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PRECISION PUBLIC HEALTH INTERVENTION FOR CARE COORDINATION: A REAL WORLD STUDY

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ABSTRACT

Background: Health emergencies disproportionally affect vulnerable populations. Digital tools can help primary care providers find and reach the right patients.

Aim: This study evaluated whether digital interventions delivered directly to general practitioners’ (GPs) clinical software are more effective than postal delivery interventions in promoting primary care appointments during the COVID-19 pandemic.

Design and setting: Real world, non-randomised, interventional study involving outpatient clinics in all Australian states.

Methods: We developed intervention material to promote care coordination for vulnerable older veterans during COVID-19 which was delivered to GPs either digitally via direct delivery to the clinical practice software system or via postal delivery. The intervention material delivered included patient specific information to general practitioners to support care coordination, and education material was also delivered via post to the veterans, identified in the administrative claims database. To evaluate the impact of intervention delivery modalities on outcomes the time to first appointment with the primary GP was measured using a Cox proportional hazards model adjusting for differences prior to the intervention in the health contact rates between the digital and postal health care providers.

Results: The intervention took place in April 2020, during the first weeks of COVID-19 social distancing rules in Australia. GPs received digital messaging for 51,052 veterans and postal messaging for 26,859 veterans. Being in the digital group was associated with earlier appointments (Adjusted hazard ratio: 1.38 (1.35, 1.4)).

Conclusion: Data-driven digital solutions can promote care coordination at scale during national emergencies, opening up new perspectives for precision public health initiatives.
Keywords: precision public health, general practice, care coordination, audit and feedback, digital health
HOW THIS FITS IN

- Digital technologies hold promise to improve public health, but most initiatives are still limited to electronic health records
- We developed a digital, data-driven intervention to promote care coordination for patients vulnerable to COVID-19 poor outcomes. The intervention was delivered Australia-wide and led to earlier GP appointments when compared to a paper-based version.
- Similar solutions can be incorporated to emergency preparedness plans to ensure care coordination for vulnerable populations.

INTRODUCTION

There is significant evidence that national emergencies, such as natural disasters or pandemics, result in long-lasting health consequences, including increased mortality months after the initial event [1]. The consequences disproportionally affect vulnerable populations, such as older people, the poor and people with mental illness [2]. The COVID-19 pandemic is an example of a harmful national emergency. Healthcare utilisation decreased by a third during the pandemic [3], either due to direct effect (increased demand) and due to access restrictions (lockdown measures). It is estimated that current disruptions in health care due to COVID-19 will cause post-pandemic increases in child mortality by up to 44% in low- and middle-income countries [4].

The COVID-19 pandemic affects older individuals with at least one co-morbidity in three different ways. Firstly, the infection is more severe in this population leading to more hospitalisations [5] and higher fatality rate [6]. Secondly, the changes induced by the pandemic and its prevention may increase the prevalence of co-morbidities, such as mental health conditions [7]. The third impact of
national emergencies is the interruption in service provision [8], with potential for reduced number of health care attendances, hospital visits and laboratory tests.

As a response to the COVID-19 pandemic, the Australian government implemented a series of policies to reduce the risk of widespread infection. Starting on March 2nd 2020, the policies included stay at home recommendations where possible for persons at high risk of poor outcomes if they were to develop COVID-19. To prevent disruptions, the Australian government also implemented a national health plan to maintain access to health services during the pandemic, including options for many medical attendances to be provided by video or telehealth where appropriate. Video and telehealth Medicare items were available for persons at risk of health care harms from COVID-19 and in quarantine from March 13th 2020 [9]. Telehealth services were extended to enable vulnerable medical practitioners and health practitioners to provide telehealth for all their patients from March 23rd 2020, and further expanded to all practitioners and all patients from March 29th 2020.[10] Major social distancing restrictions came into effect, including work from home where possible, from the week of March 23rd 2020 onwards. Despite implementation of video and telehealth options, there were concerns that many people may have delayed or avoided their health care appointments due to concerns about catching the virus or concerns about not wanting to overload busy doctors. Nationally, a 10% reduction was observed in Medicare Services in April 2020 compared to April 2019 [11].

Given the importance of continuous care provision for patients with chronic diseases, it is the responsibility of public health professionals to plan and promote strategies to ensure that the needs of patients and caregivers are addressed [12]. One of the key aspects of care coordination is to identify vulnerable individuals and activate them and their care providers, triggering appropriate action. The use of technology for epidemiological surveillance and intervention development is expected to improve access and equity [13]. Digital technologies have a growing role in public and preventive health, contributing to the comprehensiveness of care provision [14]. However, most
initiatives are still limited to electronic health records and use of alerts to drive action [14]. Effective interventions include population-centred interventions using surveillance data [15], use of telehealth to improve referral and attendance to mental health clinics [16] and decision support to promote preventative actions [17].

In this paper, we describe a real world, large-scale intervention as a rapid response to the COVID-19 pandemic. We also evaluate the efficacy of digital delivery of the intervention directly to health provider software compared to the standard postal delivery in promoting visits to the primary care provider.

METHOD

Context and setting
In Australia, the General Practitioner (GP) is the cornerstone of primary care coordination. About 84% of Australians see a GP every year, and 77% of patients have a preferred GP [18]. The goal of the proposed intervention was to help GPs identify their vulnerable patients and promote follow up appointments during the period of restrictions. The intervention material was delivered digitally or via postal service. Some particularities of the Australian health system determined the technology choice:

- **Geographical location** - Veterans are distributed across Australian states and territories. While there are a few GPs specialised in veteran care, most have less than 4 veterans under their care. Patients are free to choose their GP irrespective of geographical location. While this may increase patient satisfaction and access, the lack of patient registration makes it harder for practices to define their population, potentially reducing continuity of care [19].

- **Technological readiness** - Australian GPs have had near universal use of electronic health records for more than 10 years [20] and a large penetration of secure messaging infrastructure for receiving laboratory test results.
• Public funded, privately operated model – Primary care in Australia is provided by trained General Practitioners. Australia’s universal health care scheme, called Medicare, provides basic cover. The Australian Department of Veterans’ Affairs provides additional cover for eligible veterans. GPs and primary health clinics are independent providers, which requires any intervention focused on GPs to be highly collaborative and involve practitioners from the start. There is a high degree of agency during GP appointments, and payers have limited influence on practice.

The Veterans’ MATES program

This initiative was developed as part of the Veterans’ MATES program. The Veterans’ Medicines Advice and Therapeutics Education Services (Veterans’ MATES) program is an Australian Government Department of Veterans’ Affairs (DVA) funded program aimed at improving medicine and health services use and health outcomes for all persons in the veteran community across Australia. The program drives professional behaviour change via a multifaceted intervention, composed of an educational component and an audit and feedback component delivered to general practitioners (GPs), supported by educational components delivered to pharmacists, other relevant healthcare professionals and veterans. Interventions are created in three sequential steps. The Veterans’ MATES program is informed by Social Cognitive Theory [21], the Transtheoretical model [22], and the health promotion model Precede-Proceed [23]. As such, it has a strong focus on education, increasing veterans’ participation in their therapeutic choice, providing repeated interventions over time and providing reinforcements and tailored decision support based on available data.

The first step is an epidemiological inquiry to identify trends and potential issues in healthcare access and use. Examples include long term prescription of medicines recommended for acute issues; doses above guideline recommendations; and lack of screening tests for an eligible population. The program has access to the DVA health claims database, updated monthly. This
The database includes all dispensed medicines requiring prescription, claimed healthcare services and laboratory services, home care and aged care.

The second step is the development of educational material and audit and feedback documents. This is a collaborative process with heavy stakeholder involvement, including multiple health professionals and behaviour change specialists.

The final step is the identification and delivery of the intervention to veterans and their main healthcare provider. This step requires use of patient-level information contained in the database to print personalised audit and feedback documents at scale, reaching tens of thousands of veterans and GPs per intervention.

The program has been extensively described elsewhere [24], and has focused on increasing use of under-used medicines, reducing adverse medicine events, reducing use of unnecessary medicines and improving the utilisation of health services. It has been shown to be effective for changing professional behaviour in different domains [24], including promoting medicine review [25], promoting osteoporosis screening [26], uptake of health services [27], reducing inappropriate proton pump inhibitor use [26] and hypnotic use for insomnia [28].

The Veterans’ MATES program ran the first intervention in 2004 and, since then, has delivered 4 interventions each year. In 2019, a digital precision public health initiative was implemented which used digital technology infrastructure available at healthcare provider practices. The goal of this initiative is to use the large longitudinal claims database to create risk profiles, and use data to tailor intervention for GPs. Each digital document sent to GPs is dynamic, and may contain different elements (prompts, goal setting, charts [29]) and recommendations based on identified patient risk.

For the “care coordination during COVID-19 pandemic” intervention the aim was to improving intervention efficacy by increasing GP engagement and reducing the lag between the detection of an issue and its notification to the GP.
The digital solution developed takes advantage of Australia’s secure message infrastructure, commonly used for electronic communication of laboratory results and referral letters, from the source directly to the GP’s desktop computer. Since the electronic documents are visualised in the clinical software, a GP can request actions from the clinic nurse or reception on the same screen. The paper-based intervention documents were developed as HTML pages, converted to Portable Document Format (PDF) format, encrypted, and embedded in an HL7 version 2 [30] file using internally developed software.

**Study design and sample**

To evaluate the effectiveness of a digital precision public health intervention in promoting care coordination during national emergencies compared to usual postal delivery, we conducted a non-randomised experimental study.

Patient allocation to postal or digital group was done in two sequential steps. First, eligible patients were identified based on information contained in the administrative health claims database. Patients were eligible if they were identified as the population at highest risk of poor outcomes from COVID-19, which was persons aged over 70 years with the following comorbidities, hypertension [31-38], chronic heart disease [31-38], diabetes [31-39], chronic airways disease [32-38], cerebrovascular disease [31, 32, 35, 40], chronic liver disease [37], chronic renal failure [32, 34, 36-38], malignancy [31, 32, 35, 36, 38, 41] or being immunocompromised [37]. Identification algorithms were composed of clinical rules with varying levels of complexity, looking for past diagnostic codes (ICD-10) during hospitalisations, use of medicines indicating treatment for one of the target comorbidities (e.g., carvedilol, a medicine that can only be newly prescribed for patients with moderate or severe heart failure in Australia), and combinations of services and medicines used.

After patient eligibility checking, the primary GP was identified using a proprietary algorithm based on the frequency and recency of appointments. General practitioners with at least one eligible
patient were eligible for the intervention. All GPs who had the capability to receive the digital intervention (access to electronic health record and secure message delivery) were included in the digital group. The remainder were included in the postal group.

**Intervention development**

The main goal of this intervention was to promote care coordination during lockdown and social restrictions. The initiative was conducted using a collaborative, pragmatic approach, influenced by Greenhalgh et al diffusion of innovations model [42], in order to develop a solution that could be implemented at national scale. The model summarises a collection of theoretical and empirical findings, and highlights the interplay between an innovation, the adopter, the context in which the innovation takes place, the implementation and the diffusion process. The model suggests innovation developers to consider nine dimensions during intervention creation: 1) Innovation; 2) Adopter; 3) Assimilation; 4) Communication and Influence; 5) System Antecedents for Innovation; 6) System Readiness for Innovation; 7) Outer Context; 8) Implementation Process; 9) Linkage.

The processes involved in intervention development complements the 3-steps used by Veterans’ MATES interventions, suited for rapid care coordination (see Figure 1). The development of all content and interventions is based on the best evidence available at the time and supported by repeated reviews by healthcare professional panels. The audit and feedback document (see Figure 2) was developed and submitted to a stakeholder review group, including health professionals (pharmacists, GPs; among others). The behaviour change techniques used included, as described using the behaviour change technique (BCT) taxonomy [43]: goal setting (e.g., “Schedule appointments to ensure vulnerable patients are still receiving necessary care”); prompts (demonstrate why patient is vulnerable, such as medicine dispensing suggesting respiratory disease); and information about health consequences (rationale for suggested actions). The underlying theory was that the provision of personalised recommendations and behaviour change techniques in the form of an audit and feedback document delivered directly to a GP’s clinical software would change
GP’s behaviour, influence patient recall and trigger an early appointment. The behaviour change techniques aim to increase motivation and trigger active patient search by the GP.

In addition to the intervention material delivered to the health care practitioner, all veterans living in the community (68,872 individuals) received educational material by postal service. The material included information about COVID-19 infection prevention prompting them to maintain regular contact with care providers and to continue to adhere to health plans, as well as how to access care during the pandemic given the expansion of video and telehealth appointments and free medicine delivery services for eligible persons. The intervention aimed to promote patient activation and request for GP appointment by the veteran. The online version of the printed materials is available at the Veterans’ MATES website [44].

Outcomes and statistical analysis

To evaluate the intervention the total number of visits post-intervention and time to first appointment with the primary GP was compared between the digitally delivered and postal delivery groups. We hypothesised that the time to first appointment would be shorter in the electronically delivered material given improved workflow fit (document is downloaded directly to the clinical software, and appears next to other clinical documents) and ease to request actions in the software. The time to first appointment post intervention was measured using a time-to-event analysis where index date was the intervention delivery date, and the event was first visit with the primary GP. Events were censored at three months from index date.

At the time of the intervention, Australia had in place restrictions on visitors to aged care, thus, we excluded veterans living in aged care from the time-to-event analysis. Cox regression was used to determine whether the time to first GP appointment differed between the intervention delivery modalities after adjusting for patient age at the time of intervention and gender. To account for the difference in GP attendances prior to the intervention between the two groups we also adjusted for the number of visits in the previous year. This was done to account for the possibility that those
veterans attending clinic with a GP that has electronic clinical management systems have more regular visits to their GP.

Given the large sample and the purposeful sampling, we considered a 99% confidence interval (p <= 0.01) for all hypothesis tests. All analyses were performed in Python 3.7. The main statistical library used for time-to-event was lifelines 0.25 [45].

RESULTS

A total of 77,911 veterans were targeted for the intervention, and 18,577 GPs were identified as their main care provider (mean number of veterans per GP: 4.2, std 4.4). Among those GPs, 61.2% (11,375) were eligible to receive secure message documents. The 51,052 veterans who had these GPs as their main care providers were included in the digital group. The remaining 7,202 GPs were not eligible for digital delivery, and the 26,859 veterans under their care were included in the postal group. Veterans in both groups were similar in age, gender and geographical distribution (Table 1). However, patients assigned to the digital group had a higher number of usual visits with the primary GP (based on 2019, prior to COVID-19 pandemic), despite a similar profile in number of comorbidities.

Table 1 - Baseline comparison between digital and postal group

<table>
<thead>
<tr>
<th></th>
<th>Digital</th>
<th>Postal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total veteran participants</td>
<td>51052</td>
<td>26859</td>
</tr>
<tr>
<td>Gender - Female (%)</td>
<td>24536 (48.1%)</td>
<td>12167 (45.3%)</td>
</tr>
<tr>
<td>Average age (SD)</td>
<td>83.96 (9.24)</td>
<td>83.52 (9.34)</td>
</tr>
<tr>
<td>Living in community setting (%)</td>
<td>45759 (89.6%)</td>
<td>23113 (86.1%)</td>
</tr>
<tr>
<td>State (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW</td>
<td>17758 (34.8%)</td>
<td>9626 (35.8%)</td>
</tr>
<tr>
<td>QLD</td>
<td>10723 (21%)</td>
<td>6626 (24.7%)</td>
</tr>
<tr>
<td>VIC</td>
<td>10647 (20.9%)</td>
<td>4905 (18.3%)</td>
</tr>
<tr>
<td>WA</td>
<td>5293 (10.4%)</td>
<td>2004 (7.5%)</td>
</tr>
<tr>
<td>SA</td>
<td>4260 (8.3%)</td>
<td>1731 (6.4%)</td>
</tr>
<tr>
<td>ACT</td>
<td>1289 (2.5%)</td>
<td>1348 (5%)</td>
</tr>
<tr>
<td>TAS</td>
<td>980 (1.9%)</td>
<td>468 (1.7%)</td>
</tr>
<tr>
<td>NT</td>
<td>102 (0.2%)</td>
<td>151 (0.6%)</td>
</tr>
<tr>
<td>Number of comorbidities (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18243 (35.7%)</td>
<td>9772 (36.4%)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>16820 (32.9%)</td>
<td>8980 (33.4%)</td>
</tr>
<tr>
<td>2</td>
<td>10139 (19.9%)</td>
<td>5062 (18.8%)</td>
</tr>
<tr>
<td>3</td>
<td>4166 (8.2%)</td>
<td>2202 (8.2%)</td>
</tr>
<tr>
<td>4</td>
<td>1359 (2.7%)</td>
<td>682 (2.5%)</td>
</tr>
<tr>
<td>5</td>
<td>288 (0.6%)</td>
<td>139 (0.5%)</td>
</tr>
<tr>
<td>6</td>
<td>37 (0.1%)</td>
<td>22 (0.1%)</td>
</tr>
<tr>
<td>7 or more</td>
<td>37 (0.1%)</td>
<td>22 (0.1%)</td>
</tr>
</tbody>
</table>

Average usual number of appointments with primary GP (based on 2019) (SD)

|   | 10.24 (8.03) | 8.13 (8.64)* |

*p<.01

A total of 51,052 individualised messages were sent to GPs in four sequential batches, starting on 29/Apr/2020 over secure message. A remainder of 26,859 messages were sent via postal service to GPs ineligible for secure message delivery. From the cohort of 51,052 veterans and their GPs targeted for secure message, we received 4 (<0.01%) messages from users advising that they were not the primary care provider of targeted patient, suggesting the algorithm for finding the primary GP was highly accurate.

The total number of appointments with GPs increased substantially over April/2020, from 20,425 visits in the last week of March (25/03 to 31/03) to 25,214 in the last week of April (22/04 to 28/04). The appointment numbers increased with both the primary GP or other GPs, and was largely driven by services provided by telehealth (see Figure 3).

**Time-to-event analysis**

We found that most targeted veterans had at least one appointment with their primary GP (72.3%) during the three months after intervention. The chance of patients seeing their primary GP was higher in the digital group (77.8%) than the postal group (61.5%) which is reflected in the Kaplan-Meier curve (see Figure 4).
At baseline, the digital group had a higher average number of visits in the previous year (an indication of the usual frequency) than the postal group. To account for the possible influence of the usual number of visits as a determinant of earlier appointment after intervention, we included the number of appointments in the 2019 as a confounder (see Table 2). After adjustment, there was a statistically significant difference between the digital and postal delivery groups on time to first primary GP visit (p<0.001). Considering individuals with similar number of visits in the previous year, being in the digital delivery group increases the chance of visiting the primary provider during the three months following the intervention when compared to postal group.

Table 2 - Coefficients of the Cox model

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Unadjusted Hazard Ratio (CI 95%)</th>
<th>Hazard Ratio (CI 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group - Postal v Digital (Digital = 1)</td>
<td>1.5 (1.47, 1.52)</td>
<td>1.38 (1.35, 1.4)</td>
</tr>
<tr>
<td>Regular number of appointments</td>
<td>1.04 (1.04, 1.04)</td>
<td></td>
</tr>
<tr>
<td>(based on the year prior)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of comorbidities</td>
<td>1.09 (1.08, 1.10)</td>
<td></td>
</tr>
<tr>
<td>Gender (Female = 1)</td>
<td>1.05 (1.03, 1.08)</td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

Summary

This study demonstrated the capacity of a digital intervention to identify vulnerable individuals, reach and engage their main care providers, and measure outcomes. Additionally, we found that the digital intervention was more effective than a postal service delivered intervention at promoting early primary provider visits during the initial months of the COVID-19 pandemic.
Strengths and limitations

This study benefited from a well-established program, describing the results of a large-scale intervention at national level. The large sample size increases the confidence in the results and allowed the stratification of distinct covariate effect in promoting early GP visits.

The main limitation was the lack of a randomised controlled environment to isolate the effects of the intervention alone in promoting GP visits for vulnerable individuals. We previously conducted a randomised controlled trial, which demonstrated the increased efficacy of digital intervention in promoting health service utilisation [46]. The urgency of the situation and the current system capacity were the paramount issues driving the study design. The comparison with the postal group may have been biased by the purposeful sampling, despite adjusting for the number of usual GP visits in a year. It is possible that the variables affecting access to digital delivery (e.g. size of the health provider centre) affected the time to appointment. Several policies were enacted at different times of the COVID-19 pandemic, which may have influenced the results. These include Policy changes made by the Australian Department of Health, which promoted the use of telehealth by all Australians (including veterans). Telehealth ensured continued access to providers despite social restrictions and was sustained throughout the study period. It is possible our digital group were better set up for telehealth provision. The COVID-19 pandemic may also have changed patient predisposition to attend their GP appointment, or access telehealth appointments. It is also possible that COVID-19 changes affected the digital behaviour of physicians, enhancing the effect of the digitally delivered intervention. Furthermore, this intervention took place in the Australian health context, which may have influenced early adoption of digital solutions. Different health systems will need to adapt to local technologies and capabilities.
Comparison with existing literature

The COVID-19 pandemic promoted a surge in digital health applications for population-level public health responses. A recent review identified 247 distinct initiatives, ranging from AI and big data to diagnose and screen for COVID-19 infection, to provision of telehealth for healthcare access [47]. A common issue with data-driven solutions is scalability and integration into healthcare systems [48].

Our study shows innovative methods of data analysis can be used to extract signals from administrative claims database, in particular those containing therapeutic information (medicines and services). Access to detailed claims data was key to make possible the identification of high-risk patients and their primary care providers. Claims data have also been successfully used to detect high-risk groups during the COVID-19 pandemic in South Korea [49]. We further showed secure messaging infrastructure can be used to quickly reach primary providers, and behavioural theory influenced digital interventions are effective in promoting care by the primary provider. We envisage such systems being used to guarantee the supply of medicines use for chronic diseases, promote support for patients with mental health conditions, maintain care for persons with care-time critical illnesses, such as persons in active bouts of chemotherapy, persons undergoing dialysis, persons requiring home delivered oxygen, and maintain care of elderly patients.

An interesting and unexpected finding was the difference in number of appointments in the year prior to the COVID-19 pandemic between the digital and postal group. The only criteria separating both groups was the access to secure message delivery. Since no other differences between groups were identified, it is possible that the access to technology itself is promoting care provision. However, as shown by the Cox regression and the partial effect plots, the digital intervention retained its effect even after adjusting for the number of appointments in the previous year. Both findings suggest that access to technology and secure message delivery should be promoted to clinicians as ways to promote care coordination.
Implications for Research and/or practice

Digital infrastructure coupled with innovative solutions enables the promotion of care coordination at scale, opening new perspectives for precision public health initiatives. Besides their importance in usual public health contexts, the results suggest that solutions using current digital infrastructure can be useful in emergency preparedness systems [50]. Experiences after national emergencies and disasters recognise their impact on patients with chronic diseases and the importance of quickly reacting to healthcare needs of these patients when designing plans [51, 52]. Given that responses can vary according to emergency and condition, the capacity to identify patients with particular comorbidities may prevent consequences on vulnerable patients, such as cancer patients [53] and patients with severe kidney disease [54].

This study was one of the first nation-wide programs to use centralised health information to support GPs in caring for vulnerable patients during the COVID-19 pandemic. In Australia, involving General Practitioners is key in maintaining adequate care. Given their distributed geographical location and the multitude of clinical software in use, adequate targeting was only possible due to the existence of a mature claims databases, which are routinely updated and contain useful clinical information. The results suggest a wider collaboration between public health officials and GPs can improve efficiency and direct the use of health resources towards patients in need.

This study reinforces the value of developing solutions fit for context using iterative and participatory processes. Finding the right level of complexity of any digital health intervention is particularly susceptible to context change [55]. Health systems based on consumer-focused healthcare will benefit from solutions focused on patient activation, such as self-screening tools [56]. We also took advantage of secure messaging infrastructure, which was already incorporated into the clinician workflow. Finally, the existence of standards (HL7 and pdf) and availability of structured computer coding libraries provided the required flexibility, speed and power to develop the
intervention. We also profited from having strong stakeholder relationships having stakeholder reference groups that had continuously met since program inception in 2004. The time from conception to full implementation was less than 4 weeks, which included required approvals and having clinical and stakeholder review prior to implementation. The stakeholder and clinical goodwill that had been achieved due to engagement with Veterans’ MATES over time, meant that a team of people were available to review materials at short notice, including on the ground practitioners who felt they were being bombarded with information in the early days of the pandemic. This same structure was maintained after this study, which allowed the digital intervention to be continuously incorporated into the Veterans’ MATES program. All eligible GPs currently receive the digital delivery of the intervention directly into their clinic software.

Future research will investigate how the intervention can be further personalised, profiting from the capacity to create dynamic documents and use the web for additional education and enhanced practice auditing. Future research will also evaluate intervention effectiveness on clinical outcome measures, drawing on long term longitudinal data.

This study is one of the first to show the feasibility and increased efficacy of a digital intervention to coordinate care at national level during emergencies. Digital delivery (via secure message infrastructure) promoted visits to the primary GP. Similar solutions can be adapted as a response to emergency events to ensure care continuation of vulnerable populations.

**Ethics approval and consent to participate**

An ethics protocol for the study was approved by the University of South Australia Human Research Ethics Committee (ethics protocol P203/04) and the Department of Veterans’ Affairs Human Research Ethics Committee (E016/007).

**Consent for publication**

Not applicable.
Availability of data and material

The data that support the findings of this study are available from the Australian Government Department of Veterans’ Affairs but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.

Competing interests

The authors have no competing interests to declare.

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Authors’ contributions

AQA conceived of, designed, conducted the final analysis for this paper and drafted the manuscript.

AQA, J-PC, VTL and EER developed the protocol and study approach. LMKE and NLP were involved in the data analysis. EER conceived of and designed the study, and critically revised the manuscript for important intellectual content. All authors made important contributions to the theoretical approach and interpreting insights. All authors read and approved the final manuscript.

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Figure 1 – Schematic representation of the digital intervention delivery (created by the authors)
Identifying vulnerable DVA clients during the COVID-19 pandemic

Dear [FIRST & SURNAME]...

This Veterans’ MATES information identifies your DVA clients who are at high risk of poor outcomes if they contract COVID-19. The risk factors for poor outcomes include older age, hypertension, chronic heart disease, diabetes, chronic airways disease, cerebrovascular disease, chronic liver disease, chronic renal failure, malignancy, and being immunocompromised or taking immune suppressing medicines.

You can access the summarised evidence on risk factors by clicking on the COVID fact sheet. There, you will also find up-to-date information on medicine use during the COVID-19 pandemic.

<table>
<thead>
<tr>
<th>Potential risk factors for poor outcomes with COVID-19</th>
<th>Last hospital admission or service</th>
<th>Last medicine dispensing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertensive heart disease or hypertension*</td>
<td>-</td>
<td>1 Feb 2020</td>
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<tr>
<td>Chronic obstructive pulmonary disease†, asthma†, or previous hospital admission for pneumonia or influenza†</td>
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<td>1 Feb 2020</td>
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<tr>
<td>Recent cancer treatment, including hospital admission†, radiotherapy†, or cytotoxic therapy†,</td>
<td>27 Jan 2020</td>
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*Identified through hospital record of diagnosis
†Identified through medicine claim for indication
‡Identified through MBS claim for service

Suggested actions:

- Maintain contact with these vulnerable patients throughout the COVID-19 pandemic. Ask your patients at high risk to contact your practice by phone if they develop respiratory symptoms. Ensure they are familiar with COVID-19 symptoms, what they can do to avoid contracting COVID-19 and who to contact if they are concerned.
- If you are caring for patients with COVID-19, closely monitor markers of clinical progression especially on days five to ten after onset of symptoms, the time point where rapid deterioration has frequently been observed.
- Schedule appointments to ensure vulnerable patients are still receiving necessary care. Discuss the options of telehealth and face-to-face consultations and identify the most appropriate option for you and your patient. Confirm their understanding of telehealth services, their preferred mechanism (e.g. telephone or video service) and their capability to participate in video telehealth services with you and their other health providers.
- Administer flu and pneumococcal vaccinations, where the patient is unvaccinated or a further dose of Pneumovax is required.
  The Australian Therapeutic Goods Administration advises that the adjuvanted quadrivalent influenza vaccine, Fluideal Quad, is preferred in persons aged 65 years and over and is available through the National Immunisation Program (NIP) Schedule.

Along with this letter, you will receive information about 4 other DVA clients. We appreciate the immense pressure GPs of Australia are currently experiencing and hope we can help support your care of DVA clients at this time.

*Hospital admissions identified in claims data in the past 12 months. Medicines identified in PBS claims, with the patient having at least two claims for a medicine in this class in the past year. Most recent claim date for each service is shown in the table. Patient specific information is based on claims to DVA from all healthcare providers. Some of the medicines listed might have been prescribed by other doctors. You have been identified as the general practitioner who has written most of the recent prescriptions for this patient.

This information has been endorsed by the DVA Editorial Committee, which includes representatives from the AMA and RACGP.

For general comments and feedback please contact: MATES.comments@vha.edu.au

Figure 2 – Sample of the electronic document sent to General Practitioners as part of the intervention (created by the authors)
Figure 3 - GP appointments during the first months of the COVID-19 pandemic, by type (created by the authors)
Figure 4 - Kaplan Meyer curve depicting the chance of GP appointment in the first 3 months after intervention, by group
(created by the authors)

REFERENCES


