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Rapid summary

Question:

What digital systems could be used outside healthcare settings to book appointments, record vaccine administration and link this information to core health service records?

Brief summary:

Four primary research papers, two conference abstracts, one commentary, and one report were identified from a search of the literature conducted in June 2020.

In summary:

The literature that we have identified is limited. Besides, some of the papers were published eight years ago therefore it may not reflect recent technological advances.

The technologies covered by these papers ranged from mobiles apps and online platforms for data management, scannable forms for data collection, online client appointment systems to book appointments for mass vaccination, to scanning technologies applied to read barcodes of vaccines and driver licenses. The findings in relation to these technologies are detailed in the data extraction tables below.

The included research has not been assessed for quality and comes from a wide range of published material.

Next steps could be to contact identified organisations to access their expertise in this area.

Methods

A search of databases and grey literature and screen (details available on request) identified eight sources relevant to this question. The majority of screening was conducted by a single reviewer though consistency checks on over 20% of the records were conducted. No critical appraisal of the included sources was undertaken. Only sources from OECD countries, Hong Kong, Singapore and Taiwan were included. We looked at evidence from these developed countries because findings from these are more likely to be generalisable to the UK.



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Findings

Included sources were eight papers which were four descriptive studies, one commentary, one report, and two conference abstracts.

Information from these sources which are relevant to these questions has been extracted in the tables provided in the data extraction section. Two tables are presented where articles have been grouped by type.

Limitations:

This summary may be useful to identify key points on the topic however the included research has not been assessed for quality and comes from a wide range of published material.

Next steps:

To further inform a response, one or more of the following options could be undertaken:

We have identified several papers describing the experiences of several organisations while conducting mass vaccinations. We consider it could be useful to contact the following organisations for further/updated information, learn from their expertise and experience of digital systems during mass vaccination campaigns and perhaps gain insight into their plans for data management during COVID-19 prophylaxis:

- Denver Public Health for mobile applications and online platforms for information about data management in mass vaccination clinics.
Melissa W McClung
Epidemiologist, Epidemiology and Preparedness
Melissa.McClung@dhha.org. Phone: 303-602-3264
Website: <http://www.denverpublichealth.org/>
- Philadelphia Department of Public health for information about electronic data capture and driver license scanners.
Jessica Caum
Program Manager, Bioterrorism & Public Health Preparedness Program
Email: Jessica.caum@phila.gov
Website: <https://www.phila.gov/departments/departments-of-public-health/>
- Contact CANImmunize for information about digital platform to book appointments and record vaccine administration by the patients.
Website: <https://www.canimmunize.ca/en/home>
- Contact the Institute for Clinical Evaluative Sciences, Toronto for collection of individual-level data at the point of vaccination



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General information on immunisation systems

We identified a handbook about how to design and implement immunisation information systems (IIS), developed by the ECDC. This handbook collected examples of IIS from several European countries.

European Centre for Disease Prevention and Control (ECDC). Designing and implementing an immunisation information system Stockholm: ECDC; 2018
Available from: <https://www.ecdc.europa.eu/en/publications-data/designing-and-implementing-immunisation-information-system-handbook>.

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provided it is done so accurately and is not used in a misleading context.

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Data extraction:

The tables below give the reference of the paper, access to the paper where freely available, key relevant findings, any considerations that arise and any caveats to bear in mind about the quality or limitations of the included articles.

Primary research published in peer-reviewed journals		
Reference	Summary of Content	Comments
<p>1. Pereira JA, et al. Exploring the feasibility of integrating barcode scanning technology into vaccine inventory recording in seasonal influenza vaccination clinics. Vaccine. 2012;30(4):794-802</p> <p>Available here</p> <p>Feasibility study, Canada</p>	<p>This feasibility study examined the use of barcode scanning for the vaccine inventory in mass vaccination clinics in Canada during the 2010-2011 influenza vaccination campaign. Ontario public health units (PHUs) using an electronic immunisation system were randomised to record clinic inventory data (including vaccine lot number and expiry date): (i) barcode scanning of vials; or (ii) drop-down menus. A third group of PHUs recording vaccine inventory on paper served as an observation arm. A sample of clinics within each PHU were visited to assess barcode readability, method efficiency and data quality. Clinic staff completed a survey examining method perceptions</p> <p>The authors noted that the barcode scanning was more time consuming than the other options. Meantime spent recording data per vial was 4.3 s using barcode scanners with 1.3 scan attempts per vial, 0.5 s using drop-down menus, and 1.7 s using paper. Few errors were observed.</p> <p>The majority of the barcode scanning users reported satisfaction with the methodology and a perception of increased patient security. Nevertheless, some scanning users perceived that the process was more time-consuming than other options and being a discouraging factor for its adoption. Sixty-four perception surveys were completed by inventory staff; barcode scanning users indicated fairly strong overall satisfaction with the method (74%), and the</p>	<p>This paper is a feasibility study conducted in 2011 in Canada. The barcode scanning technology and the process may have been changed/improved since 2011.</p>

	<p>majority agreed that barcode scanning improved client safety (84%) and inventory record accuracy (77%). However, 38% of barcode scanning users felt that individually scanning vials took longer than the other approaches and 26% indicated that this increased time would discourage them from adopting the method.</p> <p>The authors concluded that although the barcode readability was good the process should be modified to be implemented in Canada.</p>	
<p>2. Heidebrecht CL, et al. Incorporating scannable forms into immunization data collection processes: a mixed-methods study. PLoS one. 2012;7(12):e49627.</p> <p>Mixed method study, Canada</p> <p>Available here</p>	<p>This article describes a feasibility study implementing scannable forms for the immunisation data collection in two vaccination settings in Ontario during the 2011-2012 influenza immunisation campaign. One of the settings was a local public health department serving the general population and the other center was a continuing care organisation administering influenza vaccines to employees.</p> <p>The study used observations, records audits, staff interviews, and client surveys and assessed the feasibility of scannable forms by examining data quality, efficiency, and usability.</p> <p>Databases were developed and adapted to the specific needs of each center to receive the data from the scannable forms. The continuing care organisation used an Access database and the local public health department selected Microsoft SQL Server (MSSQL) due to their higher demands for the quantity and quality of the forms and a more complex data management.</p> <p>The data flow followed the next steps:</p> <ol style="list-style-type: none"> 1. Form completion 2. Scanning 3. Verification 4. Automated transfer to the database. 	<p>This paper is a feasibility study conducted in Canada in 2011. The technology used in this study and the process followed may have been improved during the last ten years.</p> <p>The settings where this study was conducted had significant differences in terms of volume of work, data management, users and quality demands. These differences could have affected the results observed in this study.</p>

	<p>The authors observed that the results were mixed for the efficiency measured in time required for the process and the usability measured by the user's perceptions. The mean time required to scan and verify forms (62.3 s) was significantly shorter than manual data entry (69.5 s) in the local public health department, whereas there was no difference (36.6 s vs. 35.4 s) in the continuing care organisation. Record audits revealed no differences in data quality between records populated by scanning versus manual data entry. Data processing personnel and immunised clients found the processes involved to be straightforward, while nurses and managers had mixed perceptions regarding the ease and merit of using scannable forms. Printing quality and other factors rendered some forms unscannable, necessitating manual entry.</p>	
<p>3. McClung MW, et al. Managing public health data: Mobile applications and mass vaccination campaigns. J Am Med Inform Assoc. 2018;25(4):435-9.</p> <p>Descriptive, US</p> <p>Available here</p>	<p>This article describes the use of a mobile application called Handheld Automated Notification for Drugs and Immunizations (HANDI), an online platform, Flu Tracker, for the data collection during the Denver Health's employee influenza vaccination campaigns between 2012 and 2015 in the US.</p> <p>The HANDI app was developed as an Apple iOS mobile app supported by a Microsoft Windows Server and SQL server database. A peripheral scanner encased an iPod Touch to scan magnetic stripes and barcodes. A web-based application was developed, Flu tracker, to assist with the employee preregistration, vaccine consent, and reporting functionality. These applications facilitated the use of mobile vaccination venues for the campaigns.</p> <p>The study compared the results from the DH's vaccination campaign in 2011 (pre-HANDI) with the first campaign using HANDI and Flu tracker in 2012. The researchers observed a reduction in the number of staff and mass clinic time required to vaccinate the employees. in 2011, 3110 employees were vaccinated by 12 clinic staff during 98 clinic hours, and in 2012, 3512 employees were vaccinated by 6 clinic staff during 73 clinic hours.</p>	<p>The authors noted that a significant limitation of this study was the inability to compare pre/post accuracy and timeliness measures.</p>

Subsequent vaccination campaigns in 2013, 2014 and 2015 showed a further reduction in the mass clinic time and staffing and found a significant increasing trend in employee vaccination per hour. From 2012 to 2015, vaccinations administered off campus increased from 27% to 63%. HANDI's users reported satisfaction with the app making the data entry easy and quick.

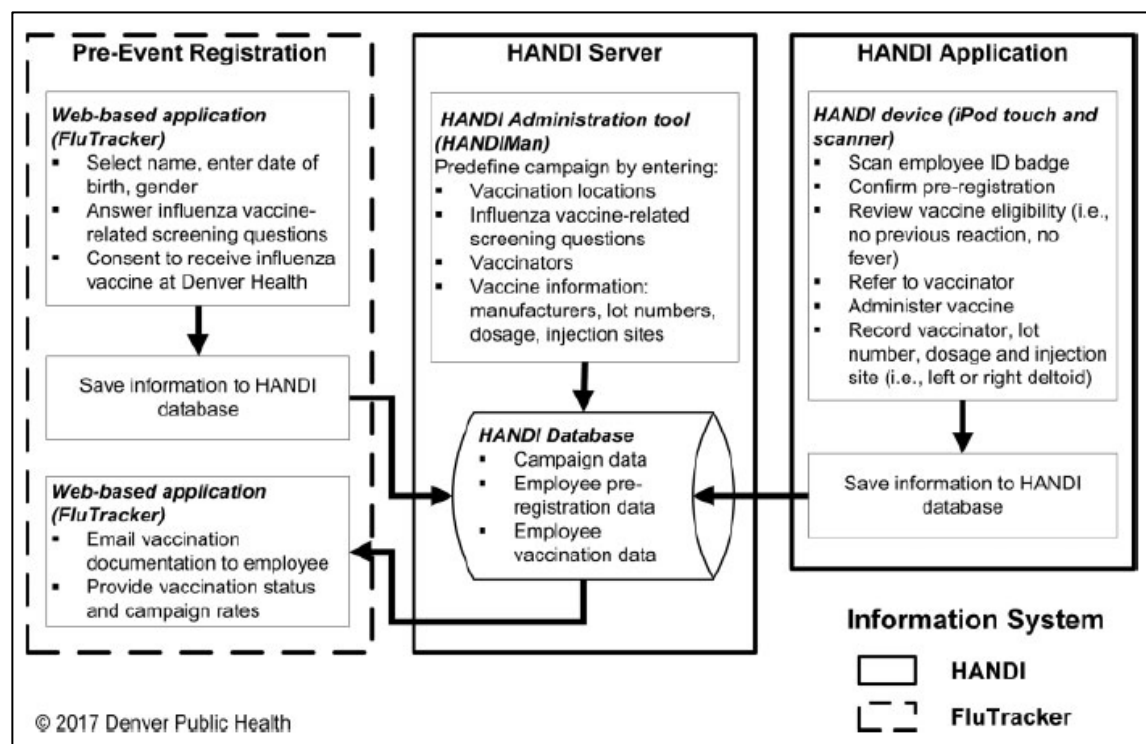


Fig. 1 Denver Health employee influenza campaign information systems and data flow.

4. Caum J, Alles S.
 Ready or not: analysis of
 a no-notice mass
 vaccination field
 response in Philadelphia.
 Biosecurity bioterrorism.
 2013;11(4):262-70.

Descriptive, US

Available [here](#)

This paper reports a no-notice, unscripted mass influenza vaccination field response for students at an all-boys boarding school in Philadelphia in 2013. Philadelphia Department of Public Health's mass vaccination model typically uses a 3-person team (vaccinator, drawer, and data collector) and a range of vaccination stations depending upon the scale of the response.

At 10:00 a.m. on January 24, 2013, program staff were notified via group text messaging system that an urgent vaccination clinic would be occurring that same day. Within 1 hour of concluding the planning meeting, program staff secured vaccine, updated the vaccination administration record database, and gathered all of the necessary technology and ancillary supplies. The vaccine administration record database was developed from a pre-existing influenza vaccination clinic database, but it had to be customised for use at the school, a process that took 35 minutes.

52 students were vaccinated with no adverse events in 54 minutes and the model was saturated providing a steady stream of work for the vaccination team until completion.

The paper notes that PDPH's Public Health Preparedness program has been using electronic data capture in the field since 2011 when driver's license scanners were procured and a corresponding vaccination administration record database was developed for use during PDPH's annual first responder influenza vaccination clinics.

PDPH has found that electronic data capture in the field facilitates accurate and efficient recordkeeping, as vaccination records can be imported directly from the custom-designed Access database to the KIDS registry (the citywide electronic tracking system used to store all immunisation records in Philadelphia). During past mass vaccination responses, such as H1N1, paper forms were used, and these had to be scanned in or the data manually entered, a process that was extremely time consuming and could introduce a litany of user errors. Although the driver's license scanners were not very useful at the school because of the age of the population (only 6 licenses were scanned), demographic data could still be manually

	<p>entered into the database, and the records collected at the clinic were shared with KIDS registry administrators the next day.</p> <p>Authors noted that PDPH expects that a significant number of people who present to points of dispensing (PODs) in the event of bioterrorism will either be adults who have driver's licenses that can be scanned or minors who are accompanied by adults, in which case the adult's license can be scanned and the minor's name and date of birth can be manually altered as necessary.</p> <p>Customising the database for use at the school was delayed in part by the vaccine ordering process as the manufacturer information and lot numbers needed to be pre-populated in the database before deployment. Also, evaluators recognised that a gap existed in database design knowledge as only 1 staff member was familiar with making changes to the back-end of a Microsoft Access database. To expedite future field responses that require electronic data capture, exercise participants agreed that multiple staff members should be trained in this function.</p>	
<p>5. Fediurek J, Tober J, Aly E. P122 A Cost Analysis of the Efficiency of H1N1 Mass Immunization Clinics. Can J Infect Dis Med Microbiol. 2010;21(4):173.</p> <p>Conference abstract, Canada</p>	<p>This conference abstract shows the cost-effectiveness and efficiency of H1N1 mass immunisation clinics and the implementation of an online client appointment system to automate client bookings for H1N1 vaccination in a mass vaccination clinic. Clients could access the system from the internet and were able to self schedule an appointment for a convenient time and location. The number of appointment slots was regulated based on staffing and vaccine availability. An electronic documentation system was used to facilitate client entry and minimise the time required for nursing documentation.</p> <p>A total of 36,636 doses of H1N1 vaccine were delivered through 136 community clinics by local health unit staff. The average time for delivery of vaccine was 5 minutes per dose per nurse for a total time for clients of 20 minutes, including a 15 minutes post-immunisation wait</p>	<p>This conference abstract has limited information and is reporting a study conducted in 2010. However, it gives some information about the efficiency of using an online client appointment system for a mass vaccination clinic.</p>

<p>Available here</p>	<p>time. At a Ministry reimbursement of \$10.00 per dose, 38 clients per hour was a cost break-even point when salary, supplies, facility costs and miscellaneous expenses were taken into account. Clinics operated at 100+% capacity with a throughput of 60 clients per hour when fully functional.</p> <p>The authors concluded that the use of an online appointment system demonstrated a cost-effective strategy for efficient scheduling of staff and provision of immunisations based on vaccine supply. An electronic documentation system enhanced the ability to provide mass immunisation clinics in a manner which maximised client volume and minimised client wait and procedure times.</p>	
<p>6. Manning K, et al. Implementation of a Mobile Device Application to Reduce the Burden of Employee Influenza Vaccination Documentation. American Journal of Infection Control. 2017;45:S83.</p> <p>Conference abstract, US</p> <p>Available here</p>	<p>This conference abstract reports about the implementation of a mobile, web-based application during the annual employee vaccination in several vaccination clinics during 2016. Patient information, informed consent and vaccination administration was uploaded to the app. The app automatically documented vaccination compliance and generated reports for the National Healthcare Safety Network (NHSN) in the USA.</p> <p>893 employees received the influenza vaccine during this study. The authors concluded that the vaccination clinics that used this mobile app eliminated the paper supply cost and time for the data entry, reduced redundant data entry and helped to send faster the vaccination compliance forms to the directors and the NHSN.</p>	<p>This conference abstract has limited information and is reporting a study conducted in 2016 in the USA.</p> <p>There is not enough information in this abstract to know if the vaccination clinics were in health care settings.</p>

Reviews, commentaries, expert opinion		
Reference	Summary of Content	Comments
<p>7. Houle SK, Atkinson K, Paradis M, Wilson K. CANImmunize: A digital tool to help patients manage their immunizations. Canadian Pharmacists Journal/Revue des Pharmaciens du Canada. 2017;150(4):236-8.</p> <p>Commentary, Canada</p> <p>Available here</p>	<p>This article publicises and promotes the use of CANImmunize by pharmacists in Canada. The immunisation services in Canada are offered in several settings including schools, pharmacies, clinics and hospitals so this app/platform lets patients manage their immunisation records.</p> <p>CANImmunize is a free bilingual app and digital platform for Canadians to keep track of their vaccination records. Other features that this app/platform offers are creating records for all the family, customised appointments for all the family, receive reminders, patient information about vaccinations and outbreaks in their local areas.</p> <p>The company is collaborating with government partners to modernise the immunisation system. Some residents in Ontario can easily report their children's vaccination records to their public health units. More information can be found on the company's website: https://www.canimmunize.ca/en/home</p>	<p>The paper promotes the app CANImmunize and its features but it did not report any results.</p> <p>This app has been developed in Canada so its application can be limited.</p>

8. Kwong JC, Foisy J, Quan S, Heidebrecht C, Kolbe F, Bettinger JA, et al. Canada's response to pandemic H1N1 influenza: the collection of individual-level data at the point of vaccination. Healthcare Quarterly. 2010;13(2):18-20.

Report, Canada

Available [here](#)

This paper is a review article which includes a section on how individual-level data was collected at the point of vaccination during Canada's H1N1 vaccination campaign. It discusses paper-based, electronic and hybrid systems and the benefits and barriers associated with each.

Contact details for the lead author are available in this paper. Given that Canadian influenza pandemic mass vaccination plans, identified for other questions in this series of responses for the health protection team are very detailed, it may be worth contacting this author for access to further expert opinion.