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Data-Driven Interventions for an Emergency Preparedness System: A National Experience in Australia

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Abstract. Natural disasters and health emergencies disproportionally affect vulnerable populations causing disruptions to usual care and increasing chronic disease burden. Data and digital technologies are important tools to identify and mitigate indirect effects of emergencies. In this paper, we describe the methods used in the development of a series of digital emergency preparedness interventions to mitigate the direct and indirect consequences of the COVID-19 pandemic in the veteran community in Australia. The case studies demonstrate the use of data for surveillance, patient phenotyping, data-driven decision support and stakeholder communication in primary care. The intervention successfully increased appropriate healthcare use by vulnerable individuals and could be expanded to other populations.

Keywords. Emergency preparedness, primary care, digital intervention

1. Introduction

Natural disasters and health emergencies have significant indirect social and health impacts which last for years after the initial event. There are two main mechanisms in which disasters affect health. The first is the increased incidence of associated conditions. A study in California during the COVID-19 pandemic, estimated an excess cost of US$ 7 billion and 192,000 QALYs lost due to six indirectly associated conditions, including depression, homelessness, opioid use disorder and stroke [1]. The second is the interruption of normal care practices. Healthcare utilisation decreased by a third during the pandemic [2], either due to direct effect (increased demand) or due to access restrictions (lockdown measures). Hospitalisations for acute cardiovascular conditions declined by 20 to 73% from pre-pandemic levels [3]. Public health professionals have a mandate to plan, coordinate and promote strategies to ensure that the needs of patients and caregivers are addressed [4]. Health systems now have sources of data that can be used for health surveillance during emergencies, detecting health gaps, monitoring recovery and evaluating interventions in almost real-time [5]. The goal of this study is to demonstrate the use of digital technologies in mitigating the impacts of national

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emergencies. For this end, we describe an intervention to mitigate the mental health issues due to the COVID-19 pandemic, developed for Australia veterans in 2020. The contributions of this study are three-fold:

1) Demonstrate the use of administrative claims data in surveillance;
2) Demonstrate the use of administrative claims data in the identification of vulnerable individuals;
3) Demonstrate the advantages of digital technologies in the creation and delivery of data-driven interventions.

2. Methods

This study is part of the Veterans' Medicines Advice and Therapeutics Education Services (Veterans' MATES) program, 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, relevant healthcare professionals and veterans. The main data sources used in the interventions include health administrative claims data from the Australian Government Department of Veterans' Affairs (DVA), and data collected as part of the Veterans' MATES program. The DVA claims database includes all health care services and medicines funded by DVA, including outpatient and hospital services, aged care, prescription medicines, allied health services, and other health coordination and support services. The DVA client population is composed of Australian veterans and their eligible family members, which may include spouses and children. An ethics protocol for the study was approved by the University of South Australia Human Research Ethics Committee (ethics protocol P203/04) and the Australian Government Department of Defence and Veterans' Affairs Human Research Ethics Committee (E016/007).

2.1. Methods for a digital intervention for emergency preparedness systems

2.1.1. Surveillance

Surveillance systems for early warning and disease detection are a core characteristic of centres of disease control. We propose an extension of the surveillance system to include use of healthcare services, with a particular focus on use by vulnerable populations. Time series analysis provides useful information to detect trends and unusual data (anomaly detection), which is used to select and develop appropriate interventions. Anomaly detection and other visualisation methods have been successfully used during the COVID-19 pandemic [6-8]. However, there is little research on the use of anomaly detection methods to measure indirect impacts and their suitability to identify targets for care coordination interventions. In June 2020, recognition grew of the mental health impacts of COVID-19 related lockdowns. This elicited an active search for potential impacts on health utilisation. Time series data of psychologist visits suggested an anomalous pattern of use evident as soon as July 2020 (see **Figure 1**).

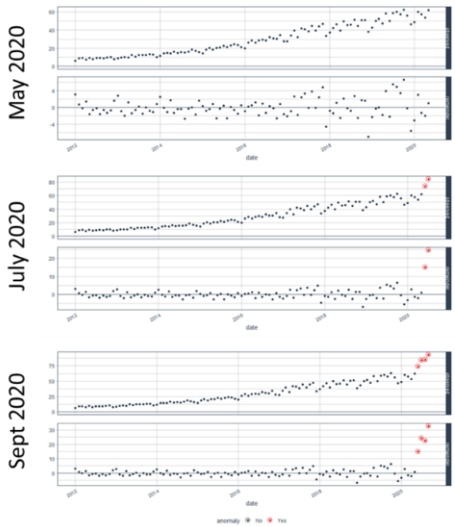


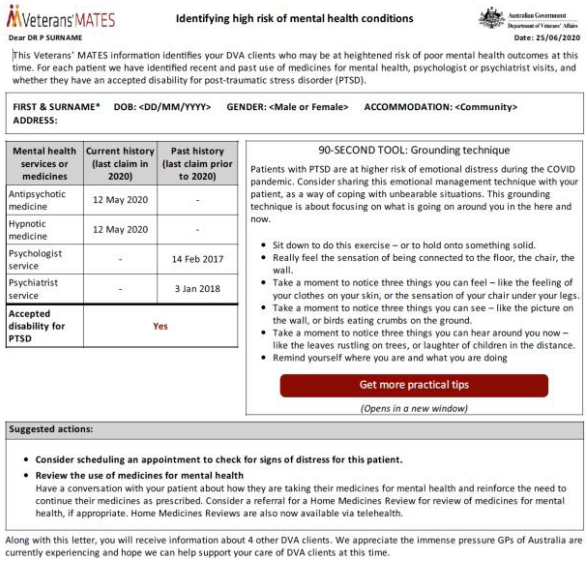
Figure 1. Time series of claimed psychologist visits collected at three time points during the COVID-19 pandemic. Anomalous points are highlighted. Picture created using the Anomalize R package [9].

2.1.2. Identification of vulnerable individuals

Administrative information is a rich resource of patient information from which information about conditions, healthcare access and continuity can be extracted. We propose the use of data to identify vulnerable individuals, using a combination of medicine data and service use. Following the identification of the impact on mental health, the database was queried for patients with evidence of mental conditions, focusing particularly on post-traumatic stress disorder (PTSD). Patients were selected based on the dispensing of medicines indicated for mental health conditions (anti-depressants, hypnotics), use of psychologist or psychiatrist services, or a diagnosis of PTSD in eligibility claims.

2.1.3. Digital interventions

In response to the identified issue, an intervention was developed and disseminated to high-risk patients promoting the use of veteran specific, freely available, evidence-based tools to support mental health and cognitive behavioural therapy. Educational content for GPs and veterans was developed. A data-driven intervention containing patient data was also developed. Two delivery methods were used. 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. Documents are created as HTML pages, converted to Portable Document Format (PDF) format, encrypted, and embedded in an HL7 version 2 [10] file using internally developed software (see **Figure 2**). GPs without access to secure message infrastructure received the intervention by post.



Veterans' MATES

Identifying high risk of mental health conditions

Australian Government Department of Veterans' Affairs

Dear DR P SURNAME

Date: 25/06/2020

This Veterans' MATES information identifies your DVA clients who may be at heightened risk of poor mental health outcomes at this time. For each patient we have identified recent and past use of medicines for mental health, psychologist or psychiatrist visits, and whether they have an accepted disability for post-traumatic stress disorder (PTSD).

FIRST & SURNAME* **DOB: <DD/MM/YYYY>** **GENDER: <Male or Female>** **ACCOMMODATION: <Community>**
ADDRESS:

Mental health services or medicines	Current history (last claim in 2020)	Past history (last claim prior to 2020)
Antipsychotic medicine	12 May 2020	-
Hypnotic medicine	12 May 2020	-
Psychologist service	-	14 Feb 2017
Psychiatrist service	-	3 Jan 2018
Accepted disability for PTSD	**Yes**	

90-SECOND TOOL: Grounding technique

Patients with PTSD are at higher risk of emotional distress during the COVID pandemic. Consider sharing this emotional management technique with your patient, as a way of coping with unbearable situations. This grounding technique is about focusing on what is going on around you in the here and now.

- Sit down to do this exercise – or to hold onto something solid.
- Really feel the sensation of being connected to the floor, the chair, the wall.
- Take a moment to notice three things you can feel – like the feeling of your clothes on your skin, or the sensation of your chair under your legs.
- Take a moment to notice three things you can see – like the picture on the wall, or birds eating crumbs on the ground.
- Take a moment to notice three things you can hear around you now – like the leaves rustling on trees, or laughter of children in the distance.
- Remind yourself where you are and what you are doing

Get more practical tips

(Opens in a new window)

Suggested actions:

- **Consider scheduling an appointment to check for signs of distress for this patient.**
- **Review the use of medicines for mental health**
  Have a conversation with your patient about how they are taking their medicines for mental health and reinforce the need to continue their medicines as prescribed. Consider a referral for a Home Medicines Review for review of medicines for mental health, if appropriate. Home Medicines Reviews are also now available via telehealth.

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.

Figure 2. Example of the digital intervention sent to General Practitioners.

3. Results

The intervention was delivered on 7 July 2020 containing 42,327 veteran specific messages for 15,588 GPs. The majority (24,532 veterans) was delivered digitally, with the remainder 17,795 delivered by post. Veterans received the intervention by post. The average age for digital and post cohort were 63.5 (SD 13.3) and 59.7 years (SD 14.5), respectively. The population was mostly male (87.8% for the digital and 85.7% for post cohort). Patients deceased within 6 months of the intervention (294) were removed from the analysis. Both groups had an increase in the average number of psychologist services in the 3 months after the intervention when compared to the three months prior (digital: 0.51 prior to 0.56 post, $p<0.001$; post: 0.59 prior to 0.65 post, t-test $p<0.001$). There was no significant difference between digital and post groups (ordinary least squares regression $p=0.1$).

4. Discussion

There are clear opportunities for better data use in emergency preparedness systems. The case study is a good example of using data to develop patient-centred health care interventions to support general practitioner response to the pandemic. Access to timely high quality claims data has been used in a few national programs, and the Veterans' MATES program was able to use it to rapidly identify health issues, and to reach and advise primary health care practitioners and their patients. The same methods showcased in this study can be used for emergency preparedness, including during floods, bushfires (wildfires), or other emerging health priorities. The model demonstrates the capacity for creating algorithms to identify patients who may need urgent care (e.g., patients on renal dialysis, currently undergoing chemotherapy, using oxygen at home) and thus the focus

of first line emergency health responses. The intervention described is one of three rapid responses delivered to support care during COVID-19. The two others focused on maintaining care co-ordination (delivered in April 2020) & use of antivirals in high risk groups (delivered in June 2022) From start to finish, each intervention was developed, targeted, & delivered to GPs across Australia in 4-8 weeks, however, the innovation demonstrates what would be possible with real time data as the secure delivery to the clinical desktop means future precision public health responses could be enabled in real time.

5. Conclusions

Anomaly detection methods are useful to diagnose healthcare utilisation changes during pandemic and guide appropriate interventions. Emergency preparedness plans should incorporate these methods to reduce the impact of national emergencies.

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