Proof-of-vaccination credentials for COVID-19 and considerations for future use of digital proof-of-immunization technologies: Results of an expert consultation

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Abstract

Objective: As part of COVID-19 pandemic control efforts, digital proof-of-vaccination credentials were launched in Canada in 2021–2022 following widespread vaccine availability. Given the controversy over proof-of-vaccination credentials—often colloquially called vaccine or immunization "passports"—it is imperative to document successes, shortcomings, and recommendations for any future uses.

Methods: This expert consultation applied inductive qualitative content analysis to online video interviews with key informants whose expertise ranged from ethics to public health to computer science to identify what we can learn from this experience with proof-of-vaccination credentials, and what decision-makers must keep in mind for possible future use of such technologies.

Results: There remains a lack of consensus regarding appropriate language and scope for digital proof-of-vaccination technologies, the respective roles of the technology sector versus government in design and implementation, and parameters for future use. However, experts agree on many recommendations, including the importance of clear communication, evidence-based rationale for the use of proof-of-vaccination credentials, multidisciplinary consultation including academic experts and the public, and the importance of pan-Canadian standards for accessibility and interoperability. Identified risks of use that emerged, and should be minimized in the future, include risks of coercion and backlash; threats to access, equity and privacy; and impacts such as costs of the technology and workload burden of enforcement and fraud detection.

Conclusions: There is much to learn from this first major use of digital proof-of-vaccination credentials. A full scientific review of the impacts on health and equity should be combined with expert recommendations to create pan-Canadian guidelines for the future use of digital proof-of-vaccination solutions.

Keywords

Vaccination, immunization, immunity, digital records, COVID-19, public health, vaccine passports, Canada

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Introduction

The COVID-19 pandemic brought the concept of proof-of-vaccination credentials (PVCs)—commonly referred to as "immunization passports"—to public attention. In Canada, provinces/territories, the federal government, and private companies developed and sometimes required digital-based verification of vaccination status. There is a long history, both in Canada and internationally, of requiring documentation of immunity or vaccination for purposes including immigration, travel, and school enrolment, but these have historically relied on paper records. More recently, digital immunization information systems have been providing centralized registries of vaccination data on populations—most commonly school-aged children. Digital personal health records have also been on the rise, both in the hands of private industry (e.g. Apple and Telus) and governments (e.g. British Columbia Health Gateway and eHealth Ontario).

In Canada, digital PVCs were launched following COVID-19 vaccine availability to the general adult population, as part of pandemic control efforts. In addition to a standardized pan-Canadian PVC announced on 21 October 2021,[1] every province and territory either administered their own PVC app (some predating the pan-Canadian standard) or provided a portal to the pan-Canadian PVC for use when traveling in Canada by air, rail, or cruise ship, and for some international travel.[2] These COVID-19 PVCs contained limited personal information including name, birth date, and a QR code linking to COVID-19 vaccination history. Some provinces or industries required PVC or alternative evidence of vaccination for access to services such as restaurants and sporting events, or to maintain employment in sectors such as health care, during periods of heightened public health protections.[3]

In late winter and spring of 2022, with high 2-dose vaccine uptake in most Canadian communities, decreasing hospitalizations and deaths, and questions about the effectiveness of COVID-19 vaccines against infection, PVCs were phased out for most uses. Previously, researchers had considered how PVCs might be implemented,[4] explored legal issues raised by such technologies,[5] and tracked public support for these types of certificates.[6] Now it is imperative to consult, reflect, assess, and document the successes and shortcomings of this first widespread use of digital PVCs in Canada.

Objectives

This expert consultation used qualitative content analysis of online video interviews to answer the questions: *What can we learn from this experience with "immunization passports"? What should decision-makers keep in mind for future outbreaks and epidemics that might merit the use of such technologies again?* Our objectives were (a) to assess ethical, legal, and policy implications from a Canadian population health perspective and (b) to make recommendations for immunization tracking solutions and evaluation strategies for the future.

Methods

This consultation collected and inductively analyzed the perspectives of Canadian and international experts with varying perspectives on PVCs. We identified key informants who would be familiar with the COVID-19 PVC experience in Canada by searching professional networks, reviewing the literature on digital PVCs, and identifying opinion leaders in the media or on expert panels. Our multidisciplinary research team spanned health information and communication studies, epidemiology, and clinical medicine. We took a social constructivist approach that assumed experts with different backgrounds would have contrasting valuable perspectives on the use of PVCs, which together could help understand the implications of the use of such technologies and result in recommendations for the future. We report this study here following the recommendations of the Standards for Reporting Qualitative Research.[7]

Sampling was purposive, aiming for representation from diverse fields of expertise as well as by experts with provincial, Canadian, and international scopes of work. Once we approached information power[8] to address our research questions, we deliberately sought informants who offered perspectives that might contrast with or disrupt our preliminary themes. Experts were contacted via email and invited to schedule an interview with the research team. Given the burden of written consent forms for remote interviews, the interviews' focus on participants' expert professional views, and the minimal risk to personal privacy the study posed, an oral consent procedure that had previously been used in key informant interviews with participants who could reasonably expected to already be familiar with research procedures was approved and used. Study and consent information was provided in advance via email, but instead of paper signatures, all participants provided verbal consent at the audio-recorded interview's start.

The interview guide was flexible, with a general section asking about definitions, risks, benefits, uses, and a participant's hopes, fears, and views on standards for PVCs (called "immunization passports" in the interview guide), followed by questions that would be applicable to some but not all participants focused on special topics such as ethics, scientific review, policy-making processes, and technological considerations. Interviewers also had the flexibility to probe and ask follow-up questions to clarify or pursue additional information in a participant's area of expertise.

Interviews were conducted in English (by DG or WP) using Zoom web conferencing software from December 2021 thorough April 2022, which was a critical window of time in Canada in which PVCs were being "retired" for COVID-19 use. Interviews were audio recorded, transcribed verbatim, and then de-identified for analysis. Interviewers wrote notes after each interview, summarizing the interview, highlighting connections among interviews, and engaging in reflexivity around the interview itself, and discussed each interview with each other. Participants were invited to review their preliminary transcripts for privacy or accuracy issues, after which transcripts and fieldnotes were added to an NVivo database for management, coding, and analysis.

Data analysis

We conducted conventional content analysis,[9] led by DG and validated via a series of conversations throughout data collection and analysis with WP, and a review of preliminary findings with JB and KW. Following initial familiarization with the data, DG coded line by line using inductive constant comparison to identify key thoughts or concepts regarding the Canadian PVC experience during the COVID-19 pandemic to date, as well as lessons and recommendations for future use of digital PVCs in Canada or internationally. Preliminary themes were discussed among authors and then refined using a combination of further coding and sketching out relationships by hand on paper, in an iterative process of coding, code organization, analysis, and writing. Results were shared with all authors for feedback before finalization.

Results

We interviewed 12 experts who each specialized in one or more of the areas of law/ethics (n = 5), public health/medicine (n = 3), health policy/administration (n = 3), computer science/information technology (n = 3) and business (n = 1). They worked at provincial (n = 5), federal (n = 4), and international (n = 2) levels, and two were scholars who were not directly practicing or advising at any of those levels (categories not mutually exclusive). Interviews ranged from 37 min to just over an hour. One interview was with two experts with contrasting expertise, while the rest were individual. Among these experts, we found both consensus and divergence on different topics. Differences ranged from the arguably superficial (e.g. what to call PVCs) to foundational for future efforts (e.g. the roles of public and private sector). Some of the strongest consensus emerged regarding recommendations for immunization tracking solutions and evaluation strategies for the future—many of which are clear and actionable. Longer quotes illustrating findings on each topic are presented in Table 1.

Areas of disagreement: Terminology, public–private balance, and future uses

The terminology used for, and definition of, PVCs was one of the topics over which there was the least consensus. While "immunization passport" and "vaccine passport" were both common, six additional terms were suggested. Some referred to the PVC itself, while others to policies requiring PVCs, suggesting a need to clarify whether language refers to the technology itself or the requirement to use it. Suggested language ranged from the popular "document" to "requirement," "certificate," or "code." Views on the importance of terminology also varied, from a technology sector expert who claimed no opinion to a bioethicist who emphasized that "language matters here."

Fewer participants commented on the ideal roles of government versus private technology companies in creating and administering PVCs, but those who did expressed a broad spectrum of opinions on the extent to which private companies should be involved. Although private technology companies hired by Canadian governments to develop PVCs were not given access to the data, multiple participants expressed reservations about the involvement of private companies based on privacy concerns. Participant 10, a healthcare provider, was not convinced technology companies "have our best interests at heart" because of their responsibility to shareholders. However, a computer science expert stated, conversely, that a "reputable and trusted high-tech company" could be *more* acceptable to the public than the government for "storing, collecting, and handling" personal data. Taking a moderate view, one bioethics expert who emphasized the "really high standards" within public healthcare nonetheless expressed that, because government health resources were "completely strapped" during the pandemic, partnerships with private companies were necessary.

Views regarding the potential future use of current PVCs came primarily from those with legal/ethical expertise, and were similarly divergent, ranging from those who felt we might as well keep them now that the work to develop them is done to those who opined that current systems were thrown together hastily, without sufficient consultation, and might best be discarded. Participant 6 suggested that "once you have a platform that can incorporate [key health information such as vaccinations], then I imagine that stays" and could replace older technology for things like the yellow fever certification for travel[10,11] or to check someone's last tetanus vaccine date if they show up to hospital with a puncture wound. However, Participant 6 expressed reservations regarding the potential creep of health technology toward serving economic goals over health and the related "ways in which [new technology] changes society and changes our interactions with each other."

Table 1. Illustrative quotes.

Theme	Expert type	Example quote
Topics of disagreement		
Terminology	Ethics	"It's a sort of chicken and egg type problem because if you knew what the function was, you would be able to design an appropriate language for it." (Participant 6)
Public–private balance	Health Administration	"I think we have to be cautious because these are confidential medical records people should have an expectation of some privacy. [...] And health is a provincial or a territorial responsibility in Canada so I certainly think that the passport should be under the jurisdiction of the province. "I'm not an expert in the IT side of it but I think that the government has to remember that this is confidential medical information, so getting private companies involved we need to consider what access of personal health information will be available to them? We need to consider this as we would any other [privacy-sensitive health data decision], for example EMR." (Participant 9)
	Computer science	"Many people already kind of accepted the fact that there are some high-tech companies who have so much information about the individual that [...] if they want to use the service of the company, they have to accept that this company will have that information anyway. So people do make decisions, which Big Brother they choose: Facebook, Apple, Google, and so on. [...] Personally, I would probably trust the high-tech companies like Google and Apple more than [provincial] government, when it comes to storing, collecting, and handling my personal data. "I personally have more trust in large, high tech companies, especially if they're held accountable legally, for properly storing my information. Because they also they have resources. Second of all, the business depends on the customers trusting them, whereas the [provincial] government or Canadian government, basically they don't have to worry about competition." (Participant 12)
Future uses	Ethics	"It might go into abeyance for a while, but the technology's not gonna be thrown away. Once you've invested however millions of dollars, it may be that you at a particular moment in time no longer require somebody to show proof of vaccination, but that technology will be there and it will be resuscitated. "[Or] it may never even go away and need to be resuscitated, it'll morph right away into something else because it can be seen as a useful tool. I mean, you know, the first step *is* really a useful tool. It would be great to have one place where all of my documentation about all of my vaccines and all of my kids' vaccines were in one place, that's so obvious [....] It is a useful tool and—but that's how a lot of technology starts, right? Like, it starts off with something that's really useful and I can see the benefit of it for me, without necessarily understanding the long-term implications. And the long-term implications I'm referring to are the ways in which it changes society and changes our interactions with each other [and] in some cases creates barriers, in some cases creates divides." (Participant 4)
	Ethics	"I hope desperately that all of this information is going to be available to researchers, because I think there's a ton of interesting questions that should be asked right now live real time, but also that when you have some time to breathe, like the work you're doing is real time now need questions right now. But then I can imagine in a year from now, there's gonna be a whole new set of questions like looking back now that you have some time and some breathing room, looking back and saying, who did this this QR code not include? Who wasn't able to use it and why? And there's really important learnings there, because then you can prep for the next time, this happens, right and have a better so we have something available, a system available to us that we could use, people that we could call on to put to stand something up, that's more inclusive, that kind of thing." (Participant 1)

Table 1. Continued.

Theme	Expert type	Example quote
Topics of consensus		
Communication	Business	"Having clear, evidence-based guidelines. [...] Having evidence-based and consistent guidelines is important." (Participant 5)
	Public health	"I think first and foremost they—you know, they have to be evidence based, like, scientific. Like, there has to be a good scientific rationale for having them." (Participant 8)
Consultation	Law	"One of the things that has happened, because provinces have generally been in states of emergency or some version of that, is that all of these decisions have been made, basically, at the executive level. And there's been almost no legislative debate at all. [...]t is, to me, a problem that these things are not sort of publicly debated and discussed, and it becomes harder to, to really say that, you know, the government has sort of a mandate to do this." (Participant 3)
	Public health	"It really needs to be made with folks that are members of different communities. Like, we need to go bac to the public health I trained in. [T]he public health I do day to day really learns from community about implementation. It shouldn't be, like, white, cis dudes that are like, 'Hey, this is what's best for you and here you go.' It should really be about communities saying, 'Actually, this would work best for us.'" "[...T]he process of its development should go back to traditional public health program development of talking with communities, particularly communities that have been historically marginalized and asking the question." (Participant 10)
Federal Standards	Health Administration	"It needs to be a federal approach. I think that's really important. [...]f anything's going to be enduring, it needs to be a federal approach, so that we have the standards up front, across the board [because] the feds need to work internationally. If it's gonna be required for travel, then they need to work with their international partners to establish some standards. I'm all about data standards and interoperability." (Participant 11)

Consensus recommendations: Communication, consultation, and pan-Canadian standards

We identified three major themes representing recommendations over which there was a great deal of consensus by experts spanning disciplines. These were (1) the importance of clear communication including evidence-based rationale for the use of PVCs, (2) a need for broad-based consultation involving the public, and (3) the necessity of pan-Canadian technical and policy standards.

Clear and consistent communication was emphasized as a requirement in every interview despite no questions intended to elicit this specifically. Participants underscored the importance of clearly and consistently articulating the goals of a PVC program, highlighting in many cases there were two competing narratives—one of creating safer public spaces where everyone would be vaccinated, and a second of incentivizing vaccination by withholding access from unvaccinated people. To maintain credibility, a consistent rationale must be communicated, and program changes (e.g. extension or removal of requirements) should be tied

to that rationale. Multiple participants expressed the view that "politics" had gotten in the way of consistent and evidence-based (i.e. based on empirical scientific research) messaging, eroding public support.

Nearly as commonly asserted as the need for clear, consistent communication was the importance of consultation with a broad base of interested parties. Communities participants suggested should have been consulted included legislators, marginalized communities, communities with low vaccine uptake, and academics. The consensus was that, while consultation done before the 2021–2022 PVC implementation was limited and perhaps rushed, future consultations should be "*Multidisciplinary!*" (Participant 1, emphatically), proactive rather than "after the fact," (Participant 5), and should involve both education of the public and "broad public engagement" (Participant 4).

Finally, pan-Canadian standards for technical and interoperability issues, privacy and data access, and in some cases, policy standards such as which settings or activities could require PVC for access, were mentioned by participants from most areas of expertise. There was consensus the federal government should set technical standards

for PVCs despite the administration of health services largely being a provincial/territorial responsibility, due to the need for pan-Canadian and international interoperability that meets global standards. Participant 11, who had a senior clinical role in information systems, explained the current pan-Canadian standards were not released until after some provinces had already implemented vaccine certification systems, risking incompatibility among provinces, like "apples talking to oranges." Standards for privacy could also be required to meet federal legal minimum requirements, while policies regarding where and when PVCs might be used would likely continue to fall under the jurisdiction regulating a particular sector (e.g. federal for aviation and provincial for restaurants).

Moderate agreement: Risks to manage

All experts consulted had concerns regarding the risks of PVC use, but there were differences regarding which risks were perceived as most salient and in some cases a perception that certain risks (e.g. privacy of vaccine data) may have been overstated. Risks that were strongly emphasized as important to minimize in future uses of digital immunization certificates include risks of coercion and backlash, as well as threats to access, equity, and privacy. Additionally, participants expressed concerns over the costs of PVC technology and the workload burden of enforcement and fraud detection. While many participants expressed concern over privacy risks, one privacy expert offered the contrasting view that PVC data privacy concerns were somewhat "blown out of proportion," in that people were inappropriately considering vaccine data to be more sensitive than other health data. Another contrasting view on privacy suggested the individualistic lens through which public health framed privacy could be improved by engaging more fully with First Nations communities and valuing community privacy concerns more strongly.

Those we consulted were mixed on the importance of the access barriers posed by a smartphone-based scheme, with some feeling this was a critical issue of social marginalization and others dismissing this as an issue affecting only a small population, with viable workarounds. These differences appeared to reflect respondents' experiences with the implementation of PVCs in different jurisdictions, as well as their different disciplinary orientations. Regarding costs and workload burden, some experts were concerned that "sunk costs" (investments already made into the technology) meant we would continue using PVCs even if they were not optimal, while others focused more on the burden to workers and businesses tasked with the additional pandemic duty of checking and verifying customers' vaccination status—and dealing with potential pushback from unwilling clientele.

Discussion

By consulting 12 experts with areas of specialization spanning ethics, public health, health administration, information technology, and business, we identified several important lessons to be learned from Canada's COVID-19 PVC experience. Future use of proof-of-vaccination technologies should be informed by robust, multisectoral consultation that includes the public as well as academic and legislative experts. Terminology should be consistent and clearly defined, and the rationale for use—and potential future discontinuation—be clearly communicated and evidence-based. Pan-Canadian technical standards must be set and maintained to ensure accessibility and interoperability, including usability for and inclusion of marginalized populations and those who travel or migrate across jurisdictions. There may be a role for private technology companies to work with the government to bring technological expertise to the table, but data privacy and security must not be compromised in such partnerships. Further, the roles of all partners in PVC development and operations, as well as the details of privacy and security safeguards on personal health data, should be clearly communicated to the public to build trust. Pre-established response pathways and legal consequences for privacy breaches should be in place before requirements are implemented.

Similar to prior literature on PVCs, experts in this consultation expressed concerns about ethics and law, international standards and travel, and the scientific evidence behind these technologies and policies requiring them.[12] However, Canadian experts also shared with us strong population health concerns about social equity impacts of, and potential backlash to, PVC requirements—topics that have previously arisen in commentaries[4,13,14] and can now be subjected to empirical analysis of data generated by the programs. Our consultation did not delve deeply into specific technical standards (e.g. W3C) or tools (e.g. blockchain)[15]; however, it did raise questions and concerns regarding data privacy and security that should be subject to retrospective review and public accountability. While we enquired about any future uses of PVCs, including specifically probing about their use for "minor" (non-pandemic) outbreaks of vaccine-preventable diseases such as measles, participants were not supportive of broadening use beyond extreme cases such as another pandemic at this time. This consensus should be monitored over time, as such views may evolve with shifting norms about digital health technologies more broadly.

Limitations of this study include the cross-sectional nature of the study and the non-exhaustive sample. While the time period December 2021–April 2022 was an important time period during which PVCs were being discontinued for most uses in Canadian provinces and territories, and therefore a ripe period for reflection on the experience, data prospectively collected during PVC implementation or

with further time passed since discontinuation would certainly provide additional insights. While we sought a diverse sample of participants with expertise in multiple domains and familiarity with Canadian contexts, study participation by some who were likely the most involved in PVC decision-making was limited by virtue of their jobs being very busy during the COVID-19 pandemic and related use of PVCs. While traditional markers of study quality in quantitative research, such as reliability or validity, are not applicable to this methodology, we strove to achieve comparable classic markers of qualitative rigor: credibility, transferability, dependability, and confirmability[16] through participant verification of their transcripts, peer debriefing among researchers including reflexive conversations between the two interviewers, attention to negative cases, collaborative analytic procedures, use of verbatim quotes, collection of and attention to contextual information, and providing information about the research team in this report.

Given concerns regarding capacity and neutrality when governments assess their own programs, future research on the topic should be conducted at arms-length from governments, by independent academic researchers to establish credibility. One stream of research should retrospectively assess the successes and shortcomings of these PVCs in controlling the public spread of disease, encouraging vaccine uptake,[17] and impacting social inequities. The other stream should begin the process of public consultations on proof-of-vaccination technologies, to inform future uses of PVCs and improve accessibility and acceptability of any future efforts.

Conclusion

There is much to learn from this first major use of PVCs in Canada. There remains a lack of consensus regarding appropriate language and scope for digital proof-of-vaccination technologies, the respective roles of the technology sector versus government in design and implementation, and ideal parameters for future use. However, experts agree on many recommendations, including the importance of clear communication, including evidence-based rationale for the use of PVCs, multidisciplinary consultation including academic experts and the public, and the importance of pan-Canadian standards for accessibility and interoperability. Identified risks of use that emerged, and should be minimized in the future, include risks of coercion and backlash; threats to access, equity, and privacy; and impacts such as costs of the technology and workload burden of enforcement and fraud detection. A full post-pandemic scientific review of the impacts of these technologies on health and social equity should be combined with expert recommendations to improve communication, consultation, and common standards for any future use of digital proof-of-vaccination solutions.

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