning of this report provides additional discussion of the key findings.

Here are some considerations, stemming from the key findings, that may be employed to ensure that health professionals are equipped to manage ZID cases when the need arises.

Resources should be relevant and realistic:

- Next steps should be grounded in the understanding that most health professionals do not realistically have the capacity for intensive study about ZIDs. Resources and capacity building efforts will be more effective if they are designed around this reality.

- Recognize that except for those who deal with ZIDs on a frequent basis, ZIDs are perceived as a low priority for learning among most health professionals because most do not report encountering patient cases of ZIDs very often.

- For those without expertise, ZIDs are easily conflated with other infectious diseases that are not zoonotic. This means that resources and education about specific ZIDs will be most effective when they are very strategic and suited to the specific audiences who are most likely to encounter these diseases.

- Look for opportunities to ensure that more general information about ZIDs is broadly covered in resources about infectious diseases, since health professionals tend not to differentiate.

Resources are most useful if they are broad in scope, accessible, and easy to use:

- The best resource for most health professionals is easy to reach in a time of need, but that otherwise does not command much time or attention. A resource that is too specific, and only used rarely, will not get traction with busy health professionals who only see ZIDs intermittently.

- Health professionals in general have a perception that resources about ZIDs will be available to them, should they be needed, and most were not able to identify specific gaps in the resource landscape. In developing resources, it is therefore necessary to anticipate their needs to some extent by prioritizing what is most important for them to know.

- It may be useful to enhance or expand existing resources that health professionals already know about and reach for in everyday practice. In other words, consider opportunities to meet health professionals where they already are.

Health professionals know what resources have worked for them in the past:

- While knowledge and experience with ZIDs is low, health professionals do respect public health, and take it seriously when an infectious disease becomes a threat to the community. They will pay attention to bulletins and alerts about outbreaks or diseases of concern, and they appreciate materials like fact sheets and posters that tell them key points quickly and help them to identify risk factors in their patients.

- It may be useful to look at the resources and education approaches used for the few ZIDs where health professionals had higher levels of experience and self-reported confidence. Many health professionals recalled learning about Lyme, mpox, West Nile virus, and rabies from resources sent to them by public health at the local, provincial, or federal level.

- Physicians will also take note of diseases they read about in journals and magazines. These formats could be applied as a way to gradually build awareness of diseases that are not on their radar, but should be.

Resources can be designed to be very strategic to increase their relevance and uptake:

- Multivariate analysis was used to identify four key clusters, or segments, of health professionals who are alike in their experience with ZIDs; further analysis shows that this linked to practice setting and other attributes. This information could be applied to more effectively target resources and communication with topics and formats that are most effective for specific settings or types of health professionals.

- The quantitative analysis also identified seven groups of diseases that share common attributes and contexts where health professionals may be more likely to see them. This information could be used to inform communication about specific diseases to the audiences who need them most. For example, fact sheets about the diseases from crowded living conditions could be very beneficial to health professionals who serve vulnerable groups, like incoming refugees and remote Indigenous communities, while those in family practices serving affluent communities could find it useful to learn about the rarer emerging and travel-related illnesses.

Collaboration and consultation with colleagues can grow capacity:

- The single biggest influence on self-reported confidence in managing ZIDs is experience with specific diseases. In the qualitative interviews, several participants noted that they often relied on the expertise of experienced colleagues when managing suspected ZIDs cases in practice. Consultation with colleagues also ranked as an important resource in the quantitative results.

- Consider ways to encourage more health professionals to build knowledge and confidence with ZIDs at different stages of their career. Having even one colleague with more ZID experience can be a good way for others to learn, and it can build capacity for an entire practice.

Appendix A: Quantitative methodology

1. Sample design and weighting

This assignment involved quantitative research, consisting of an online panel-based survey of 1,000 health professionals in Canada in two groups: general practitioners/physicians, and nurses/nurse practitioners. The survey was administered in English and French depending on the respondent's preference.

The survey sample was obtained from a proprietary panel of health professionals, MDBriefCase. MDBriefCase was responsible for inviting and directing qualified respondents to the survey hosted by Environics. With an opt-in membership of more than 103,000 pre-profiled healthcare professionals, broken out by occupation, with whom MDBriefCase regularly interacts, this panel provides a cost-effective mechanism to engage HCPs in a timely manner. As this online survey utilized an opt-in list of health professionals, it is a non-probability survey. Thus, it cannot be assumed to be fully representative of the target population and no margin of sampling error is calculated. Results in this report were described as based on those responding and not representative of the population of doctors and nurses.

Environics achieved the following regional distribution based on CIHI population data[10]; final data were weighted to reflect regional distribution within each group.

Table 42 – Regional distribution of completed surveys

Occupation	Canada	Atlantic	Quebec	Ontario	MB/SK	Alberta	BC + Terr
Physicians/GPs	526	29	57	270	32	61	77
Nurses/nurse practitioners	497	58	44	171	77	85	62

Respondents were offered an incentive of $35 for their participation. MdBriefCase was responsible for providing incentives to their panellists through gift cards. 953 surveys were administrated in English and 70 in French depending on the respondent's preference.

2. Questionnaire design

Environics worked with the Public Health Agency of Canada to develop a questionnaire that ensured the research objectives were met and all questions were appropriately worded, and that they adhered to federal government standards for public opinion research. Upon approval from the Public Health Agency of Canada, the questionnaire was translated into French. The final questionnaire is included in Appendix C.

3. Pre-test

Prior to the launch of the survey, Environics provided test links to the Public Health Agency of Canada for both language versions of the survey and changes were made based on their comments. Environics arranged to conduct pretests in both official languages. For the pretests MDBriefcase issues invitations to a limited number of records and conducted a "soft launch" in each language. These preliminary surveys included standard Government of Canada pretest probing questions at the end, to ascertain the survey length and language was

[10] Canadian Institute for Health Information, "Health workforce in Canada: In focus (including nurses and physicians)," 2020, https://www.cihi.ca/en/health-workforce-in-canada-in-focus-including-nurses-and-physicians.

appropriate. The pretest took place on December 5, 2023, and achieved 17 completes in English. No changes were required as a result of the pretests. The pretest responses were retained in the data set. Because no French participants responded to the pre-test, early French completions were monitored carefully to ensure accuracy. No changes were required as a result of this monitoring.

4. Fieldwork

The online survey was conducted from December 5, 2023, to February 7, 2024. The final average survey length was 15 minutes.

The surveys were conducted by Environics using a secure, fully featured web-based survey environment. Environics' data analysts programmed the questionnaires then performed thorough testing to ensure accuracy in set-up and data collection. This validation ensured the data entry process conformed to the survey's basic logic. The data collection system handles sampling invitations, quotas and questionnaire completion (skip patterns, branching, and valid ranges).

Environics assumed overall responsibility for all aspects of the survey fieldwork. The survey was conducted according to the following steps:

- Environics programmed and hosted the online surveys on a secure server. All data were stored on Canadian servers and Canadian back-up servers located and only accessible in Canada, and physically independent from all other databases, directly or indirectly, that are located outside Canada.
- Invitations including a unique URL link (to ensure only one version of the survey is accepted per respondent) were sent to panel members. Non-responders were sent periodic reminders to encourage participation.
- Technical support was provided to online survey respondents as required. Steps were taken to assure (and also guarantee) complete confidentiality and anonymity of survey responses.
- All survey responses were electronically captured as they were submitted and combined into an electronic data file that was coded and analyzed (including open-ended responses).

All respondents were offered the opportunity to complete the surveys in their official language of choice. All survey respondents were informed of Government of Canada's sponsorship of the research, that their participation was voluntary, and that information collected was protected under the authority of privacy legislation.

All research work was conducted according to best practices in the industry, such as the Standards for the Conduct of Government of Canada Public Opinion Research – Online Surveys (http://www.tpsgc-pwgsc.gc.ca/rop-por/enligne-online-eng.html) as well as applicable federal legislation (Personal Information Protection and Electronic Documents Act, or PIPEDA). Environics is a founding member of the Canadian Research Insights Council (CRIC) and registered the survey with CRIC's Research Verification System, which permits the public to verify a survey call, inform themselves about the industry and/or register a complaint. For more information about CRIC: https://www.canadianresearchinsightscouncil.ca/

5. Data coding and tabulation

Following data collection and prior to analysis, data analysts performed a data-cleaning and validation process, in accordance with the highest industry standards. Open-ended question data were coded and Environics designed banner tables in consultation with the project authority. Data tables were submitted in CSV format.

Differences between sub-groups are noted based on Z-test results at 95% probability for comparing proportions, and based on two-tailed T-test results at 95% probability for comparing means. Comparisons are based on differences between exclusive sub-groups, and not on differences compared to the total in overlapping groups.

6. Limitations

Non-response bias analysis

The following table compares the survey respondents to the closest professional categories available in CIHI data for 2020 therefore the non-response bias analysis is limited to what can be ascertained from this data; the survey somewhat over-represents older physicians and under-represents younger nurses, but otherwise is close to the distribution of health professionals in Canada as far as it can be quantified by the CIHI data.

Table 43 – Non-response bias analysis

Proportions by profession (read across)	CIHI 2020					ZID Survey				
	Gender		Age			Gender		Age		
	Male	Female	<30	30-59	60	Male	Female	<30	30-59	60+
Physicians	60	40	4	73	23	47	53	3	70	27
Regulated nurses	9	91	17	72	11	9	91	9	78	13

Notes:

CIHI gender: excludes PEI and Quebec (no data available for 2020)

Survey gender: excludes those preferring not to respond and other gender identification to correspond to CIHI gender categories

CIHI age: excludes PEI, Quebec and Manitoba (no data available for 2020)

Survey age: categories in survey did not align with CIHI statistics; results in two categories were divided by two to align with CIHI age categories (i.e. 25 to 34 and 55 to 64)

Self-report / recall bias

Research that relies on self-reporting, including surveys like this one, can be subject to bias due to poor recall, the influence of social desirability, and other factors that may influence respondents to provide responses that are incorrect or dishonest. This bias should be taken into consideration while interpreting results. For this study, several steps were taken to minimize the impact of this type of bias. These measures include:

- The decision to use a survey methodology limits the risk of answers based on social desirability, since respondents are answering the survey anonymously without being observed.
- Drawing sample from a reliable source that is known to produce high quality respondents.
- Designing the survey to be self-limiting in its measurement precision; respondents are not asked to recall complex details about their past work, questions with numeric inputs like years of experience are designed with checks built-in to improve accuracy.
- Providing context and definitions to assist respondents in understanding what they are being asked.

Sampling bias

Sampling bias is when some members of a target population (in this case, health professionals) have a higher or lower likelihood of being included in the sample. This type of bias can be a result of flaws in the sampling methodology or the sources available for sampling. As discussed in the sampling section above, the sample source for this study is a large database of medical professionals working in Canada (i.e., MDBriefCase). This source was used specifically because it is considered to be a high quality and extensive list of such individuals. There is a risk that some members of the target population could be excluded from this sampling technique, mainly those who are not subscribed to MDBriefcase, or those who have low engagement with the company. Because this sample source is, for all intents and purposes, an opt-in panel, it is considered a non-probability sample.

7. Completion results

The completion results for survey are presented in the following table.

Table 44 – Online survey contact disposition

Disposition	N
Total invitations (c)	49,398
Total completes (d)	1,023
Qualified break-offs (e)	538
Disqualified (f)	356
Not responded (g)	47,189
Quota filled (h)	292
Contact rate = (d+e+f+h)/c	4.47
Participation rate = (d+f+h)/c	3.38

Appendix B: Qualitative methodology

The qualitative interviews were conducted between January 18 and February 6, 2024. The objective of the qualitative research was to further explore the barriers to accessing information and the information needs of physician and nurses in primary care and public health with respect to ZIDs.

IDI participants were selected from the survey respondents, as screening for the IDIs first took place within the quantitative survey instrument. The screener is attached to this report at the end of the questionnaire in Appendix C.

1. Sample design

A total of 38 interviews were conducted with 41 participants in total, 34 in English and 5 in French. Interviews were conducted with 22 doctors and 19 nurses. An incentive of $320 per participant was paid to all those who completed the exercise.

2. Recruiting

Interview participants were mainly recruited via the online survey. To broaden the pool of potential interview participants and hear perspectives reflecting different roles in clinical settings, interview participants were permitted to invite a colleague to participate in the interview with them; just three pursued this option. To recruit participants, the quantitative survey included a qualitative screener which invited participants to the interviews. The recruitment was aimed at including members of specific groups, including:

- 13 doctors and nurses with experience in working with Indigenous populations
- 5 doctors and nurses with experience practicing in the North

The screener was designed with standard questions to ensure participants were qualified to participate in the qualitative research in accordance with Government of Canada requirements, specifically:

- Participants met all requirements specified in the study
- Since the research consisted of IDIs and participants were drawn from a survey sample, personal acquaintances between participants were not relevant.
- No participant was recruited who had attended a qualitative research session within the past six months.
- No participant was recruited who had attended five or more qualitative research sessions in the past five years.

Data from survey respondents who qualified and opted-in to the qualitative research were extracted into a data file containing information, basic demographics, and answers to key survey questions to determine quit attempts, and screener responses. This file was used by the Environics research team to recruit qualified participants to interviews.

Using the file extracted from the initial survey, qualified respondents were invited by email to participate in an interview. Invitations were sent directly from Environics Research. Invitation wording included critical details about the study to help overcome hesitance, and assurances that confidentiality will be preserved.

Respondents were invited on a priority basis, based on target quotas for region, language and experience. Ultimately, 115 survey respondents were invited to participate in interviews, 45 scheduled interviews, and 38 completed interviews (3 invited colleagues, bringing the total number of participants to 41).

3. Interviewing

The qualitative interviews were conducted between January 18 and February 6, 2024. Interviews were scheduled to be 45 minutes; completed interviews ranged from 25 minutes to over an hour in length, averaging around 35 minutes.

Environics drafted a discussion guide for review and approval by the Public Health Agency of Canada. Participants were mainly interviewed in an online platform called Recollective, where they could schedule their own interviews at times that were convenient for them. However, some opted for interviews on Zoom or by telephone. Interviews were offered in both English and French.

At the outset of each interview, the facilitator confirmed the participant's consent to proceed and verified the participant's identity and qualification to participate. Sessions were recorded with participants' consent, and transcribed automatically by the Recollective or Zoom platforms; interviews conducted by telephone were not recorded. All resulting data were stored securely on servers located in Canada. Immediately following each session, the recordings were transcribed; recordings were deleted upon completion of the report. Transcriptions have been provided to the Public Health Agency of Canada with personally identifying details removed.

Appendix C: Questionnaire

Public Health Agency of Canada/Agence de la santé publique du Canada

Zoonotic Infectious Diseases – Health professionals

Final Questionnaire

E-MAIL INVITATION

Subject line: The Public Health Agency of Canada wants to hear from you about zoonotic infectious diseases.

Dear [CONTACT],

You are invited to participate in an online survey about zoonotic infectious diseases, which are infections that are transmissible between animals and humans, including via vectors. These are important issues facing health care professionals given global health developments and our experience of the COVID-19 pandemic. The survey is being conducted by Environics Research, an independent research company, on behalf of the Public Health Agency of Canada.

Participants who qualify and complete the survey will receive a $35 (CAD) Virtual Visa electronic Gift card!

The survey will take about 15 minutes to complete, and is best viewed on a desktop or laptop computer, rather than a mobile device. You will be asked about your experiences with, and opinions about, zoonotic infectious diseases in the context of patient care. The aim of this project is to build capacity for health professionals related to zoonotic infectious diseases. This research will gather the existing knowledge/resource gaps and needs of Canadian health professionals for zoonotic infectious diseases. The findings will inform the development and dissemination of resources for Canadian health professionals, which will ensure that they can support the health and safety of individuals and communities affected by zoonotic infectious diseases. The survey is voluntary. Your decision on whether or not to participate will not affect any interactions you may have with the Government of Canada.

By default, your responses will not be attributed to you. Please do NOT include personal information or information about specific cases in your answers to the survey questions.

We are additionally conducting qualitative interviews as part of this research. At the end of the survey, you may be asked if you are interested in participating in this component of the research. In that case, with your explicit, informed consent, we will ask if you wish to provide contact information. This contact information and some survey data would be used solely for the purpose of contacting you for an interview. Your survey data will never be linked with your contact details in the analysis, and your identity will never be shared with the Government of Canada.

If you don't have time to complete the survey in one sitting, you can return to it by clicking on the link below again. Once the survey period closes on [DATE], if you do not complete the entire survey, your answers will not be retained. Your answers will be deleted from Environics Research's system and not included for analysis in the survey data. Only those who complete the survey will be compensated.

Please click on the following link to complete the survey:

INSERT LINK

If you have any questions about the survey, please contact Stephanie Coulter of Environics Research by phone (437-990-2393) or email (stephanie.coulter@environics.ca).

This study has been registered with the Canadian Research Insights Council's Research Verification Service so that you may validate its authenticity. If you would like to enquire about the details of this research, you can visit CRIC's website www.canadianresearchinsightscouncil.ca and reference project code XXXXXXX.

LANDING PAGE/PAGE D'ACCUEIL

Welcome and thank you for your interest in our survey / Bienvenue et merci de l'intérêt que vous portez à ce sondage.

Please select your preferred language for completing the survey / Veuillez choisir la langue dans laquelle vous préférez remplir le sondage

01 – English / Anglais

02 – Français / French

PAGE BREAK

This study has been registered with the Canadian Research Insights Council's Research Verification Service so that you may validate its authenticity. If you would like to enquire about the details of this research, you can visit CRIC's website www.canadianresearchinsightscouncil.ca and reference project code XXXXXXX.

PUT IN BOX

About this survey

What about your personal information?

- The personal information you provide to Environics Research will be collected by Environics Research on behalf of the Public Health Agency of Canada (PHAC) Centre for Food-borne, Environmental and Zoonotic Infectious Diseases (CFEZID) in accordance with the *Privacy Act*, and applicable Treasury Board Directives. This collection is authorized by Section 4 of the Department of Health Act. We only collect the information we need to conduct the research project.
- **Purpose of collection:** Personal information such as demographics (e.g. age, gender, etc.) will be collected to better understand the topic of the research. Your responses are always combined with the responses of others for analysis and reporting, you will never be identified.
- **For more information:** This personal information collection is described in the standard personal information bank Public Communications – PSU 914, in Info Source, available online at infosource.gc.ca.
- **Your rights under the *Privacy Act*:** In addition to protecting your personal information, the *Privacy Act* gives you the right to request access to, and correction of, your personal information. For more information about these rights, or about our privacy practices, please contact the Public Health Agency of

Canada at privacy-vieprivee@phac-aspc.gc.ca. You also have the right to file a complaint with the Privacy Commissioner of Canada if you think your personal information has been handled improperly.

- Your personal information will be collected, used, retained and disclosed by Environics in accordance with the applicable provincial privacy legislation or the Personal Information Protection and Electronic Documents Act (PIPEDA). Please click here to review Environics' privacy policy.
- Your survey answers will remain anonymous and will not be attributed to you in any way.

What happens after the survey?

- The final report written by Environics will be available to the public on the Library and Archives Canada website: http://www.bac-lac.gc.ca/ approximately 6 months after the end of the fieldwork.

What happens if I don't complete the survey?

- If you don't have time to complete the survey in one sitting, you can return to it by clicking on the link in the invitation again. Once the survey period closes on [DATE], if you decide not to complete the entire survey, your answers will not be retained. Your answers will be deleted from Environics Research's system and not included for analysis in the survey data. Only those who complete the survey will be compensated.

If you have any questions about the survey, please contact Environics at stephanie.coulter@environics.ca

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< PROGRAMMING NOTE: All questions are mandatory unless otherwise indicated.>

<PROGRAMMING NOTE: Add progress bar.>

Screening

1. Please provide the first 3 digits of the postal code of the location where **you practice** most often.

   This information will be used to categorize your work location (i.e. province/territory and urban / rural / remote) for analysis purposes.

   ENTER: X#X [CATEGORIZE INTO PROVINCE BASED ON FIRST LETTER, IF NOT VALID ASK 1B]

   99 - Prefer not to say

1A) [IF VALID IN Q1] If you currently practice in more than one location, please provide the first 3 digits of this/these postal code(s): ENTER: X#X [CATEGORIZE INTO PROVINCE BASED ON FIRST LETTER]

ENTER: X#X [CATEGORIZE INTO PROVINCE BASED ON FIRST LETTER]

ENTER: X#X [CATEGORIZE INTO PROVINCE BASED ON FIRST LETTER]

ENTER: X#X [CATEGORIZE INTO PROVINCE BASED ON FIRST LETTER]

ENTER: X#X [CATEGORIZE INTO PROVINCE BASED ON FIRST LETTER]

NEW OPTION: I don't have the postal codes [ASK 1C]

NEW OPTION: Not applicable [ASK Q2]

1B. [IF PREFER NOT TO SAY OR NOT VALID IN Q1, OR NO POSTAL CODE IN 1A] In what province or territory do you currently practice? If you practice in more than one location, please select your Practice setting.

DROP DOWN LIST – SEE QUOTAS

1. British Columbia
2. Alberta
3. Saskatchewan
4. Manitoba
5. Ontario
6. Quebec
7. New Brunswick
8. Nova Scotia
9. Prince Edward Island
10. Newfoundland and Labrador
11. Yukon
12. Northwest Territories
13. Nunavut
14. Practicing outside Canada THANK AND TERMINATE: "Thank you. We are only looking for health care professionals practicing in Canada at this time."
15. Prefer not to answer [TERMINATE]

1C) [IF 1-13 in Q1B] If you currently practice in more than one province or territory, please identify additional provinces or territories where you practice (*select all that apply)* [USE DROP DOWN LIST OF PROVINCES AND TERRITORIES]

[INCLUDE OPTIONS:

No other provinces or territories

Prefer not to answer]

2. What is your **primary** profession?
   Select one only

   1. Registered Nurse or Nurse Practitioner
   2. Physician/Resident (Doctor of Medicine – MD)
   3. Other health professional THANK AND TERMINATE
   4. Prefer not to answer [THANK AND TERMINATE]

THANK AND TERMINATE WHEN QUOTA ACHIEVED FOR PROFESSION

3. Which of the following categories best describes your current employment status as a health professional? Are you...
   Select one only

   1. Working full-time, that is, 35 or more hours per week
   2. Working part-time, that is, less than 35 hours per week
   3. Not in the workforce (e.g. unemployed, retired, studying but not practicing) [THANK AND TERMINATE]
   4. Prefer not to answer [THANK AND TERMINATE]

4. What is your area of practice or clinical specialty?
   Select all that apply

   1. Infectious disease
   2. Family medicine
   3. Public health and preventive medicine
   4. Obstetrics/Gynecology
   5. Pediatrics
   6. Community Health
   7. Emergency medicine/critical care
   8. Internal medicine
   9. Surgery *(please specify)*
   10. Other *(please specify)*
   11. Prefer not to answer

4B. **[CHECK FOR INFECTIOUS DISEASE SPECIALIST QUOTA]**

[IF PROFESSION = PHYSICIAN AND AREA OF PRACTICE IS ONLY INFECTIOUS DISEASE, ASK]

Are you an infectious disease specialist?

1. Yes **[MAX OF 5 IN STUDY – TERMINATE IF QUOTA IS REACHED]**
2. No

5. On average, how often do you encounter patients with zoonotic infectious diseases in your practice? **[SHOW DEFINITION OF ZIDS AS POP-UP:** An infection that is transmissible between animals and humans, including via vectors.]

Select the option that best describes your experience on average

1. Daily
2. At least once a week
3. At least once a month
4. At least once a year
5. Less than once a year
6. Never but is still part of my practice
7. Never **THANK AND TERMINATE**
8. Prefer not to answer **THANK AND TERMINATE**

Current Landscape

This survey is about your experience with patient care as it pertains to zoonotic infectious diseases. Please answer the following questions as they reflect your current practice.

6. How would you characterize your level of knowledge regarding zoonotic infectious diseases in humans?

Select one only

1. Expert knowledge
2. Advanced knowledge
3. General knowledge
4. Limited knowledge
5. No knowledge

7. How satisfied are you with the zoonotic infectious disease education provided **during your formal healthcare training** (e.g., medical school, residency, nursing school)?

1. Very dissatisfied
2. Somewhat dissatisfied
3. Somewhat satisfied
4. Very satisfied
5. I was not provided with zoonotic infectious disease education during my formal healthcare training

8. How satisfied are you with the **continuing professional education** you have completed on zoonotic infectious disease **after** completing your formal healthcare training?

    1. Very dissatisfied
    2. Somewhat dissatisfied
    3. Somewhat satisfied
    4. Very satisfied
    5. I have not completed continuing education related to zoonotic infectious diseases

9. Please indicate if you have used any of the following resources to inform your practice regarding zoonotic infectious diseases.

    Please select all that apply

    1. Government of Canada (canada.ca) web pages for specific zoonotic infectious diseases
    2. Provincial and territorial health websites (e.g., BCCDC, Public Health Ontario)
    3. Non-Canadian organizational websites (e.g., WHO, CDC)
    4. Advisory committee statements (e.g., CATMAT, NACI)
    5. Canadian health professional organizations (e.g., AMMI, CASN, CMA)
    6. Non-Canadian health professional associations (e.g., AMA)
    7. Digital clinical support tools (e.g., UpToDate, Merck manuals, Medscape)
    8. Physical clinical support tools (e.g., medical textbooks)
    9. Peer-reviewed medical websites (e.g., Johns Hopkins, MayoClinic)
    10. Medical academic journals and databases (e.g., NEJM, PubMed)
    11. Webinars and conferences and workshops/learning modules (e.g., CMA, CPHA)
    12. Colleague or expert consultation
    13. Traditional media (e.g., television, radio, newspaper and/or online news articles)
    14. Social media (e.g., blogs, Twitter, YouTube, TikTok)
    15. Other *(please specify)*
    16. None of the above

Specific Diseases

For the next few questions you will be looking at a list of specific zoonotic infectious diseases. **It is important to consider each one individually as you answer the questions.**

You may notice that these diseases are organized into groups with shared characteristics. This is simply to make the survey easier to follow, and these groups are not meant to be discrete or definitive.

[PROGRAMMING – LIST OF DISEASE IS BELOW. LIST TO BE USED FOR Q10.]

[PROGRAMMING – DEFINE INSTRUCTIONS FOR RANDOMIZING DISEASE LIST – IF IT IS GROUPED BY TYPE, RANDOMIZE WITHIN TYPES]

[GROUP 1]

Encephalitides:

- California encephalitis
- Jamestown Canyon virus
- Japanese encephalitis virus
- La Crosse encephalitis
- Snowshoe hare encephalitis
- Eastern equine encephalitis virus
- Western equine encephalitis virus
- Nipah virus disease

[**GROUP 2]**

Tick-borne and mosquito-borne diseases:

- Babesiosis
- Human granulocytic anaplasmosis
- Lyme disease
- Powassan virus disease
- Tick-borne encephalitis
- Tularemia
- Ehrlichiosis
- Rocky mountain spotted fever
- Cache valley virus disease
- Chikungunya
- Dengue
- St. Louis encephalitis
- West Nile virus infection
- Yellow fever
- Zika virus infection

[GROUP 3]

Hemorrhagic fevers:

- Crimean Congo hemorrhagic fever
- Ebola disease
- Marburg virus disease
- Lassa hemorrhagic fever
- Hantavirus - Hemorrhagic fever with renal syndrome

[GROUP 4]

Direct Zoonoses:

- Bovine tuberculosis
- Brucellosis
- Cryptosporidiosis
- Leptospirosis
- Rabies
- Toxoplasmosis

[GROUP 5]

Influenza, Influenza-like, and respiratory:

- Avian (zoonotic) influenza: H5N1
- Avian (zoonotic) influenza: H7N9
- Hantavirus – Hantavirus pulmonary syndrome
- Q fever
- Rift Valley Fever
- MERS-CoV infection
- Psittacosis

[GROUP 6]

Parasitic and other:

- Alveolar echinococcosis
- Cystic echinococcosis
- American trypanosomiasis (Chagas disease)
- Cutaneous larva migrans
- Toxocariasis
- Plague
- Anthrax
- Bartonellosis (cat scratch disease)
-Mpox (monkeypox)

- Murine typhus / endemic typhus
- Louse-borne relapsing fever

10. In the following grid, please indicate which diseases you have encountered in your practice, AND rate your level of confidence in managing each zoonotic infectious disease. **[GRID, USE LIST]**

Disease name	Encountered disease in your practice		Please rate your level of confidence in managing each zoonotic infectious disease (including patient assessment, diagnosis, infection prevention and control measures, patient management, patient education, contact tracing, public health reporting)			
	1. Yes	2. No	1. Not at all confident	2. Somewhat confident	3. Confident	4. Very confident
[Randomize disease names]						

[PROGRAMMING: PLEASE ADD A POP UP BOX WITH THE FOLLOWING TEXT:

- Patient assessment: Risk factors and physical assessment

- Diagnosis: Taking patient history, assessing patient's clinical presentation, ensuring appropriate tests are ordered, interpretation of results for laboratory diagnosis, understanding differential diagnoses

- Infection prevention and control measures: Implementing infection control protocols to prevent healthcare-associated transmission, as appropriate.

- Patient management: Selecting the appropriate treatment plan and follow-up.

- Patient education: Educating patients and their families about zoonotic diseases such as transmission, and preventive measures.

- Contact tracing: Identifying and monitoring individuals who may have been exposed to the ZID-infected patient.

- Public Health Reporting: Reporting cases to local public health authorities per your jurisdictional requirements]

11. The past few questions were about a list of specific diseases. Are there any zoonotic infectious diseases NOT in the list that you consider to be relevant in your practice for which you would like to have more resources? **OPEN END**

ADD OPTION: No other relevant diseases to add.

12. Please rate your confidence at providing each of the following types of information or services related to the zoonotic infectious diseases you encounter as identified in this survey.

RANDOMIZE ORDER

1. Not at all confident	2. Somewhat confident	3. Confident	4. Very confident	5. Not applicable

1. Patient assessment: Risk factors and physical assessment
2. Diagnosis: taking patient history, assessing patient's clinical presentation, ensuring appropriate tests are ordered, interpretation of results for laboratory diagnosis, understanding differential diagnoses
3. Infection prevention and control measures: Implementing infection control protocols to prevent healthcare-associated transmission, as appropriate.
4. Patient management: Selecting the appropriate treatment plan and follow-up.
5. Patient education: Educating patients and their families about zoonotic diseases such as transmission, and preventive measures.
6. Contact tracing: Identifying and monitoring individuals who may have been exposed to the ZID-infected patient.
7. Public Health Reporting: Reporting cases to local public health authorities per your jurisdictional requirements

Barriers

13. From the following list, select the **three most significant information/resource-related barriers** when it comes to **providing care for patients** with zoonotic infectious diseases in your own practice.

RANDOMIZE ORDER, ALLOW THEM TO SELECT LESS THAN THREE

1. There aren't enough trusted medical sources for information on zoonotic infectious diseases
2. Trusted sources are costly to access
3. It is difficult to stay up-to-date on the latest information about a disease
4. It takes too much time to look up specific symptoms for each patient
5. It's too difficult to find relevant information
6. Information is not easy to access online
7. Information changes too frequently
8. Available information is conflicting
9. Information is not relevant to my specific context (e.g., specialty, geographic region)
10. Other (specify)

Information Needs & Learning Preferences

13B. From the following list, select **up to three topics that are most important** for you as a Canadian health professional to be informed on in relation to zoonotic infectious diseases?

RANDOMIZE ORDER

1. Incidence in Canada
2. Zoonotic (animal to human, including via vector) transmission
3. Human to human transmission
4. Prevention
5. Treatment
6. Diagnostics
7. Current environmental climate
8. Clinical manifestations (severity of illness and long-term sequelae)
9. Disease trend
10. Case fatality rate
11. Risk perception
12. Other (specify)

[PROGRAMMING: OFFER POP-UP DEFINITIONS FOR EACH – SEE LIST BELOW

- Incidence in Canada: Number of new cases in Canada over a specified time period.

- Zoonotic (animal to human) transmission: Potential of spread of a disease from animals to humans.

- Human to human transmission: Potential of spread of a zoonotic disease between humans.

- Prevention: Ability to prevent the disease in humans; considering for instance the efficacy of vaccination and other forms of chemoprophylaxis, personal protective measures, and public health measures; and control measures in animals/vectors.

- Treatment: Ability to treat the disease in humans in Canada, using drugs, interventions or procedures. This includes the following indicators: effectiveness, availability of the treatment/supportive therapies as well as their specificity.

- Diagnostics: Ability to diagnose the disease in humans in Canada, considering factors such as the possibility of clinical diagnosis, and the availability of lab tests and other diagnostic procedures (e.g. imaging).

- Current environmental climate: The influence of the present environmental climate in Canada in the introduction, establishment or expansion of endemic and non-endemic diseases.

- Clinical manifestations: Severity of disease in humans (natural progression of disease). Considering the extent to which the disease compromises the state of health of infected individuals.

- Long-term sequelae: Persistent signs or symptoms that may develop during or after the acute phase of the illness, while they can still be linked to the same etiology.

- Disease trend: disease trend in Canada over a specified time period (including travel-related) within the context of currently available Canadian data.

- Case fatality rate: case fatality rate (CFR) in humans (natural progression of disease).

- Risk perception: Level of risk perceived by the public (personal or societal) in Canada based on the current state of knowledge, media influence and coverage (news and entertainment), and controllability over exposure.]

14. How interested are you in receiving additional professional education on zoonotic infectious diseases?

    1. Very interested
    2. Somewhat interested
    3. Not interested [SKIP Q15]

15. **[IF Q14 is 3 (Not interested) SKIP TO Q16]** If you were to learn more about zoonotic infectious diseases, what would you be interested in learning about?
    (e.g. outbreaks, infection prevention and control, latest treatment, etc.)

    [OPEN QUESTION]

16. If you were to receive additional professional education and resources on zoonotic infectious diseases, in which formats would you prefer to receive the information?
    Please select all that apply

    1. Interactive classroom courses
    2. Lecture based classroom courses
    3. Interactive online courses
    4. Lecture based online courses
    5. Advisory publications such as CATMAT or CDC recommendations
    6. Mobile applications (apps)
    7. Continued Medical Education programs in Canada
    8. Self-directed learning online
    9. Self-directed learning with physical resources (e.g., textbooks)
    10. Postgraduate courses
    11. Workshop sessions
    12. Conferences
    13. Onsite educational outreach
    14. Webinars
    15. Infographics
    16. Evidence briefs
    17. Fact sheets
    18. Decisional algorithms
    19. Toolkits
    20. Other (please specify)

Demographics

The following are a few questions about you, for statistical purposes only. By default, your answers will not be attributed to you , and you may skip questions that you do not wish to answer.

<PROGRAMMING: Respondents should be able to skip ALL demographic questions without responding / leave them unanswered.>

17. Please indicate the number of years of experience that you have as a practicing health professional...

ENTER NUMBER 0 TO 75

A. Total years of experience	B. Years practicing in Canada	C. Years practicing outside of Canada*
##	##	##
Prefer not to answer	Prefer not to answer	Prefer not to answer

[SHOW BELOW TABLE] *As many zoonotic infectious diseases are not endemic in Canada, the purpose of asking for additional information about medical experience outside of Canada is to assess if there is a difference in zoonotic disease capacity amongst health professionals with domestic and international experience.

18. **[IF YEARS OUTSIDE OF CANADA >1 ASK]** Please specify in which countries you have practiced (optional).

a. **OPEN END**

b. Prefer not to answer

20. Do you have previous health professional experience working in the Canadian territories within the last 5 years? If yes, please indicate the Canadian territory or territories where you have experience (optional).

1. No
2. Yes (optional: Please specify the territory or territories)
3. Prefer not to answer

22. What type of setting best describes your Practice setting?
Select one only

1. Family medicine clinic
2. Hospital setting
3. Walk-in clinic or urgent care
4. Specialized travel health centre/clinic
5. Community health centre
6. Long-term care residence
7. Public health clinic/setting
8. Other (Please specify)
9. Prefer not to answer

23. Please indicate to which of the following age categories you belong?

1. 18 to 24
2. 25 to 34
3. 35 to 44
4. 45 to 54
5. 55 to 64
6. 65 or older
7. Prefer not to answer

24. What language(s) do you speak most often in the workplace?
Select all that apply

1. French
2. English
3. Other languages [please specify]
4. Prefer not to answer

25. How do you identify yourself?
Select one only

1. Woman
2. Man
3. Another gender (optional: specify)
4. Prefer not to answer

26. Do you have significant experience (at least one year) of providing comprehensive health care services to Indigenous (First Nations, Inuit, Métis) populations in Canada?

Significant experience may be acquired through working in a health capacity with an Indigenous community and/or on a First Nations reserve.

If you are unsure that you have significant experience working in a health capacity with Indigenous population, please provide additional details (optional).

Select one only

1. Yes
2. No
3. Not sure – please describe the experience you have **OPEN END**
4. Prefer not to answer

Qualitative Research Screening

Thank you for completing the survey!

We will be conducting follow-up qualitative research to better understand current practices around zoonotic infectious diseases in the medical context. This would involve a more in-depth one-on-one discussion for professionals like yourself. **Participants will receive an honorarium of $320 as a thank you for your time.**

The discussions would be conducted by Environics Research (https://environicsresearch.com/) on behalf of the Government of Canada.

The discussions will happen in January. Participation would involve an interview that would last for approximately 30-45 minutes. The interview will take place in an online platform. The interview will be conducted by a highly trained researcher from Environics Research who will ask questions about your practice and zoonotic infectious diseases.

All data gathered will be securely stored on Environics Research servers in Toronto for approximately 12 months for documentation and insight generation purposes only. Environics Research will take reasonable steps to retain Personal Information only for as long as needed to complete the research. For more information, please see Environics Research's privacy policy: https://environicsresearch.com/privacy-policy/

Taking part in these interviews is completely voluntary. If you are interested, you will need to provide your first name and email address. Please note that this information (name and email address) will only be used to invite you to participate, should you be selected, and will be kept separate from your responses in the interview.

Additionally, we may use some of your demographic and practice information from the survey to help us ensure that we include a diverse range of participants in our interviews. These details will only be used for the purposes of selecting and contacting interview participants and they will not be linked to your interview responses.

QUAL1. Understanding how your information will be used, are you interested in participating?

- Yes **CONTINUE**
- No GO TO **END OF SURVEY**

The information you provide during the interview will not be linked with your name on any written document or report. Environics may record the conversations to aid them in analyzing the results, so we ask that you do not disclose your last name and/or any identifiable information about yourself. We will provide instructions about securing your identity in advance of the session.

QUAL2. Do you agree to these terms of participation?

- Yes **CONTINUE**
- No GO TO **END OF SURVEY**

QUAL3. Please provide us with the following contact information so we can send you details about the interviews if you are selected to participate. Please note again that this information (first name and email address) will only be used to invite you to participate, should you be selected, and will be kept separate from your responses in the interview.

First name	_____
Email address	_____@_____

□ I am not willing to provide my contact information (you will not be invited to participate).

Survey Completion Screen

SHOW ALL: This completes the survey. The gift card is being administered by MDBriefcase; they will be contacting you. On behalf of the Public Health Agency of Canada, thank you for your valuable input. In the coming months, the results of this survey will be available on the Library and Archives Canada website.

ENG	FRE
Thank you for taking our survey. Your efforts are greatly appreciated!	**Merci d'avoir répondu à notre sondage. Nous vous sommes reconnaissants de vos contributions.**

Appendix D: IDI discussion guide

Public Health Agency of Canada

Individual In-depth Interviews with healthcare professionals (re: Zoonotic Infectious Diseases)

Interview Guide

December 18, 2023

Participant Name:

Date:

Interviewer:

Introduction (5 minutes)

Hello, my name is _____ from Environics Research. Thanks for joining me today.

We are conducting interviews on behalf of the Public Health Agency of Canada. This is a follow-up to a survey you recently completed about zoonotic infectious diseases.

The interview will take approximately 30 minutes to complete.

I would like to assure you that your responses will be only reported in aggregate with other respondents. Your name and identifying details will not be shared in the report or in any documents that are published or shared with the client.

This interview is voluntary. We are interested in learning about your experiences for research purposes and it's important to us that you feel comfortable and safe. If there is anything you don't wish to answer, that is okay. You can also choose to end the interview at any time.

Do you consent to proceeding with the interview? [CONTINUE IF YES]

I would like to record the interview for note-taking and quality control purposes. The recording files will not be sent to anyone outside of Environics, uploaded to any websites, or included in any reports.

We may play select AUDIO portions of some interviews for PHAC and Environics staff in a closed setting. Identifying details like your name and details about you or your practice will be removed if we do this.

Do I have your permission to record this interview? [CONTINUE WITHOUT RECORDING IF NO]

Do you have any questions before we begin?

Participant Introduction – Warm-up (3 minutes)

1. Before we get started talking about Zoonotic diseases, could you please tell me a little bit about your practice and your experience?

    a. Can you describe your practice setting (e.g. walk-in clinic, public health unit, hospital)

    b. How long have you been working at your current place of practice?

    c. How long have you been working as a health care professional?

2. We are asking healthcare professionals about their experiences with zoonotic infectious diseases.

   a. Can you tell me what you tend to see in your practice?

   b. How frequently do you encounter patients with zoonotic infectious diseases? Is it frequent? Rare?

   c. Are there any zoonotic infectious diseases that are common in your practice?

   d. From the list of 52 diseases that was presented in the survey, are there any particular diseases or disease groups that stood out to you?

      [*PROBE*]: Can you elaborate?

Theme 1: Zoonotic infectious disease questions from Topline Data

3. Preliminary results from the survey we conducted, identified that health professionals are not confident in managing many zoonotic infectious diseases, do you feel the same?

   a. [IF YES] Why do you not feel confident in managing these diseases?

   b. [IF NO] What is it that makes you confident in managing these zoonotic diseases (e.g., exposure, education, credible resources)

4. Health professionals have identified having low confidence in managing specific diseases and disease groups, can you provide suggestions on what you think the drivers of this low confidence are for these diseases:

   [INSERT DISEASE NAMES/GROUPINGS]

5. Health professionals have identified having more confidence in managing specific diseases and disease groups, can you provide suggestions on what you think the drivers of this confidence are for these diseases:

   [INSERT DISEASE NAMES/GROUPINGS]

6. Preliminary survey results demonstrate that many health professionals are dissatisfied with continuing education on zoonoses. Have you completed any continuing education related to zoonoses? Do you feel the same?

   a. [IF YES] Can you explain why? What sort of continuing education related to zoonoses have you done?

   b. [IF NO] What makes you satisfied with existing continuing education on zoonoses? What sort of continuing education related to zoonoses have you done?

   c. [IF THEY HAVE NOT COMPLETED CONTINUING EDUCATION ON ZOONOSES] MOVE TO NEXT QUESTION

Theme 2: Resources they access (10 minutes) I would like to hear about your experience in accessing zoonotic infectious diseases resources.

7. In your practice, what sources of information and resources do you access for zoonotic infectious diseases?

   [IF THE ANSWER IS TOO GENERAL, PROBE] Can you give me some specific examples? [This can include: Clinical tools, websites, webinars; please ask for specific names of resources, websites etc].

   a. How often do you access them? When do you access them?

      i) Do you review resources about this topic on a regular basis?

      ii) Do you tend to use them only when you encounter a patient case?

   b. Do you use different resources when needing to retrieve information promptly (e.g., during a patient interaction or in an urgent situation)?

      i) Why or why not?

      ii) [IF YES] What draws you to consult these resources?

   c. [PROBE]: If you had a patient that you suspected had a disease such as [Nipah virus disease or bovine tuberculosis or anaplasmosis], what sources would you go to? What resources would you use?

8. Now going back to talk more generally about zoonotic infectious disease resources that you access, do you have confidence in the resources you use when encountering or potentially encountering a patient with a zoonotic disease?

   a. Please elaborate.

   b. What might increase your confidence in resources related to Zoonoses?

9. Do you use any Government of Canada online zoonotic infectious disease resources in your practice?

   a. [If YES], which ones have you used? [Note for moderator: Examples could include surveillance reports, travel health notices, health professional diseases pages]

      i) What do you think about this/these resource(s)?

      ii) Could it/they be made more useful to you? In what way?

   b. [If NO], is there a particular reason why you haven't used them?

Theme 3: Resource Gaps

10. Next, let's talk about the amount and the quality of information available for you and other health professionals regarding zoonotic infectious diseases.

    a. Are there enough resources available to you about these diseases?

    b. Do you find the resources that are available, useful?

    c. What are some good qualities in these resources?

11. Next, let's talk about knowledge and resource gaps for health professionals related to zoonotic infectious disease care.

    a. Do you feel there are knowledge gaps about zoonotic infectious diseases among health professionals in general? What are those gaps?

    b. As a health professional, do you have any needs that resources are failing to address specifically regarding zoonotic infectious diseases?

    c. Preliminary results from the survey we conducted, identified that it is difficult for health professionals to stay up to date on the latest information as a significant barrier when it comes to providing care for patients with zoonotic infectious diseases, would you agree?

        i) [IF YES] Can you elaborate why?

        ii) [IF NO] What would you say is a significant barrier?

        iii) Probe: How would you recommend addressing this barrier?

Theme 4: Ideal Resource (10 minutes)

12. What would your ideal information resource for zoonotic infectious diseases look like?

    a. What are some of the key qualities of your ideal resource?

       [PROBE]: Cost, Depth of Information, Usability, Focus, Canadian, Centralized location

    b. What type of information would it contain? (e.g., regional differences (epidemiology, reporting), considerations for high-risk populations, considerations for marginalized populations, management of diseases)

    c. How would you like this information to be presented?

        i) What format?

    d. Where would you like to access this resource?

        i) What type of platform?

e. Who do you look to and trust to develop this information (e.g., federal organizations, provincial or territorial organizations, non-governmental organizations, Canadian or international organizations, etc.)

13. When it comes to finding resources on zoonotic infectious diseases, which of the following factors are a priority and why?

(Note to moderator: List all the following factors. Please use the prompts as necessary*)*

- Cost:
  - [PROMPT:] Does it matter if resources are free or require payment?
- Depth of Information:
  - [PROMPT:] Are you looking for information that is quick and concise, or more detailed?
- Usability:
  - [PROMPT:] This may include a user-friendly interface and easy navigation?
- Focus:
  - [PROMPT:] Are you more interested in research-focused content, or do you find clinically-oriented information more relevant to your needs?
- Canadian:
  - [PROMPT:] Is it important that the information is developed by a Canadian organization?
- Centralized location:
  - [PROMPT:] Is it important that all the information is centralized in one location?

Conclusion

14. This research is being conducted on behalf of the Public Health Agency of Canada, to better understand educational needs about zoonotic infectious diseases. Is there anything you would like to expand on or that I've failed to ask?

15. Do you have any other comments about this topic in general?

Thank you for your valuable contribution and input into this project. The report for this project will be published by Library and Archives Canada in a few months.

Appendix E: IDI invitation and screener

Recollective Process / Set-Up for PHAC Qualitative Interviews

Invitation Process

Invitations to be sent by email, with separate open links for French or English. See invitation documents.

Participants will create their own log in for Recollective, and join the study in the language of their choice.

English

French

Recollective Home Page

Items will be set up as “cards” on the home screen.

Welcome Card

[card visible for participants who have not completed the screener]

Welcome

Thank you for your interest in our research, conducted on behalf of the Public Health Agency of Canada (PHAC). To confirm your participation and schedule your interview, you will be asked to complete some simple questions.

Privacy Information Card

[card visible on home screen to all participants for duration of study, including those disqualified]

Privacy Information

Included below is some additional information about your privacy and your rights as a research participant:

- The interview is voluntary and you may withdraw your consent to participate at any time. Your decision on whether or not to participate will not affect any interactions you may have with the Government of Canada. If you withdraw from the study after the interview begins, your responses will be removed from the research data.
- If you are not able to complete the interview at the scheduled time due to other circumstances, we will offer an opportunity for you to reschedule.
- Participants who withdraw or cannot complete an interview after it begins will still be provided an honorarium. We ask that you join the study with best intentions of completing the interview.
- The interview may be recorded to aid Environics in the analysis of results, so we ask that you do not disclose your last name and/or any identifiable information about yourself. Select audio portions of some interviews may be shown to Public Health Agency of Canada and Environics staff in a closed setting. Your comments will not be attributed to you in the reporting and your identity will never be shared with the Government of Canada (unless you request otherwise). Your responses will be aggregated with interview responses from other health professionals.

- All data gathered will be gathered in the Recollective platform, and then securely stored on Environics Research servers in Toronto for approximately 12 months for documentation and insight generation purposes only. Environics Research will take reasonable steps to retain Personal Information only for as long as needed to complete the research. For more information, please see Environics Research's privacy policy and Recollective's privacy policy.
- The final report written by Environics will be available to the public on the Library and Archives Canada website approximately 6 months after the end of the fieldwork.
- If you have any questions about this research, you may contact Environics Research or the Public Opinion Research Team at PHAC:
  - Stephanie Coulter, Senior Research Associate: stephanie.coulter@environics.ca
  - Public Opinion Research Team: cpab_por-rop_dgcap@hc-sc.gc.ca
- This research study is registered with the Canadian Research Insights Council, under registration number 20231204-EN251. Accessible to you is the CRIC Research Verification Service.

Disqualified Thank You Card

[appears at top of home screen for disqualified respondents]

Thank you for your interest

At this time, you do not qualify for an interview. Thank you for your interest in this research. If you have any questions, please contact Stephanie Coulter, Senior Research Associate at Environics Research (stephanie.coulter@environics.ca).

Colleague / Diad Thank You Card

[appears at top of home screen for participants who are doing interviews with colleagues]

Thank you!

You may wish to add an email address to your profile so we can send you important information about your interview.

Single Interview Thank You Card

[appears at top of home screen for participants who scheduled a one-on-one interview without a colleague]

Thank you!

Don't forget to log back in for your interview.

You may wish to add an email address to your profile so we can send you important information.

Participant Qualification Screening Activity

Activity Title:

Tell us about you!

Tasks:

1. Prompt - ALL

Name:

Start

Text:

We have a few questions just to confirm that you qualify for the interview.

Button:

Continue

2. Poll - ALL

Name:

Respondent or colleague

Question:

Did you complete the survey, or were you invited by a colleague?

Choices:

I completed the survey → Survey respondent stream

I was invited by a colleague → Colleague stream

3. Poll – Survey respondent stream

Name:

Single or joint interview

Question:

In the invitation letter, you were given the option to include a colleague in your interview.

Are you planning to do your interview with a colleague?

Choices:

Yes → Diad stream

No → Single stream

4. Poll – All

Name:

Region

Question:

In what province or territory do you currently practice?

Choices:

1. British Columbia
2. Alberta
3. Saskatchewan
4. Manitoba

5. Ontario
6. Quebec
7. New Brunswick
8. Nova Scotia
9. Prince Edward Island
10. Newfoundland and Labrador
11. Yukon
12. Northwest Territories
13. Nunavut
14. Practicing outside Canada

5. Poll - All

Name:

Profession

Question:

What is your primary profession?

Choices:

Registered Nurse or Nurse Practitioner

Physician/Resident (Doctor of Medicine – MD)

Other health professional → Disqualified

Prefer not to answer → Disqualified

6. Multimedia - All

Name:

Area or Specialty

Question:

What is your area of practice or clinical specialty?

[text box for response]

7. Poll - All

Name:

Question:

On average, how often do you encounter patients with zoonotic infectious diseases in your practice?

Select the option that best describes your experience on average.

Choices:

Daily

At least once a week

At least once a month

Less than once a year

Never but is still part of my practice

Never → Disqualified

Prefer not to answer → Disqualified

8. Prompt – Qualified Participants (Survey Respondents)

Name:

Scheduling

Text:

Thank you for your responses.

Click on the link below to schedule an interview.

Button:

Schedule my interview

9. Prompt – Qualified Participants (Colleagues)

Name:

Colleague prompt

Text:

Thank you for your responses.

Click on the link below to help us match you with the colleague who invited you.

Button:

Match me with my colleague

10. Prompt – Disqualified Participants

Name:

Thank you for your interest.

Text:

Thank you for your interest in this study. At this time, you do not qualify for an interview.

If you have any questions, please contact Stephanie Coulter, Senior Research Associate at Environics Research (stephanie.coulter@environics.ca).

Button:

Return to home screen

Colleague Confirmation Activity

Name: Colleague matching

Tasks:

1. Multimedia – Colleague stream

Name:

Colleague information

Question:

Please give us the email address of the colleague who invited you to participate in this interview.

This will only be used to match you with your colleague for the interview.

[text box for response]

2. Prompt – Colleague stream

Name:

Thank you

Text:

Thank you for providing your details. You have qualified for the interview.

We will be asking the colleague who invited you to provide us with your availability for an interview. Please coordinate with them so they can provide us with this information.

You will receive a notification from us when the interview has been scheduled.

Button:

Return to home screen

Scheduling for one-on-one interviews

Name:

Scheduling a one-on-one interview

[the module allows participants to choose an available time slot]

Meeting Invitation:

Schedule a one-on-one interview

Select an available date and time between January 9 and January 31.

Schedule Meeting

Scheduling for diads

Name:

Scheduling an interview with a colleague

Tasks:

1. Grid – Survey respondents who are scheduling with a colleague

Name:

Availability

Text:

We would like to schedule an interview with you and your colleague. Please indicate some dates and times that you could be available for a 30 to 45 minute interview **with your colleague**.

The times noted are start times for the interviews, and represent the Eastern time zone.

Please note that interview timing is subject to availability. We will contact you to schedule an interview with you and your colleague.

Please confirm availability with your colleague before completing this form. You can return to the site later if you need more time to contact your colleague.

If your colleague is no longer available or interested, please contact Stephanie Coulter, Senior Research Associate, at stephanie.coulter@environics.ca if you would like to schedule a one-on-one interview.

2. Multimedia

Name:

Colleague information

Question:

Please give us the email address of the colleague you invited to participate in this interview.

This will only be used to match you with your colleague for the interview.

[text box for response]

3. Prompt

Name:

Thank you

Question:

Thank you for providing your availability.

We will follow up with you and your colleague to confirm an interview.

Button:

Return to home screen

Final comments activity

Name:

Final comments

Tasks:

1. Multimedia – All interview participants

Name:

Additional comments

Text:

Thank you for completing the interview.

This research is being conducted on behalf of the Public Health Agency of Canada, to better understand educational needs about zoonotic infectious diseases.

Do you have any other comments about this topic in general?

[text box for response]

Appendix F: criteria for the prioritization of zoonoses

The Shapley regression analysis incorporated external data about each disease. This data was provided by PHAC. Definitions for these variables are outlined in this appendix.

Incidence: Number of new reported cases of a specific disease in Canada in the last 5 years (between 2015-2019).

Disease trend: Indicates whether a disease is declining, stable, increasing, or emerging in Canada over the past five years (between 2015-2019). Includes travel-related illness.

Case fatality rate: Case fatality rate (CFR) in humans is the proportion of people who die from a disease among those diagnosed; CFR is based on the natural progression of a disease.

Severity of illness: Indicates the severity of disease in humans, i.e. the extent to which the disease compromises the state of health of infected individuals based on the natural progression of the disease.

Long-term sequelae: Persistent signs or symptoms that may develop during or after the acute phase of the illness, while they can still be linked to the same etiology.

Treatability: Ability to treat the disease in humans in Canada, using drugs, interventions, or procedures. This includes the effectiveness and availability of the treatment/supportive therapies as well as their specificity.

Capacity to detect and diagnose: Ability to diagnose the disease in humans in Canada, considering factors such as the possibility of clinical diagnosis, and the availability of lab tests and other diagnostic procedures (e.g., imaging).

Preventability: Ability to prevent the disease in humans; considers the effectiveness of vaccination and other forms of chemoprophylaxis, personal protective measures, public health measures; and control measures in animals and/or vectors.

Mode of transmission – Animal-To-Human: Potential of spread of a disease from animals to humans, considering common modes of transmission.

Mode of transmission – Human-To-Human: Potential of spread of a disease between humans, under the condition that there is animal to human transmission also occurring.

Current environmental climate: The influence of the present climate of Canada in the introduction, establishment and expansion of endemic and non-endemic diseases.

Risk perception: Level of risk perceived by the public (personal or societal) in Canada based on the current state of knowledge, media influence and coverage (news and entertainment), and controllability over exposure. Considers whether information available to the public is limited, inconsistent, or not trusted, if there is a high likelihood of public attention, and if the disease has identifiable victims.

Appendix G: PCA analysis values

Name	Label	RC1	RC2	RC3	RC4	RC5	RC6	RC7	Factor
Q10A5r25	Rift Valley Fever	0.656	0.079	0.103	0.041	-0.022	0.108	-0.009	1
Q10A3r3	Marburg virus disease	0.650	0.144	0.149	0.192	0.059	0.079	0.075	1
Q10A1r24	La Crosse encephalitis	0.643	0.052	-0.029	0.033	0.061	0.074	0.192	1
Q10A3r4	Lassa hemorrhagic fever	0.600	0.141	0.105	0.256	-0.055	0.052	0.019	1
Q10A6r26	Plague	0.581	0.074	0.376	0.183	0.133	0.034	-0.096	1
Q10A1r21	California encephalitis	0.557	0.170	0.102	-0.023	0.094	0.142	0.355	1
Q10A2r13	St. Louis encephalitis	0.524	0.117	0.146	0.083	0.022	0.104	0.379	1
Q10A1r28	Nipah virus disease	0.478	0.083	0.162	-0.054	0.113	0.105	0.422	1
Q10A2r4	Powassan virus disease	0.459	-0.036	0.041	0.113	0.036	0.356	0.139	1
Q10A3r1	Crimean Congo hemorrhagic fever	0.452	0.140	0.065	0.379	-0.139	-0.092	0.202	1
Q10A3r2	Ebola disease	0.391	0.298	0.180	0.291	0.288	-0.026	-0.052	1
Q10A1r27	Western equine encephalitis virus	0.373	0.154	0.186	-0.112	0.171	0.327	0.156	1
Q10A1r26	Eastern equine encephalitis virus	0.370	0.058	0.341	-0.160	0.168	0.267	0.204	1
Q10A2r10	Cache valley virus disease	0.310	-0.010	-0.098	0.043	0.177	0.200	0.285	1
Q10A2r12	Dengue	0.103	0.634	0.221	0.036	0.000	0.112	0.046	2
Q10A2r16	Zika virus infection	0.055	0.628	0.026	0.102	0.088	0.146	0.036	2
Q10A2r14	West Nile virus infection	0.000	0.558	0.036	0.125	0.159	0.170	0.020	2
Q10A2r11	Chikungunya	0.090	0.547	0.268	0.015	-0.185	0.100	0.141	2
Q10A2r15	Yellow fever	0.314	0.508	0.096	0.091	0.204	0.073	0.111	2
Q10A4r5	Rabies	0.179	0.475	-0.023	0.061	0.201	-0.056	-0.028	2
Q10A1r23	Japanese encephalitis virus	0.273	0.427	0.161	0.160	0.091	0.126	0.040	2
Q10A2r3	Lyme disease	-0.051	0.426	0.004	-0.024	0.045	0.159	0.041	2
Q10A4r6	Toxoplasmosis	0.052	0.423	0.148	-0.050	0.122	0.402	-0.018	2
Q10A2r5	Tickborne encephalitis	0.246	0.412	-0.030	0.107	0.206	0.298	-0.065	2
Q10A6r29	Mpox (monkeypox)	0.029	0.372	0.163	0.354	0.107	-0.036	0.089	2
Q10A2r1	Babesiosis	0.029	0.111	-0.038	0.017	0.032	0.605	0.104	3
Q10A4r2	Brucellosis	0.096	0.191	0.272	0.182	0.103	0.522	0.066	3
Q10A4r3	Cryptosporidiosis	0.093	0.254	0.198	0.200	-0.004	0.511	-0.093	3
Q10A2r2	Human granulocytic anaplasmosis	0.103	0.049	-0.124	0.337	-0.056	0.471	0.207	3
Q10A2r6	Tularemia	0.159	0.199	0.290	0.102	0.075	0.463	0.249	3
Q10A5r27	Psittacosis	0.324	0.102	0.278	0.045	0.121	0.447	-0.048	3
Q10A2r9	Rocky mountain spotted fever	0.184	0.400	0.018	-0.072	0.127	0.411	0.095	3
Q10A2r7	Ehrlichiosis	0.346	0.153	0.040	0.026	-0.040	0.382	0.136	3
Q10A6r28	Bartonellosis (cat scratch disease)	-0.059	0.251	0.346	-0.080	-0.015	0.367	-0.017	3
Q10A4r4	Leptospirosis	0.207	0.262	0.224	0.105	0.042	0.347	0.068	3
Q10A5r24	Q fever	0.115	0.234	0.266	0.129	0.169	0.289	0.172	3
Q10A6r23	American trypanosomiasis (Chagas disease)	0.210	0.271	0.558	0.046	0.098	0.127	0.153	4
Q10A6r30	Murine typhus / endemic typhus	0.306	0.144	0.529	-0.006	0.126	-0.053	0.122	4
Q10A6r27	Anthrax	0.303	0.076	0.494	0.125	0.222	-0.019	0.029	4
Q10A6r22	Cystic echinococcosis	-0.084	-0.028	0.470	0.370	-0.031	0.380	0.111	4
Q10A6r24	Cutaneous larva migrans	-0.040	0.200	0.453	0.146	-0.177	0.229	0.032	4
Q10A6r25	Toxocariasis	0.306	0.000	0.446	0.065	0.141	0.269	0.255	4
Q10A3r5	Hantavirus – Hemorrhagic fever with renal syndrome	0.226	0.279	-0.020	0.583	0.168	0.159	-0.041	5
Q10A5r23	Hantavirus – Hantavirus pulmonary syndrome	0.149	0.225	0.049	0.525	0.307	0.171	0.026	5
Q10A6r21	Alveolar echinococcosis	0.193	0.000	0.368	0.455	-0.073	0.224	0.262	5
Q10A6r31	Louse-borne relapsing fever	0.296	-0.080	0.305	0.452	0.034	0.138	0.120	5
Q10A5r22	Avian (zoonotic) influenza H7N9	0.073	0.102	0.078	0.103	0.726	0.069	0.091	6
Q10A5r21	Avian (zoonotic) influenza H5N1	0.011	0.156	0.040	0.015	0.703	0.144	0.032	6
Q10A5r26	MERS-CoV infection	0.026	0.217	0.059	0.047	0.552	-0.040	0.089	6
Q10A4r1	Bovine tuberculosis	0.277	0.063	0.230	0.079	0.286	0.245	-0.058	6
Q10A1r22	Jamestown Canyon virus	0.143	0.111	0.135	0.120	0.008	0.065	0.743	7
Q10A1r25	Snowshoe hare encephalitis	0.250	0.045	0.166	0.089	0.128	0.146	0.737	7

Appendix H: Diseases encountered by cluster (with factors)

	Factor	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Cache valley virus disease	1	7%	3%	1%	1%
California encephalitis	1	30%	3%	<1%	2%
Crimean Congo hemorrhagic fever	1	13%	2%	0%	1%
Eastern equine encephalitis virus	1	34%	6%	1%	3%
Ebola disease	1	38%	14%	2%	4%
La Crosse encephalitis	1	16%	2%	1%	1%
Lassa hemorrhagic fever	1	17%	1%	<1%	1%
Marburg virus disease	1	23%	1%	0%	1%
Nipah virus disease	1	23%	1%	1%	0%
Plague	1	26%	4%	<1%	2%
Powassan virus disease	1	20%	1%	<1%	2%
Rift Valley Fever	1	18%	1%	<1%	1%
St. Louis encephalitis	1	25%	2%	<1%	<1%
Western equine encephalitis virus	1	47%	8%	1%	8%
Chikungunya	2	68%	25%	7%	17%
Dengue	2	94%	54%	12%	29%
Japanese encephalitis virus	2	52%	13%	2%	8%
Lyme disease	2	100%	95%	65%	94%
Mpox (monkeypox)	2	53%	30%	6%	22%
Rabies	2	75%	62%	20%	41%
Tick-borne encephalitis	2	66%	35%	3%	16%
Toxoplasmosis	2	97%	68%	16%	35%
West Nile virus infection	2	90%	54%	1%	96%
Yellow fever	2	67%	22%	2%	11%
Zika virus infection	2	83%	61%	7%	33%
Babesiosis	3	35%	10%	2%	6%
Bartonellosis (cat scratch disease)	3	77%	34%	18%	33%
Brucellosis	3	72%	13%	4%	7%
Cryptosporidiosis	3	79%	20%	6%	18%
Ehrlichiosis	3	36%	5%	2%	2%
Human granulocytic anaplasmosis	3	28%	5%	2%	2%
Leptospirosis	3	61%	13%	2%	9%
Psittacosis	3	51%	9%	2%	5%
Q fever	3	63%	17%	2%	10%
Rocky mountain spotted fever	3	73%	25%	4%	14%
Tularemia	3	66%	7%	2%	6%
American trypanosomiasis (Chagas disease)	4	51%	6%	1%	2%
Anthrax	4	27%	2%	1%	5%
Cutaneous larva migrans	4	59%	15%	9%	16%
Cystic echinococcosis	4	39%	5%	2%	4%
Murine typhus/ endemic typhus	4	25%	3%	1%	1%
Toxocariasis	4	30%	3%	1%	1%
Alveolar echinococcosis	5	28%	2%	<1%	1%
Hantavirus – Hantavirus pulmonary syndrome	5	49%	15%	2%	5%
Hantavirus – Hemorrhagic fever with renal syndrome	5	49%	13%	2%	5%
Louse-borne relapsing fever	5	18%	<1%	1%	2%
Avian (zoonotic) influenza: H5N1	6	69%	72%	18%	23%
Avian (zoonotic) influenza: H7N9	6	41%	48%	7%	8%
Bovine tuberculosis	6	46%	16%	4%	6%
MERS-CoV infection	6	47%	69%	18%	7%
Jamestown Canyon virus	7	20%	1%	1%	<1%
Snowshoe hare encephalitis	7	25%	2%	1%	0%

Appendix I: Shapley Regression Values

Variable	Variable description	Alveolar Echinococcosis	Chagas disease	Anthrax	Avian influenza A(H5N1)	Avian influenza A - H7N9	Babesiosis	Bartonellosis
R2	**R-squared value**	**40%**	**34%**	**26%**	**43%**	**37%**	**36%**	**49%**
Q6	Level of knowledge	18%	26%	26%	10%	10%	23%	12%
Q10A	Encountered disease	55%	39%	33%	76%	72%	52%	69%
Q1B	Province	2%	4%	2%	1%	1%	3%	2%
Q2	Profession type	2%	4%	4%	<1%	<1%	4%	3%
Q4r2	Specialty - Family medicine	1%	1%	1%	<1%	<1%	<1%	<1%
Q7	Satisfaction with education	3%	3%	6%	1%	2%	3%	2%
Q4r6	Specialty - Community health	<1%	1%	1%	<1%	<1%	1%	<1%
Q22_1	Practice setting - Family medicine clinic	1%	1%	1%	<1%	1%	1%	1%
Q17Ar1	Years of practice	<1%	<1%	<1%	<1%	1%	<1%	<1%
Q17Cr1	Years of practice internationally	4%	6%	8%	<1%	1%	4%	2%
Q4r1	Specialty - Infectious disease	6%	5%	3%	2%	3%	2%	<1%
Q4r3	Specialty - Public health and preventive medicine	<1%	<1%	<1%	<1%	<1%	1%	1%
Q4r4	Specialty - Obstetrics/Gynecology	<1%	<1%	1%	<1%	<1%	1%	1%
Q4r7	Specialty - Emergency medicine/critical care	1%	<1%	<1%	3%	2%	<1%	1%
Q4r8	Specialty - Internal medicine	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q4r91	Specialty - Surgery	<1%	1%	1%	<1%	<1%	<1%	<1%
Q22_2	Practice setting - Hospital setting	1%	3%	2%	2%	1%	2%	1%
Q22_5	Practice setting - Community health centre	<1%	<1%	1%	<1%	<1%	<1%	<1%
Q22_7	Practice setting - Public health clinic/setting	1%	1%	1%	<1%	<1%	<1%	2%
Q12r1	Confidence - Patient assessment	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r2	Confidence - Diagnosis	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r3	Confidence - Infection prevention and control measures	<1%	<1%	1%	<1%	1%	<1%	<1%
Q12r4	Confidence - Patient management	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r5	Confidence - Patient education	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r6	Confidence - Contact tracing	<1%	<1%	<1%	<1%	<1%	1%	<1%
Q12r7	Confidence - Public health reporting	<1%	<1%	1%	1%	1%	<1%	<1%
URBAN_RURAL	Urban vs Rural setting	<1%	1%	<1%	<1%	<1%	<1%	<1%
Q4r5	Specialty - Pediatrics	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_3	Practice setting - Walk-in clinic or urgent care	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_4	Practice setting - Specialized travel health centre/clinic	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_6	Practice setting - Long-term care residence	<1%	<1%	3%	<1%	1%	<1%	<1%
Q20	Northern experience	1%	1%	1%	<1%	<1%	<1%	<1%
Q26	Indigenous experience	<1%	1%	1%	<1%	1%	1%	<1%

Variable	Variable description	Bovine tuberculosis	Brucellosis	Cache Valley virus	California encephalitis	Chikungunya	Crimean-Congo hem. fever
R2	**R-squared value**	**42%**	**46%**	**24%**	**31%**	**40%**	**26%**
Q6	Level of knowledge	14%	20%	23%	26%	16%	19%
Q10A	Encountered disease	62%	55%	38%	49%	63%	38%
Q1B	Province	1%	2%	2%	2%	4%	6%
Q2	Profession type	1%	4%	<1%	1%	4%	2%
Q4r2	Specialty - Family medicine	1%	<1%	1%	<1%	<1%	1%
Q7	Satisfaction with education	2%	2%	2%	5%	1%	3%
Q4r6	Specialty - Community health	<1%	<1%	<1%	<1%	1%	<1%
Q22_1	Practice setting - Family medicine clinic	1%	<1%	<1%	<1%	1%	<1%
Q17Ar1	Years of practice	<1%	1%	<1%	<1%	<1%	<1%
Q17Cr1	Years of practice internationally	5%	6%	15%	6%	3%	9%
Q4r1	Specialty - Infectious disease	2%	3%	6%	2%	2%	9%
Q4r3	Specialty - Public health and preventive medicine	<1%	<1%	1%	1%	<1%	1%
Q4r4	Specialty - Obstetrics/Gynecology	1%	<1%	<1%	1%	<1%	<1%
Q4r7	Specialty - Emergency medicine/critical care	<1%	<1%	1%	<1%	<1%	<1%
Q4r8	Specialty - Internal medicine	<1%	1%	<1%	<1%	<1%	<1%
Q4r91	Specialty - Surgery	<1%	<1%	<1%	<1%	<1%	<1%
Q22_2	Practice setting - Hospital setting	1%	1%	1%	1%	<1%	2%
Q22_5	Practice setting - Community health centre	<1%	<1%	<1%	<1%	<1%	<1%
Q22_7	Practice setting - Public health clinic/setting	<1%	1%	1%	1%	1%	1%
Q12r1	Confidence - Patient assessment	<1%	<1%	<1%	<1%	<1%	<1%
Q12r2	Confidence - Diagnosis	<1%	<1%	<1%	<1%	<1%	1%
Q12r3	Confidence - Infection prevention and control measures	<1%	<1%	<1%	<1%	<1%	<1%
Q12r4	Confidence - Patient management	<1%	<1%	1%	<1%	<1%	<1%
Q12r5	Confidence - Patient education	<1%	<1%	<1%	<1%	<1%	1%
Q12r6	Confidence - Contact tracing	<1%	<1%	<1%	<1%	<1%	<1%
Q12r7	Confidence - Public health reporting	<1%	<1%	<1%	<1%	<1%	<1%
URBAN_RURAL	Urban vs Rural setting	<1%	<1%	<1%	<1%	<1%	<1%
Q4r5	Specialty - Pediatrics	<1%	<1%	<1%	<1%	<1%	<1%
Q22_3	Practice setting - Walk-in clinic or urgent care	<1%	<1%	1%	<1%	<1%	<1%
Q22_4	Practice setting - Specialized travel health centre/clinic	<1%	<1%	<1%	1%	<1%	<1%
Q22_6	Practice setting - Long-term care residence	<1%	<1%	1%	1%	1%	1%
Q20	Northern experience	4%	1%	2%	<1%	<1%	2%
Q26	Indigenous experience	2%	<1%	1%	<1%	<1%	1%

Variable	Variable description	Cryptosporidiosis	Cutaneous Larva Migrans	Cystic Echinococcosis	Dengue virus	E. equine encephalitis virus	Ebola disease	Ehrlichiosis
R2	**R-squared value**	**51%**	**51%**	**44%**	**37%**	**39%**	**26%**	**37%**
Q6	Level of knowledge	23%	10%	18%	19%	17%	15%	22%
Q10A	Encountered disease	59%	69%	54%	59%	57%	43%	52%
Q1B	Province	1%	2%	2%	2%	1%	4%	3%
Q2	Profession type	2%	7%	3%	3%	1%	3%	1%
Q4r2	Specialty - Family medicine	1%	1%	1%	<1%	1%	2%	1%
Q7	Satisfaction with education	2%	2%	4%	1%	2%	2%	4%
Q4r6	Specialty - Community health	1%	1%	1%	<1%	<1%	<1%	<1%
Q22_1	Practice setting - Family medicine clinic	1%	1%	1%	<1%	<1%	1%	<1%
Q17Ar1	Years of practice	<1%	<1%	<1%	1%	1%	1%	<1%
Q17Cr1	Years of practice internationally	2%	2%	6%	10%	8%	6%	5%
Q4r1	Specialty - Infectious disease	4%	1%	3%	1%	5%	4%	3%
Q4r3	Specialty - Public health and preventive medicine	<1%	1%	<1%	<1%	1%	<1%	<1%
Q4r4	Specialty - Obstetrics/Gynecology	1%	<1%	<1%	1%	<1%	1%	1%
Q4r7	Specialty - Emergency medicine/critical care	<1%	<1%	1%	<1%	<1%	2%	1%
Q4r8	Specialty - Internal medicine	<1%	1%	<1%	<1%	<1%	<1%	<1%
Q4r91	Specialty - Surgery	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_2	Practice setting - Hospital setting	1%	<1%	1%	<1%	1%	3%	1%
Q22_5	Practice setting - Community health centre	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_7	Practice setting - Public health clinic/setting	<1%	1%	1%	<1%	1%	1%	1%
Q12r1	Confidence - Patient assessment	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r2	Confidence - Diagnosis	<1%	<1%	<1%	<1%	<1%	1%	<1%
Q12r3	Confidence - Infection prevention and control measures	<1%	<1%	<1%	<1%	<1%	1%	<1%
Q12r4	Confidence - Patient management	<1%	<1%	<1%	<1%	<1%	1%	<1%
Q12r5	Confidence - Patient education	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r6	Confidence - Contact tracing	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r7	Confidence - Public health reporting	<1%	<1%	<1%	<1%	<1%	1%	<1%
URBAN_RURAL	Urban vs Rural setting	<1%	<1%	<1%	1%	<1%	1%	<1%
Q4r5	Specialty - Pediatrics	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_3	Practice setting - Walk-in clinic or urgent care	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_4	Practice setting - Specialized travel health centre/clinic	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_6	Practice setting - Long-term care residence	<1%	<1%	1%	<1%	<1%	1%	1%
Q20	Northern experience	<1%	<1%	1%	<1%	<1%	2%	1%
Q26	Indigenous experience	<1%	<1%	1%	<1%	1%	3%	1%

Variable	Variable description	Hantavirus - Pulmonary	Hantavirus - Hemorrhagic	H. granulocytic anaplasm.	Jamestown Canyon virus	Japanese encephalitis virus	La Crosse encephalitis
R2	**R-squared value**	**39%**	**35%**	**35%**	**35%**	**33%**	**31%**
Q6	Level of knowledge	13%	19%	21%	18%	23%	16%
Q10A	Encountered disease	70%	50%	53%	59%	58%	55%
Q1B	Province	3%	5%	3%	2%	2%	2%
Q2	Profession type	<1%	1%	1%	<1%	1%	<1%
Q4r2	Specialty - Family medicine	1%	1%	2%	<1%	<1%	<1%
Q7	Satisfaction with education	1%	2%	3%	4%	2%	7%
Q4r6	Specialty - Community health	<1%	<1%	<1%	<1%	<1%	<1%
Q22_1	Practice setting - Family medicine clinic	<1%	1%	<1%	1%	1%	<1%
Q17Ar1	Years of practice	1%	<1%	<1%	<1%	<1%	<1%
Q17Cr1	Years of practice internationally	2%	5%	5%	4%	4%	10%
Q4r1	Specialty - Infectious disease	4%	6%	5%	3%	2%	2%
Q4r3	Specialty - Public health and preventive medicine	<1%	<1%	<1%	<1%	1%	1%
Q4r4	Specialty - Obstetrics/Gynecology	1%	1%	<1%	1%	<1%	1%
Q4r7	Specialty - Emergency medicine/critical care	<1%	<1%	<1%	<1%	<1%	<1%
Q4r8	Specialty - Internal medicine	<1%	<1%	<1%	<1%	<1%	<1%
Q4r91	Specialty - Surgery	<1%	<1%	<1%	<1%	<1%	<1%
Q22_2	Practice setting - Hospital setting	<1%	2%	1%	1%	<1%	<1%
Q22_5	Practice setting - Community health centre	<1%	<1%	<1%	<1%	1%	<1%
Q22_7	Practice setting - Public health clinic/setting	<1%	1%	1%	<1%	1%	1%
Q12r1	Confidence - Patient assessment	<1%	<1%	<1%	<1%	<1%	<1%
Q12r2	Confidence - Diagnosis	<1%	1%	<1%	<1%	<1%	<1%
Q12r3	Confidence - Infection prevention and control measures	<1%	<1%	<1%	<1%	<1%	<1%
Q12r4	Confidence - Patient management	<1%	<1%	1%	<1%	<1%	<1%
Q12r5	Confidence - Patient education	<1%	<1%	<1%	<1%	<1%	<1%
Q12r6	Confidence - Contact tracing	<1%	<1%	<1%	1%	<1%	<1%
Q12r7	Confidence - Public health reporting	<1%	<1%	<1%	<1%	<1%	<1%
URBAN_RURAL	Urban vs Rural setting	<1%	<1%	<1%	<1%	<1%	<1%
Q4r5	Specialty - Pediatrics	<1%	1%	<1%	<1%	<1%	<1%
Q22_3	Practice setting - Walk-in clinic or urgent care	<1%	<1%	<1%	<1%	<1%	<1%
Q22_4	Practice setting - Specialized travel health centre/clinic	<1%	<1%	<1%	2%	<1%	<1%
Q22_6	Practice setting - Long-term care residence	<1%	<1%	<1%	1%	<1%	2%
Q20	Northern experience	<1%	1%	<1%	<1%	<1%	<1%
Q26	Indigenous experience	2%	2%	1%	<1%	<1%	<1%

Variable	Variable description	Lassa haemorrhagic fever	Leptospirosis	Louse-borne relap. fever	Lyme disease	Marburg virus disease	MERS-CoV	Mpox
R2	**R-squared value**	**28%**	**41%**	**25%**	**32%**	**26%**	**51%**	**36%**
Q6	Level of knowledge	16%	21%	30%	32%	18%	6%	20%
Q10A	Encountered disease	42%	52%	24%	24%	42%	82%	55%
Q1B	Province	3%	2%	5%	11%	2%	1%	4%
Q2	Profession type	1%	3%	1%	6%	1%	1%	<1%
Q4r2	Specialty - Family medicine	1%	<1%	3%	5%	2%	1%	1%
Q7	Satisfaction with education	3%	3%	5%	3%	2%	<1%	1%
Q4r6	Specialty - Community health	<1%	<1%	<1%	2%	<1%	<1%	<1%
Q22_1	Practice setting - Family medicine clinic	<1%	<1%	1%	2%	1%	1%	1%
Q17Ar1	Years of practice	1%	<1%	<1%	2%	1%	1%	<1%
Q17Cr1	Years of practice internationally	15%	8%	9%	2%	6%	<1%	<1%
Q4r1	Specialty - Infectious disease	5%	2%	9%	1%	9%	1%	3%
Q4r3	Specialty - Public health and preventive medicine	<1%	<1%	1%	1%	1%	<1%	3%
Q4r4	Specialty - Obstetrics/Gynecology	1%	1%	1%	1%	1%	<1%	1%
Q4r7	Specialty - Emergency medicine/critical care	<1%	<1%	1%	1%	<1%	2%	1%
Q4r8	Specialty - Internal medicine	<1%	<1%	<1%	1%	<1%	<1%	1%
Q4r91	Specialty - Surgery	<1%	<1%	<1%	1%	<1%	<1%	<1%
Q22_2	Practice setting - Hospital setting	1%	1%	2%	1%	1%	1%	<1%
Q22_5	Practice setting - Community health centre	<1%	<1%	<1%	1%	<1%	<1%	<1%
Q22_7	Practice setting - Public health clinic/setting	<1%	<1%	1%	1%	1%	<1%	3%
Q12r1	Confidence - Patient assessment	<1%	<1%	<1%	<1%	<1%	<1%	1%
Q12r2	Confidence - Diagnosis	<1%	<1%	1%	<1%	<1%	<1%	<1%
Q12r3	Confidence - Infection prevention and control measures	<1%	<1%	1%	<1%	<1%	<1%	<1%
Q12r4	Confidence - Patient management	<1%	<1%	1%	<1%	1%	<1%	<1%
Q12r5	Confidence - Patient education	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r6	Confidence - Contact tracing	<1%	<1%	1%	<1%	<1%	<1%	<1%
Q12r7	Confidence - Public health reporting	<1%	<1%	<1%	<1%	<1%	1%	<1%
URBAN_RURAL	Urban vs Rural setting	<1%	1%	<1%	<1%	1%	<1%	<1%
Q4r5	Specialty - Pediatrics	<1%	<1%	1%	<1%	<1%	<1%	1%
Q22_3	Practice setting - Walk-in clinic or urgent care	1%	<1%	<1%	<1%	1%	<1%	1%
Q22_4	Practice setting - Specialized travel health centre/clinic	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_6	Practice setting - Long-term care residence	4%	1%	1%	<1%	2%	1%	<1%
Q20	Northern experience	1%	1%	1%	<1%	3%	<1%	<1%
Q26	Indigenous experience	2%	1%	<1%	<1%	2%	<1%	1%

Variable	Variable description	Nipah virus	Plague	Powassan virus disease	Psittacosis	Q Fever	Rabies
R2	**R-squared value**	**28%**	**21%**	**27%**	**48%**	**54%**	**32%**
Q6	Level of knowledge	24%	30%	25%	14%	6%	18%
Q10A	Encountered disease	36%	27%	37%	65%	83%	49%
Q1B	Province	1%	3%	4%	4%	1%	3%
Q2	Profession type	<1%	3%	2%	2%	<1%	1%
Q4r2	Specialty - Family medicine	<1%	1%	1%	<1%	1%	<1%
Q7	Satisfaction with education	4%	7%	5%	2%	1%	2%
Q4r6	Specialty - Community health	<1%	<1%	<1%	<1%	<1%	1%
Q22_1	Practice setting - Family medicine clinic	1%	1%	<1%	<1%	<1%	1%
Q17Ar1	Years of practice	<1%	<1%	1%	1%	<1%	1%
Q17Cr1	Years of practice internationally	13%	6%	9%	3%	1%	2%
Q4r1	Specialty - Infectious disease	7%	4%	5%	4%	4%	1%
Q4r3	Specialty - Public health and preventive medicine	2%	<1%	1%	<1%	<1%	4%
Q4r4	Specialty - Obstetrics/Gynecology	1%	1%	1%	<1%	1%	1%
Q4r7	Specialty - Emergency medicine/critical care	<1%	<1%	<1%	<1%	<1%	3%
Q4r8	Specialty - Internal medicine	<1%	<1%	<1%	1%	<1%	2%
Q4r91	Specialty - Surgery	<1%	<1%	<1%	<1%	<1%	1%
Q22_2	Practice setting - Hospital setting	2%	3%	1%	1%	<1%	<1%
Q22_5	Practice setting - Community health centre	<1%	<1%	<1%	<1%	<1%	<1%
Q22_7	Practice setting - Public health clinic/setting	2%	<1%	1%	<1%	<1%	5%
Q12r1	Confidence - Patient assessment	<1%	<1%	<1%	<1%	<1%	<1%
Q12r2	Confidence - Diagnosis	<1%	<1%	<1%	<1%	<1%	<1%
Q12r3	Confidence - Infection prevention and control measures	<1%	<1%	<1%	<1%	<1%	2%
Q12r4	Confidence - Patient management	<1%	<1%	1%	<1%	<1%	<1%
Q12r5	Confidence - Patient education	<1%	<1%	<1%	<1%	<1%	<1%
Q12r6	Confidence - Contact tracing	1%	<1%	<1%	<1%	<1%	<1%
Q12r7	Confidence - Public health reporting	<1%	1%	<1%	<1%	<1%	<1%
URBAN_RURAL	Urban vs Rural setting	<1%	<1%	<1%	<1%	<1%	<1%
Q4r5	Specialty - Pediatrics	<1%	1%	<1%	<1%	<1%	<1%
Q22_3	Practice setting - Walk-in clinic or urgent care	<1%	1%	<1%	<1%	<1%	<1%
Q22_4	Practice setting - Specialized travel health centre/clinic	1%	<1%	<1%	<1%	<1%	<1%
Q22_6	Practice setting - Long-term care residence	1%	2%	1%	1%	<1%	<1%
Q20	Northern experience	<1%	<1%	1%	<1%	<1%	1%
Q26	Indigenous experience	1%	3%	2%	<1%	1%	1%

Variable	Variable description	Rift Valley fever	R. mountain spotted fever	Snowshoe hare enceph.	St. Louis encephalitis	Tick-borne encephalitis	Toxocariasis	Toxoplasmosis
R2	**R-squared value**	**31%**	**37%**	**33%**	**35%**	**43%**	**36%**	**36%**
Q6	Level of knowledge	23%	22%	24%	17%	21%	19%	22%
Q10A	Encountered disease	52%	52%	50%	63%	64%	47%	51%
Q1B	Province	3%	1%	2%	1%	1%	2%	4%
Q2	Profession type	1%	3%	1%	2%	2%	3%	5%
Q4r2	Specialty - Family medicine	1%	<1%	<1%	<1%	<1%	1%	<1%
Q7	Satisfaction with education	3%	4%	4%	1%	1%	4%	2%
Q4r6	Specialty - Community health	<1%	1%	<1%	<1%	<1%	<1%	1%
Q22_1	Practice setting - Family medicine clinic	1%	1%	1%	<1%	1%	<1%	<1%
Q17Ar1	Years of practice	<1%	1%	<1%	<1%	<1%	<1%	<1%
Q17Cr1	Years of practice internationally	4%	5%	7%	5%	4%	8%	4%
Q4r1	Specialty - Infectious disease	4%	1%	3%	3%	2%	6%	1%
Q4r3	Specialty - Public health and preventive medicine	<1%	<1%	1%	1%	<1%	<1%	1%
Q4r4	Specialty - Obstetrics/Gynecology	1%	1%	<1%	1%	<1%	<1%	<1%
Q4r7	Specialty - Emergency medicine/critical care	1%	2%	<1%	<1%	1%	1%	<1%
Q4r8	Specialty - Internal medicine	1%	<1%	<1%	<1%	<1%	<1%	<1%
Q4r91	Specialty - Surgery	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_2	Practice setting - Hospital setting	1%	1%	1%	1%	1%	1%	2%
Q22_5	Practice setting - Community health centre	<1%	<1%	1%	<1%	<1%	<1%	<1%
Q22_7	Practice setting - Public health clinic/setting	<1%	2%	1%	1%	<1%	1%	<1%
Q12r1	Confidence - Patient assessment	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r2	Confidence - Diagnosis	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r3	Confidence - Infection prevention and control measures	<1%	<1%	<1%	<1%	1%	<1%	<1%
Q12r4	Confidence - Patient management	<1%	1%	<1%	<1%	<1%	<1%	<1%
Q12r5	Confidence - Patient education	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r6	Confidence - Contact tracing	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q12r7	Confidence - Public health reporting	<1%	<1%	<1%	<1%	<1%	<1%	<1%
URBAN_RURAL	Urban vs Rural setting	<1%	<1%	<1%	<1%	<1%	1%	<1%
Q4r5	Specialty - Pediatrics	<1%	<1%	<1%	<1%	<1%	1%	<1%
Q22_3	Practice setting - Walk-in clinic or urgent care	<1%	1%	<1%	<1%	<1%	<1%	<1%
Q22_4	Practice setting - Specialized travel health centre/clinic	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Q22_6	Practice setting - Long-term care residence	<1%	<1%	2%	1%	<1%	1%	<1%
Q20	Northern experience	1%	<1%	<1%	1%	<1%	<1%	1%
Q26	Indigenous experience	<1%	1%	<1%	1%	1%	2%	2%

Variable	Variable description	Tularemia	Murine typhus	West Nile virus	W. equine encephalitis	Yellow fever	Zika virus
R2	**R-squared value**	**44%**	**30%**	**39%**	**41%**	**36%**	**32%**
Q6	Level of knowledge	17%	24%	20%	19%	21%	26%
Q10A	Encountered disease	59%	42%	56%	61%	56%	55%
Q1B	Province	3%	3%	6%	<1%	4%	4%
Q2	Profession type	4%	3%	<1%	1%	<1%	2%
Q4r2	Specialty - Family medicine	<1%	1%	<1%	<1%	<1%	<1%
Q7	Satisfaction with education	2%	5%	2%	3%	1%	1%
Q4r6	Specialty - Community health	1%	1%	1%	<1%	<1%	1%
Q22_1	Practice setting - Family medicine clinic	<1%	1%	1%	1%	<1%	<1%
Q17Ar1	Years of practice	<1%	<1%	<1%	<1%	1%	2%
Q17Cr1	Years of practice internationally	4%	4%	<1%	5%	6%	4%
Q4r1	Specialty - Infectious disease	3%	4%	3%	2%	1%	2%
Q4r3	Specialty - Public health and preventive medicine	<1%	1%	1%	<1%	<1%	<1%
Q4r4	Specialty - Obstetrics/Gynecology	<1%	1%	2%	1%	1%	1%
Q4r7	Specialty - Emergency medicine/critical care	<1%	1%	1%	<1%	1%	<1%
Q4r8	Specialty - Internal medicine	<1%	<1%	1%	<1%	<1%	<1%
Q4r91	Specialty - Surgery	<1%	<1%	<1%	<1%	<1%	<1%
Q22_2	Practice setting - Hospital setting	1%	2%	1%	1%	<1%	1%
Q22_5	Practice setting - Community health centre	<1%	<1%	<1%	<1%	<1%	<1%
Q22_7	Practice setting - Public health clinic/setting	<1%	2%	1%	<1%	<1%	<1%
Q12r1	Confidence - Patient assessment	<1%	<1%	<1%	<1%	<1%	<1%
Q12r2	Confidence - Diagnosis	<1%	<1%	<1%	<1%	<1%	<1%
Q12r3	Confidence - Infection prevention and control measures	<1%	<1%	1%	<1%	1%	<1%
Q12r4	Confidence - Patient management	<1%	<1%	<1%	<1%	<1%	<1%
Q12r5	Confidence - Patient education	<1%	<1%	<1%	<1%	<1%	<1%
Q12r6	Confidence - Contact tracing	<1%	<1%	<1%	<1%	<1%	<1%
Q12r7	Confidence - Public health reporting	<1%	<1%	<1%	<1%	1%	<1%
URBAN_RURAL	Urban vs Rural setting	<1%	<1%	1%	<1%	<1%	<1%
Q4r5	Specialty - Pediatrics	<1%	<1%	<1%	<1%	<1%	<1%
Q22_3	Practice setting - Walk-in clinic or urgent care	<1%	1%	<1%	<1%	<1%	<1%
Q22_4	Practice setting - Specialized travel health centre/clinic	<1%	<1%	<1%	1%	<1%	<1%
Q22_6	Practice setting - Long-term care residence	1%	1%	<1%	1%	1%	<1%
Q20	Northern experience	1%	1%	<1%	<1%	1%	<1%
Q26	Indigenous experience	1%	<1%	1%	1%	1%	<1%

Appendix K: ZIDs encountered/confidence

The following table lists all 52 diseases, ranked by the % encountered, along with mean self-reported confidence ratings.

Q10A and Q10B. Please indicate which diseases you have encountered in your practice, and rate your level of confidence in managing each zoonotic infectious disease. Base: All respondents (n = 1,023).

Disease	Encountered %	Mean confidence	Disease	Encountered %	Mean confidence	Disease	Encountered %	Mean confidence	Disease	Encountered %	Mean confidence
Lyme	80%	2.20	Cryptosporidiosis	17%	1.32	Ebola disease	7%	1.31	Snowshoe hare encephalitis	3%	1.12
West Nile	38%	1.63	Cutaneous larva migrans	15%	1.34	Western equine encephalitis	7%	1.19	Alveolar echinococcosis	3%	1.13
Rabies	37%	1.96	Rocky mountain spotted fever	15%	1.37	Babesiosis	7%	1.20	St. Louis encephalitis	2%	1.13
Toxoplasmosis	37%	1.65	Yellow fever	13%	1.42	Chagas	6%	1.20	Nipah virus	2%	1.12
H5N1	34%	1.76	Q fever	11%	1.29	Cystic echinococcosis	6%	1.16	Jamestown Canyon virus	2%	1.12
Dengue	30%	1.55	Brucellosis	11%	1.27	Ehrlichiosis	5%	1.17	Powassan virus	2%	1.13
Zika	30%	1.60	Bovine tuberculosis	10%	1.27	Eastern equine encephalitis	5%	1.17	Louse-borne relapsing fever	2%	1.12
MERS-CoV	29%	1.66	Leptospirosis	10%	1.27	Human granulocytic anaplasmosis	4%	1.16	La Crosse encephalitis	2%	1.13
Bartonellosis	29%	1.52	Japanese encephalitis	9%	1.26	Anthrax	4%	1.21	Marburg virus	2%	1.10
H7N9	19%	1.56	Hantavirus pulmonary	9%	1.26	California encephalitis	3%	1.14	Lassa hemorrhagic fever	2%	1.12
Mpox	18%	1.50	Tularemia	8%	1.23	Toxocariasis	3%	1.15	Cache valley virus	2%	1.11
Chikungunya	17%	1.36	Hantavirus - Hemo. fever + renal syndrome	8%	1.21	Plague	3%	1.22	Rift Valley Fever	2%	1.13
Tick-borne encephalitis	17%	1.38	Psittacosis	8%	1.23	Murine typhus	3%	1.15	Crimean Congo hemorrhagic fever	1%	1.09

Note: Confidence mean is based on 4-point scale where 1 = “Not at all confident” and 4 = “Very confident.” The mean ranges from 1 to 4 and includes all respondents, regardless of encounter.

Mean Self-Rated Confidence Among Encountered

The table below shows confidence means for diseases among those who had encountered each disease in their practice. Calculated this way, confidence ratings exist in a tight range from 1.80 to 2.59.

Q10A and Q10B. Please indicate which diseases you have encountered in your practice, and rate your level of confidence in managing each zoonotic infectious disease. Base: All respondents (n = 1,023); means calculated based only on those who encountered each disease.

Disease	Encountered %	Mean confidence	Disease	Encountered %	Mean confidence	Disease	Encountered %	Mean confidence	Disease	Encountered %	Mean confidence
Lyme	80%	2.33	Cryptosporidiosis	17%	2.17	Ebola disease	7%	2.07	Snowshoe hare encephalitis	3%	2.34
West Nile	38%	2.13	Cutaneous larva migrans	15%	2.41	Western equine encephalitis	7%	2.17	Alveolar echinococcosis	3%	2.55
Rabies	37%	2.41	Rocky mountain spotted fever	15%	2.06	Babesiosis	7%	2.08	St. Louis encephalitis	2%	2.47
Toxoplasmosis	37%	2.11	Yellow fever	13%	2.26	Chagas	6%	2.01	Nipah virus	2%	2.11
H5N1	34%	2.41	Q fever	11%	2.59	Cystic echinococcosis	6%	2.26	Jamestown Canyon virus	2%	2.49
Dengue	30%	2.15	Brucellosis	11%	2.19	Ehrlichiosis	5%	2.14	Powassan virus	2%	2.18
Zika	30%	2.11	Bovine tuberculosis	10%	2.19	Eastern equine encephalitis	5%	2.17	Louse-borne relapsing fever	2%	1.80
MERS-CoV	29%	2.56	Leptospirosis	10%	2.14	Human granulocytic anaplasmosis	4%	2.19	La Crosse encephalitis	2%	2.39
Bartonellosis	29%	2.25	Japanese encephalitis	9%	2.06	Anthrax	4%	2.02	Marburg virus	2%	1.99
H7N9	19%	2.41	Hantavirus pulmonary	9%	2.22	California encephalitis	3%	2.08	Lassa hemorrhagic fever	2%	2.15
Mpox	18%	2.27	Tularemia	8%	2.29	Toxocariasis	3%	2.26	Cache valley virus	2%	1.98
Chikungunya	17%	2.16	Hantavirus - Hemo. fever + renal syndrome	8%	1.94	Plague	3%	1.93	Rift Valley Fever	2%	2.55
Tick-borne encephalitis	17%	2.11	Psittacosis	8%	2.40	Murine typhus	3%	2.18	Crimean Congo hemorrhagic fever	1%	2.18

Note: Confidence mean is based on 4-point scale where 1 = “Not at all confident” and 4 = “Very confident.” The mean ranges from 1 to 4 and is calculated based on those who encountered each.