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Communication tools to support public understanding and awareness of COVID-19 information

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ABSTRACT

Building evidence-based knowledge, and access to the right information at the right time, are critical factors in enhancing health and wellbeing within communities, particularly during a health crisis such as a pandemic. The COVID-19 pandemic required trusted information resources and effective communication tools to support public understanding and awareness of COVID-19 information. The COVID-19 Printables project was a collaborative initiative which aimed to design and develop a rapidly deployable and inclusive communication tool to inform diverse communities and populations about COVID-19 precautions and response. The Printables were initiated to fill a public health communication gap in understandable and accessible communication tools for lower literacy levels, and minority and marginalized groups, such as immigrant and refugee communities. A community based participatory approach supported the engagement of community members and frontline physicians in the design process, guided by health information behaviour and social inclusion frameworks. The project resulted in the development of a series of open access, easy to use, adaptable, and multilingual (40+ languages) printables that have been used widely from emergency departments to refugee services and community health centres, in Canada and worldwide. They have been used by over 40,000 people in Canada alone.

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Covid-19; participatory approach; public health; communication; information design

Introduction

The impact of the COVID-19 pandemic on public health required effective strategies in to support public understanding and behavior change on an unprecedented scale and timeline (Bin Naeem and Kamel Boulos 2021). There was limited knowledge,

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limited access to information, and limited effective public facing communication tools early in the pandemic.

With the rapid adaptation of emergency departments for COVID-19 cases, there was an urgent need for accurate and up-to-date communication tools to support public communication, for broad communication and at point of care (Norredam, Mygind, and Krasnik 2006). Although information became available from major public health organizations, it was not available in languages for groups who are most vulnerable, often written at a higher than grade 6 level, heavy on text, and not supportive of visual based communication for low to no literacy levels (Zachariah et al. 2022). While written materials are a valuable complement to health information (Coulter and Ellins 2007), visual-based materials are more effective in explaining health related information, especially for individuals with lower health literacy or language barriers (Galmarini, Marciano, and Schulz 2024), such as using icons with minimal text that may be most helpful in conveying health message (Schubbe et al. 2020). Although social media generally allows health information sharing more broadly to the general public, specific subgroups including refugees and recent immigrants may not have access to web hosted resources and are at higher risk for COVID-19 infection (Leung et al. 2023).

Many factors impact refugees' access to healthcare, including low awareness of available services; language barriers; cultural barriers, and structural barriers, including inadequate services for refugees' specific needs (Norredam, Mygind, and Krasnik 2006). In the context of COVID-19, refugees' physical living conditions, such as crowded living and communal spaces, contributed to an increased risk of infection. Individuals who have recently immigrated to Canada also contribute disproportionately to groups of essential workers who may be unable to properly practice social distancing (van Dorn, Cooney, and Sabin 2020). There was a need to develop specific tools to provide COVID-19 information that were inclusively designed for emergency departments, and, for frontline health workers and allied support services to use with immigrant and refugee populations. An accessible tool that provides clear information for identifying COVID symptoms, actions to take to prevent and minimize spread of the virus (i.e. social distancing, wearing mask, testing, and vaccination), and vaccination after care.

A group of clinicians and the Health Design Studio at OCAD University were collaborating on redesigning the discharge process after emergency department (ED) care when the pandemic was declared. The team temporarily redeployed to work on developing easy to understand educational materials for patients coming into the ED for COVID-19 suspected illness. To support this effort, in February 2020, the COVID-19 Printables project began between the the Health Design Studio at OCAD University, Unity Health Toronto, Access Alliance, and Alberta Health Services, and more recently Women's College Hospital, and 19toZERO. The project aimed to generate understanding around COVID-19 in an accessible, spreadable, and inclusive manner using infographics and simple language to serve a range of literacy levels. It aimed to provide easy to understand and low cost resources to communicate COVID-19 information and advice quickly and accurately, specifically for vulnerable communities.

The project used a rapid iterative design method, using principles of inclusive and participatory design to develop and validate the Printables (Clarkson et al. 2003). The project was informed by health communication theories that emphasize a true

understanding of the intended audience's needs, skills, and situational environment (Schiavo 2013). Health communication is transdisciplinary in nature and drawing on multiple disciplines. It can be achieved through a participatory process that involves all intended audiences and uses audience-specific message and channels (Schiavo 2013).

A participatory and community-first approach was used to engage community members and subject matter experts in developing the messaging from conception to delivery (Vaughan and Tinker 2009). Participatory approaches strongly rely on building trust and close collaborations, which was challenging during the socially distances pandemic context, especially when it involved marginalized or vulnerable groups such as refugees and new immigrants (Hall, Gaved, and Sargent 2021). However, the project partners and their network played a crucial role in involving the target audiences in the design process of the project.

The design of the Printables contrasts with existing communication resources by providing a collection of open access, downloadable, adaptable, multilingual, 1-page, black and white printable sheets for easy dissemination and adaptation for various settings such as emergency departments, COVID testing sites, or for digital dissemination. The Printables use a deliberately supportive reassuring tone, avoiding negative direction or phrasing. Since March 2020, nine evidence-based digital health communication tools (Printables) have been developed in over 40 languages and accessed from across Canada and North America, Europe, Australia, and China. The resources were updated based on public health guidelines and can be edited by staff at hospitals and clinics to adapt to their local guidelines and protocols. The project was spread over social media (Figure 2) via medical groups and physicians, and then picked up by refugee health programs, not for profit initiatives, community health centres and public health organizations. The endorsement of the Canadian Association of Emergency Physicians (CAEP), and the Canadian Institute for Health Information (CIHI) was pivotal in enabling smaller health centres and groups to confidently download, adapt, and use the Printables.

The evolving nature of the COVID-19 pandemic and changes in public health guidelines created a need for an iterative and flexible approach to the design process. Rapid changes necessitated the ability to quickly and consistently revise the Printables with the most up to date public health guidance and medical advice. The purpose of this paper is to present the design process and approach used for the Printables project and to contribute insights on effective strategies for designing health information resources during and beyond the COVID-19 pandemic, with a particular focus on newcomer and refugee populations.

Methods

The project applied a rapid iterative design method, using principles of inclusive design (Clarkson et al. 2003), information design (Pettersson 2010), social inclusion framework (Caidi and Allard 2005), and guided by best practices for designing effective communication tools for patients and family caregivers (Borba, Waechter, and Borba 2015; Waisman et al. 2005). This encompassed a community-first approach, engaging community members in the design, development, and testing of the Printables, as

well as the use of metrics and feedback surveys for tracking usage and priority setting. Research activities included:

1. Participatory design.
   An inclusive participatory approach (co-design) involved engaging subject matter experts and community members in the identification of project needs and evidence based guidance. Design studio members were engaged in the interpretation of communication, information design, social inclusion, and information seeking behaviour research and best practice (Caidi and Allard 2005). The community based participatory approach ensured the project credibility and usefulness by aligning it with the community's needs that significantly facilitate better practices (Molassiotis et al. 2022; Steen, Manschot, and Koning 2011).
2. Community Based Testing. Short open ended feedback (online) were conducted to validate community/culturally specific factors in the Printable designs.
   Three top priority handouts (Safety advice for COVID-19, Wearing a mask, COVID-19 Vaccine After Care) were tested to ensure the legibility of the icons with community members from high risk groups with varied literacy levels. Comprehension testing was used to assess more complex ideas that used graphic icons thisenabled unstructured feedback to validate community/culturally specific factors in the Printable designs.
3. Survey of Printable Use Among Health Providers and Organizations.
   The survey was developed to further understand the usage, effectiveness and improvement of the Printables project. Key objectives of the survey included:
   a. Factors enabling the adoption of the Printables among healthcare providers and community health units/centres/organizations.
   b. Factors limiting the uptake and use of the COVID-19 Printables
   c. Understand what could be changed or improved
4. Metrics Monitoring
   a. Website analytics – page visits
   b. Social media impressions - views, retweets, likes, and reach

   The Health Design Studio website analytics were used to measure the uptake of each Printable and language using bitly links associated to each Printable. Social media impressions and engagement on posts was used to understand the reach of a particular post and its correlation to increased traffic to the Printables project website. The organic reach of each post helped identify which hashtags were most effective for the promotion of COVID-19 Printables.

Sample and recruitment

A snowball approach was used to recruit the project partners and participatory design team including emergency physicians, public health specialists, epidemiologists, information designers, medical students, design students, family physicians, pharmacists.

The participatory design team changed as new needs emerged. A weekly virtual participatory design workshop with collaborative online editing (Google docs) was established from March 2020 to June 2021 to enable easy participation and contribution. The team used a purposive approach to recruitment within a convenience sample of community and refugee health clients, with recruitment facilitated by not-for-profit partners, for testing and feedback survey. Testing with open ended feedback was conducted in two phases. The first phase included 19 participants and focused on the COVID-19 Safety and Mask Wearing Printables. The second phase included 6 additional participants focusing on the Vaccine Aftercare Printable. Participants represented major age groups, gender, race/ethnic groups, and spoken languages. Participants had to be adults (18+) living in Ontario, available during the study time using a video conferencing platform, could provide informed consent, comprehend icons, and give feedback. Participants were invited to select a time convenient to them, and were provided a $30 giftcard following completion of the research activity. Each testing session and feedback took approximately 30 minutes to complete. Research ethics approval was sought and obtained from the Research Ethics Board of OCAD University protocol # 2020-61.

Data analysis

Descriptive statistics (number of errors in interpretation, and participant ranking of comprehensibility) were used to identify icons in need of further refinement, and metric interpretation (relative rank of Printable sheet by page views, relative rank of language needs by page views), and were used for basic survey data (likert scales for different design criteria) (Vandever 2020. The process facilitated the understanding of the research results and helped interpret qualitative feedback by identifying the most frequently selected icons and text in terms of comprehension and legibility issues following procedures in similar studies (Mohamadpour et al. 2024).

Qualitative analysis using an inductive approach, a conventional content analysis approach (Hsieh and Shannon, 2005) to identify commonalities of responses (content), patterns in responses (themes), and derive meaning from unstructured participant feedback on the Printables during testing, and for analysis of open-ended survey data. Two researchers reviewed notes and survey responses to identify commonalities among responses that indicated design refinements or enabling/limiting factors. This was achieved through comparative reading and grouping of responses. Unstructured feedback was deliberately limited to brief comments during testing and short entries in the survey targeted to specific questions, so rich analysis of themes and meaning typical of thematic analysis was not appropriate or possible using the data available.

Printables sheet design process

The Printables sheet design followed an iterative process. It involved the evaluation and improvement of the design work through an iterative process of prototyping, obtaining feedback, and revising designs. The process allowed experimentation with the information design of the sheets (i.e. message, layout, and icons) to ensure the

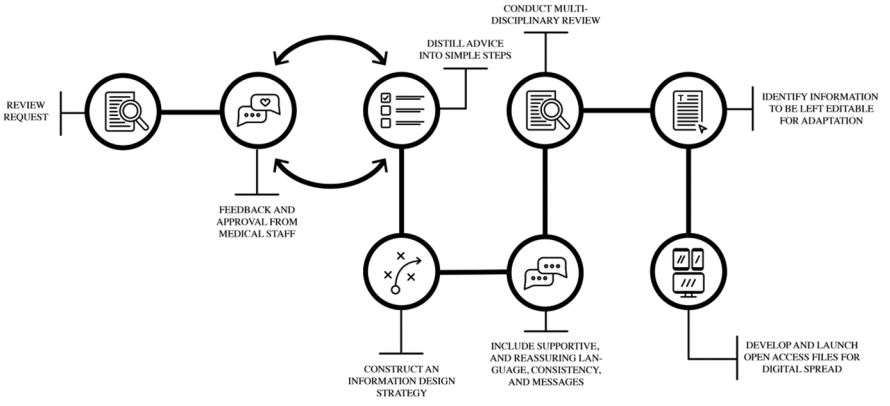

Figure 1. Printables sheet design process diagram. Source: Authors.

final design is an effective visual communication that resonates with the target audience (Ivanova 2024). Figure 1 provides an overview of the sheet design process with a description below.

The design process used, maps to the Double Diamond Model: discover phase (in identification of project needs and evidence- based guidelines), define (interpretation of communication and information design), develop phases (iterative process of testing) and deliver phases (online dissemination) of the Printables (Banathy 2013).

The process consisted of 8 steps beginning with a review of requests from the community to describe the requirements and rationale for the development of any given Printable. Next, a multidisciplinary participatory team, including medical experts, reviewed the requests, validated the need among project partners, and identified evidence based guidance for content. Subsequently, heavy text-based guidance was distilled into low literacy level language style, with matching concepts for simple, friendly, flexible, and inclusive icons. An information design strategy was established to structure the steps of all Printable designs based on the idea of experience (ex. Leaving your apartment), place (ex. Isolating at home), or state (ex. Feeling worse). Content was reviewed and refined to ensure the language was simple, consistent, supportive, and reassuring. Once an initial draft was complete, designs underwent a multidisciplinary review including physicians, public health and patient experience specialists. Upon consensus, areas to be left editable for adaptation to local guidelines, contacts, or useful resources were identified. Finally, the design was translated and developed into priority languages and launched as open access files for digital spread, downloading, and printing under a creative commons licence.

Results

Overall results of the project

The Printables project resulted in the development of nine open access, online, adaptable/customizable, easy-to-use, one-pagers, translated into over 40 languages. The Printables rapidly met communication needs through a combination of design features (Figure 2) for nine key COVID-19 topics including: COVID-19 Self-Management,

- One page
- Black and white printable sheets
- Plain and supportive language
- Reassuring tone
- Infographic style
- Multilingual: community partnership to develop translations
- Open access and downloadable
- Editable and customizable for local adaptation
- Multi-media use: printouts, posters, digital media

Figure 2. Key features of the printables. Source: Authors.

COVID-19 Self-Isolation, Testing for COVID-19, Physical Distancing in Apartments, COVID-19 Terminology Differences, COVID-19 Hospital Visitation, Wearing a Mask, Safety Advice for COVID 19, and COVID-19 Vaccine After Care.

Survey feedback and testing results

The Printables development process included usability/comprehension testing and survey based feedback which resulted in the improvement of various sheets and icons to create more inclusive and accessible communication and ensure comprehension of the iconography.

Survey results

The survey participants consisted of 15 people, including physicians (5), emergency department physicians (4), registered nurses (2), including emergency department registered nurses (2), a clinical coordinator (1) in a COVID assessment centre, and a pharmacy executive assistant (1).

Most survey participants described the demographics they serve as 'diverse' and as a 'broad spectrum'. Other participants were more specific in stating they serve demographics that are broad in age, speak many languages, many experiencing homelessness, lower education and income, and often English not being their first language. Survey participants expressed that features such as:

- clear and simple instructions, terminology,
- graphic icons,
- minimal text,
- the availability of many languages,
- easy to explain, and quick to read all in one page, were key reasons why they would choose the Printables over another resource.

However, one participant raised the issue of 'risk management and communication aversion' for resources that do not come from an official public health source. The immediate timely availability of the sheets was an important factor in using the resource as the knowledge and circumstances surrounding the pandemic were rapidly changing and resources required rapid updating. One participant said they 'used

whatever I could find on the day - if something was printed and available in my area, I used that over something I had to search for'. The majority of participants said they printed out the Printables to be available as a handout for patients and three participants said they added the Printables to their department website/intranet for healthcare providers to download and use. Most participants agreed that the Printables were delivered in a way that was appropriate for their practice, organization, or unit. This was important to note as the intent of the Printables was to make them easily accessible online and printable with basic printing capacity on a single page rather than multiple pages or requiring professional production. It was also expressed that the Printables were more simple compared to public health resources, noting that 'too many words or too much info can become a barrier instead of a help'. Two participants however, mentioned they were unable to implement the Printables in their setting due to the risk management of using a resource that seemed unofficial despite the professional endorsements and collaborations. The results of the survey pre-date some of the subsequent sheets that were developed which saw significant uptake such as the Vaccine After Care Printable.

The survey feedback and testing supported further the participatory approach taken both for individual Printables content and the direction of the overall project. Testing and interviews were conducted in two phases. The first phase included 19 participants and focused on the COVID-19 Safety and Mask Wearing Printables. The second phase included 6 participants focusing on the Vaccine Aftercare Printable. Participants (50% of the total sample) were recruited from members of the Immigrant Researchers Support Network (IRSN) who are internationally trained newcomer researchers. Half of the participants were recruited from the clients (21%) and members of the Community Reference Group (29%) of Access Alliance. Participants represented major age groups, gender, race/ethnic groups, and spoken languages.

Comprehension testing Round 1

Participants were presented with the 'Safety advice for COVID-19' and subsequent 'Wearing a mask' Printables sheet (Figure 3) with the text redacted to keep focus on the icon comprehension.

Participants had an overall positive attitude toward the safety and mask wearing printables. 'If they were taken together they would be a full picture' (P8). One participant said 'it's self-explanatory' (P23), and while many had particular recommendations to improve individual icons within each sheet, the Printables icons were well-understood without the need for text but required some adjustments. Supplementary Appendices A and B outline the icon comprehension results of the 'Safety advice for COVID-19' and 'Wearing a Mask' Printables. Where results indicated poor comprehension with a relatively high 'No' (N) response, the team reviewed feedback to determine ways to improve icon legibility and comprehension.

Comprehension testing Round 2

The 'COVID-19 Vaccine After Care' Printable was the focus of the second round of testing. The second round of testing consisted of three parts including the 'COVID-19 Vaccine After Care' Printables for testing comprehension, an A/B test (Figure 4) to

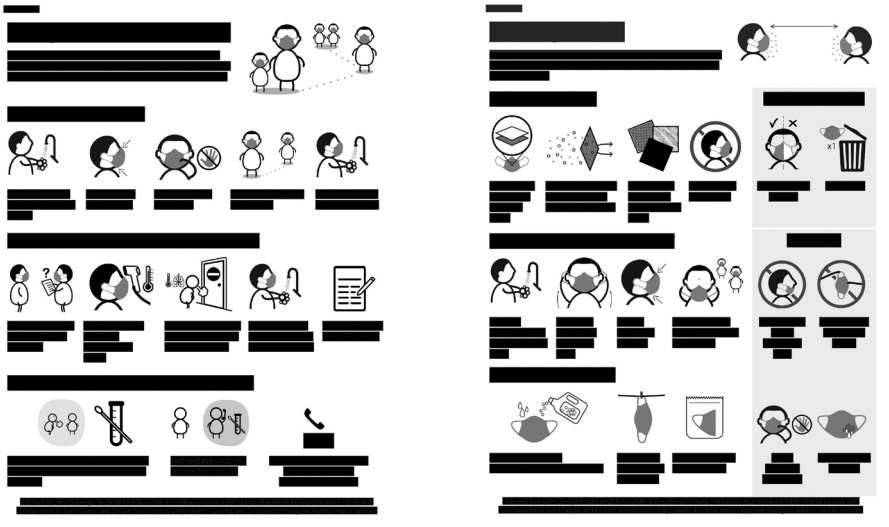

Figure 3. 'Safety advice for COVID-19' and 'Wearing a mask' redacted printables comprehension testing sheets. Source: Authors.

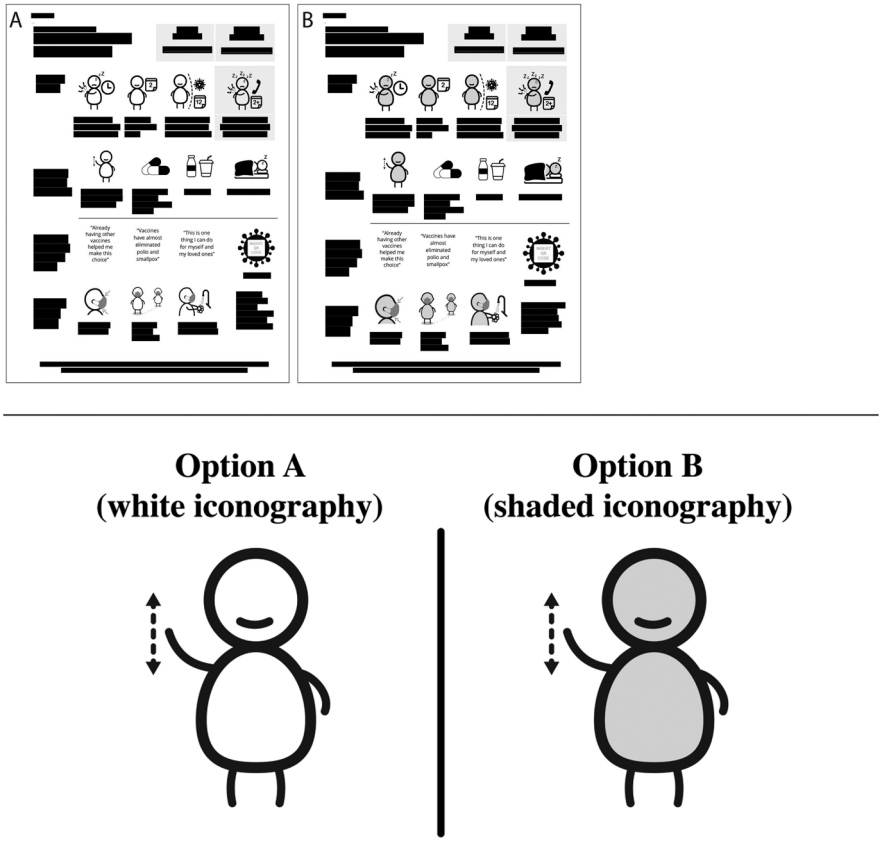

Figure 4. 'COVID-19 Vaccine after Care' redacted printable comprehension testing sheet a/B options. Source: Authors.

Overall feedback on the 'COVID-19 Vaccine After Care' Printable was positive but the icons presenting new concepts related to COVID-19 and Vaccine After Care resulted in low comprehension and required refinements. Participants also mentioned that it was difficult to interpret some icons without supporting text. Supplementary Appendices C indicates the results of the icon comprehension test. It was notable that icons that were used in previously tested Printables had relatively high comprehension scores. The QR code on the Printable was not interpreted as intended without supporting text. As part of the iterative process for the Printables, the icons were revised and refined to more clearly communicate the intended messages based on participant feedback. The testing illustrated that the supporting text was helpful and sometimes necessary where complex messaging was portrayed in a single icon.

Website traffic results

The use of the Printables was tracked over time through website traffic analytics and social media impressions. Supplementary Appendices D indicates the rankings for each printable by number of requests and the top 10 languages for each based on website traffic. Website traffic data showed Printables were requested from various locations around the world including the United States, Australia, France, China, Jordan, Vietnam, India, and the majority coming from Canada. It is important to note the limitations of the data collected from the Health Design Studio website which does not provide a fulsome picture of the actual usage and spread of the Printables. The website data only tracked page visits and downloads. Beyond the download, the adaptation, printing, and distribution of the Printables could not be tracked due to the open access availability and nature of organic sharing of the resources outside of the website. The spread and use of the Printables is much broader than the data we collected suggests.

Initially created for emergency departments with existing project partners, who requested resources for different literacy levels, and diverse groups whose first language is not English, the Printables quickly spread to community and refugee health networks. An adaptable participatory approach enabled us to engage with refugee services (i.e. Access Alliance r*efugee services partner, is part of a national collaborative of 15 organizations working with resettled refugees*) and community partners uncovering specific needs and gaps to deliver meaningful resources for immediate needs. Part of this process included receiving requests directly through the Health Design Studio website for priority communication needs and languages as the pandemic progressed and the project was shared. Requests included issues related to specific settings or experiences, such as COVID information relevant specifically to apartment building living, and for specific groups, for example one request read, 'people from the Eritrean and Ethiopian communities in Canada that would benefit [from the resource]… [and that] it is more challenging to access Kurdish and Rohingya but many of the people speaking these languages are incredibly vulnerable'. The COVID-19 Safety Measures and the Mask Wearing Printables arose out of these website requests to urgently support public understanding of what to do to keep safe. 'We need (resources) with regards to Covid-19 safety measures… such as wash your hands, wear a mask, sneeze into [your] elbow, don't go out unnecessarily, etc'. Requests were often time sensitive with the changing nature of the pandemic 'as numbers [were] sky rocketing amongst the community'. New languages and

Figure 5. Health design StudioTwitter posts. Source: Authors.

Printables were rapidly added to address various community and language needs where gaps were identified in availability of public health messaging and guidance.

The Printables are endorsed and digitally circulated nationwide by the Canadian Association of Emergency Physicians (CAEP), Canadian Institute for Health Information (CIHI), through many smaller community health partners, and task forces, in addition to a national collaborative of 15 organizations working with resettled refugees (Access Alliance Multicultural Health and Community Service). The endorsements enabled smaller health centres and groups to confidently download, adapt, and use the materials. This enabled the quick spread of the Printables to reach refugee and newcomer communities. The Printables are also available on the Health Design Studio website and were disseminated through social media via medical groups and physicians (Figure 5). They have been used widely from emergency departments, to refugee services and community health centres, both in Canada and worldwide. Resources were regularly updated, based on evolving public health guidelines and could be edited by staff at hospitals, clinics and centres to adapt to their local guidelines and protocols. The Printables project was awarded the International Institute for Information Design (IIID) COVID-19 Prize (16–17) and Silver IIID Award 2020 (132–133) recognizing its contribution to supporting community level response and increasing awareness of COVID-19 through information design, specifically notable is there use in vaccination sites in Toronto's most vulnerable neighborhoods and mass vaccination events (Scotiabank Arena Vaccination Clinic). During this mass vaccination event over 25,000 people received vaccinations, and the COVID-19 Vaccine After Care Printable was handed out in 10 different languages.

Discussion

The COVID-19 pandemic required communities to embark on a public health response at an unprecedented scale and timeline. It is evident that misinformation spreads rapidly when access to information resources is slow, and credible information is hard to come by Bin Naeem and Kamel Boulos (2021). 'Communications in a public health crisis are as crucial as medical intervention. Effective health communication plays a critical role in speeding up the flow of information and

building trust among people regarding health information sources and services' (Bin Naeem and Kamel Boulos 2021). During crises, such as a pandemic, 'The ability to rapidly communicate with and meet the needs of diverse multicultural populations became essential for effective COVID control and for supporting more equitable COVID-19 outcomes for underserved populations' (Zachariah et al. 2022). Since public health typically relies on printed materials for sharing information, most health information documents are in print format, which might be because of the need for resources that are easily accessible and tangible, allowing better distribution in clinics, emergency department, and community spaces where people can readily use them (Shieh and Hosei 2008). Frontline health workers, allied support services, and community partners needed accessible, easy to understand and inclusive tools to communicate COVID-19 information and advice quickly and accurately to a diverse community group, specifically high risk and vulnerable populations, such as refugees and newcomers. Therefore, the project used print format to design information sheets that provide better distribution, access and engagement (Shieh and Hosei 2008).

The Printables project initially started as a continuation of a patient communication project for EDs and shifted into a broader communication tool for refugee, immigrant, and underserved populations. This shift was a response to an urgent need for accurate, resilient, and up to date communication tools to address lack of awareness of available services; language barriers; cultural barriers, and structural barriers (Norredam, Mygind, and Krasnik 2006).

The project is situated amongst other existing works, including the Emergency Design Collective ('Emergency Design Collective' 2020), Toronto COVID Collective ('Toronto COVID Collective' 2020), and the COVID-19 Health Literacy Project in collaboration with Harvard Health Publishing ('COVID-19 Health Literacy Project' 2020), mostly focus on reaching healthcare providers. Among those, the COVID-19 Health Literacy Project is the only one that provides resources in 30+ languages. Although this project provided language diversity, the resources available did not feature graphics nor accessible, inclusive language in their design.

The project aimed to address a critical gap in available resources and build capacity for community health, emergency medicine, COVID-19 vaccine sites, and among refugee health organizations to promote access to information.

This was done using a participatory approach that involved all stakeholders in the research, design, and development phases of the Printables sheet design process. The inclusive and interdisciplinary project team was responsible for reviewing various sources of evidence, information, and perspectives, including the latest academia and gray literature (iterative revisions and updates based on evidence), informal accounts, blogs, and expert voices (e.g. social media scan of emerging practices and official public health messaging). This collaborative effort resulted in the easy-to-understand, infographic based, plain language, engaging communication tools on critical information for COVID-19 safety precautions, vaccine aftercare, and support for positive conversations with peers or family who may be vaccine hesitant (Cortinois 2008; Zanchetta and Poureslami 2006).

Key to this work has been community partnership with Access Alliance Multicultural Health and Community Service who have been integral in translation services,

disseminating across refugee health and community health networks, hosting the Printables on RioMix (Multilingual Information Library (Access alliance, 2021)), and facilitating participation of community members and Access Alliance staff. This close collaboration has been successfully growing over the course of the pandemic leading to more connections and collaborations across networks (e.g. COSTI, Refugee 813, COVID 19 to Zero) and public health units (e.g. Guelph, London, Sudbury, Alberta Health Services).

Access Alliance played a crucial role in the rapid scaling of the project in identifying and validating key needs and gaps, which led to orienting the Printables beyond public health identified needs and further toward refugee and marginalized groups.

The Printables used visual communication best practice in the form of narrative and visuals, text, and storytelling (Kearns and Kearns 2020). Visual communication relies on concepts of visual literacy (capacity to communicate complex concepts), visual thinking (the way mental images are classified for meaning) and visual learning (considering the process of awareness, meaning and learning) (Rodríguez Estrada and Davis 2015). Graphic and information design played an integral role in the Printables to 'effectively communicate with a culturally and linguistically diverse population' (Roberts 2020) regardless of level of literacy. Perception and information processing are defined as the process of recognizing, organizing and interpreting sensory information to help understand a situation and environment (Goldstein 2010) and influence the decision making process. Under high stress, such as the pandemic, the capacity to perceive and process information may be reduced (Hancock and Szalma 2003), resulting in the need for relevant information to be presented in ways that can easily be understood and perceived as relevant in the immediate situation. Instructional or information design for high stress situations in both print and digital forms should consider gestalt principles and comply with accessibility standards to ensure information is accessible and digestible. These principles as applied to the Printables attempt to address cognitive, sensory, social and cultural barriers through guiding principles such as the use of plain language, chunking of information and information hierarchies, high contrast foreground and background colors for maximum visibility and readability for vision impairments, as well as quickly recognizable visuals (Moore and Fitz1993).

A dissemination strategy was critical to the success of the project to ensure the Printables reached the intended audiences and was easily accessible and shareable using digital platforms such as social media. Although social media generally allows academic information to be shared more broadly to the general public, but specific subgroups such as refugees and recent immigrants still may not have proper access to the knowledge being disseminated. Therefore, Social media has played a crucial role in the dissemination of the Printables among healthcare workers and providers who serve and support these groups. The optimal utilization of this digital tool helps to build and improve community resilience through providing access to constructive information and fighting misinformation (Banerjee and Meena 2021). Social media was integrated as a tool to rapidly disseminate the Printables to broader audiences using specific hashtags relevant to COVID-19 and trending topics around public health messaging.

As the pandemic progressed, the Printables project continued to support communication and knowledge translation needs under changing circumstances and public

health measure updates and recommendations. Addressing the emerging gaps and needs, iterative testing and evaluation processes played a significant role in the development of the Printables throughout the pandemic.

The testing and evaluation process was employed to ensure the delivered information was useful, usable, desirable, findable, accessible, and credible (Moreville, 2014). The process enabled the project team to discover if potential participants understood the desired communication content, including key messages, recommended tips, images, and multimedia that were used (Halvorson, 2012). Tracking helped the team prioritize key languages to focus on, which printables to prioritize in updates, and for the development and translation of new sheets. At the beginning of the pandemic, the COVID-19 self management and COVID-19 self isolation Printables were used the most and as the pandemic progressed and public health guidance evolved, other sheets such as the testing for COVID-19 and Vaccine aftercare sheets showed significant use. For example, the 'Testing for COVID-19' Printable saw an uptick in usage once testing for COVID 19 was more widely accessible and its usage dissipated when testing centres were phased out.

One of the project's limitations included the lockdowns and limited access to on-site locations, and knowledge about the Printables usage, where it was not reported or seen. In addition, since the sheets are open access, we do not have full visibility of how, when and where sheets were used. The priority use of public health or city developed information sources was another limitation that impacted the uptake of the sheets.

Despite the given limitations, the project has resulted in the design and development of a series of open access, web delivered set of adaptable, printable 1-pagers in plain language, infographic style on key communication needs, in multiple languages. The COVID-19 Printables proved to be clear tools to support communication and public understanding and met the need for easy-to-understand instructions in the greatest number of languages. They are widely used in emergency departments, refugee health clinics, and community health centres, both in Canada and worldwide. While we were able to conduct community-based testing focusing on comprehension and legibility, a different type of study may be required to anser questions of the efficacy of the Printables. This would require a randomized controlled trial to compare baseline (text heavy existing printed materials) with the Printable's alternative. This would need to be done per Printable i.e. by health behaviour or outcome intent for example adoption of preventive strategies or efficacy of at home care for COVID symptoms. Such trials would be costly and complex to construct. It is open for debate the relative merits of running such trials on communication materials based on prior knowledge and disciplinary standards (applied cognitive ergonomics, information design, and evidence-based content). The next steps for the Printables project include strengthening the existing project by building capacity in community health, and refugee health organizations to promote the acceptance of ongoing vaccines. This includes continuing work with community partners to secure translation of communications, turning top priority languages into digital animations with voiceover, and to co-design digital mechanisms for accessing and spreading the support.

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Data availability statement

Aggregated data is available upon request in accordance with the ethics protocol for this study.

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