

CONTEXTUALISING DIGITAL HEALTH CONTRIBUTIONS TO FIGHTING THE COVID-19 PANDEMIC

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Abstract

The COVID-19 pandemic has catalysed numerous changes worldwide in healthcare systems and service delivery practices, many relying on biomedical technologies including digital health. The rapid development and widespread adoption of these changes has led to many being reported on extensively in grey literature and public media, but not yet in the conventional scientific peer reviewed literature. In particular, digital health contributions have received much attention but the main topics of reporting have been prominent public perception issues, with technical aspects being largely ignored. This perspective paper therefore responds to the need for a systematic contextualisation framework to describe digital health contributions to the current COVID-19 pandemic situation. The framework recommends four focus areas or “dimensions” for contextual settings: clinical processes, health system, stakeholder and technology. Two examples are used to motivate these dimensions: mobile phone tracking, and telehealth consultations. It is suggested that use of the framework in presenting digital health innovations more broadly and in context using these example cases, will convey a more informative understanding of the nature of such contributions now and in the post-COVID-19 period.

Keywords: COVID-19; clinical process; health system; stakeholder; technology; framework

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Introduction

The current COVID-19 pandemic has been characterised by immediate and dramatic changes in many aspects of daily life, and the business and government support systems on which these depend. The rapid evolution and adoption of new response approaches has been initially unpredictable and unquantifiable until trends became established, leading to acceptance of new principles for activities in our lives which we previously took for granted. Some profound social examples are self-isolation, social distancing, home-based work, online meetings and neighbourhood community activities.

In the health arena, many similarly dramatic changes have occurred. For instance, the way in which health services are delivered has shifted from face-to-face to remote care, and additionally clinical decisions on treatment must be made using less information (e.g. uncertainty of infection) and under tight resource constraints (e.g. scarcity of personal protective equipment). One facet of the health arena in which several leapfrog changes have occurred and gained considerable publicity is digital health. In many countries, there has been rapid revision of clinical guidelines and

healthcare reimbursement models to facilitate expansion of remote telehealth consultation services.^{1,2} This has involved a wide range of practitioners (primary physicians, specialists, allied health professionals) and many different patient types (aged care, chronic disease, precautionary presentations) for example in the Australian setting.³

Numerous digital health driven innovations and revisions to healthcare processes have emerged to support health system management during the pandemic. However, important aspects such as their efficacy within areas of clinical application and fit to the overall health system, and their impact on affected individuals and acceptance by society at large, have not been clearly articulated. Indeed, there has been a tendency to focus rather on far-reaching claims conventionally directed at information and communication technology (ICT) innovation.⁴ In such circumstances, how can we expect to rapidly identify promising new digital health contributions and assess their effectiveness?

Digital Health Frameworks

Digital health, broadly speaking the use of aspects of ICT in the health domain, is a recent and rapidly developing field

which has not been as rigorously defined and contextualised as other specialised areas in health. Its uptake and impact has spread widely through many areas of healthcare services, as well as in public health and consumer health matters. Common established aspects of digital health which support conventional health systems include electronic health records, health messaging and care coordination, health datasets and registries, clinical decision support systems, telehealth and telemonitoring, medical devices and imaging. New emerging aspects include many which push the boundaries of convention healthcare models with a stronger focus on consumer health, such as apps and games for health, mobile health and wearable devices, online health assistance via conversational agents, personalisation of care to individual needs, preventive health and wellbeing platforms, and health smart homes. Digital methods are also being widely used in many types of health research, such as bioinformatics, artificial intelligence, systems simulation and clinical trials delivery.

In consequence of this diversity, much attention has been paid in recent years to studies concerning development, adoption and effectiveness of digital health solutions. This knowledge can provide useful guidance on current and future trends⁵ and help to identify factors affecting success and failure of digital health contributions. It has become a *de facto* contextual element in describing digital health innovations, along with the extensive literature on technical design and implementation aspect⁶ for the underlying hardware and software components, as well as the overall information systems in which these are embedded.

Convergent thinking from such studies has led to the development of numerous *frameworks* for describing specific Digital Health “ecosystems”.⁷ Many of these frameworks are applicable at *micro-scale*, frequently extending existing structures for specific healthcare settings or mechanisms to allow digital health inclusion, such as chronic disease management,⁸ health behaviour change,⁹ telehealth systems evaluation,¹⁰ and mobile health data security.¹¹ Other more generic topics have been addressed through *meso-scale* frameworks which address significant digital health contribution areas across a broad spread of clinical applicability, such as incorporation of digital health components in health services,¹² biomedical research,¹³ health literacy,¹⁴ health systems evaluation.¹⁵ At a strategic and policy level, high end frameworks at the *macro-scale* have also been developed explicitly for dominant digital health themes in which the digital technology aspects are intrinsic, such as digital health interventions,¹⁶ health technology assessment,¹⁷ digital health system strengthening,¹⁸ health system transformational change.¹⁹

Frameworks such as these offer numerous benefits. First and foremost, they provide a shared and widely accepted understanding of the area of discourse, with overview and synthesis of individual contributions to that body of knowledge often leading to definition of common concepts

and terminology. They offer a means to compare and critique past and future contributions, and guidance to help identify major aspects that should be included. They establish conceptual (and sometimes practical) tools which can be used to analyse and develop the area further. They can also allow the linking of different areas, through juxtaposition or hybridisation of their frameworks, or subsumption within higher level frameworks.

COVID-19 Digital Health Contributions

We next consider how we can use the framework construct to help us describe and follow the rapidly emerging digital health contributions which are appearing in the overall fight against the pandemic. Our aim is to provide a canvas against which these and further developments can be mapped, so that connections between different contributions can be easily seen, and so that the contextual issues surrounding contributions can be identified. These capabilities will help us to establish the sources of the major influential factors on which the success or otherwise of a new contribution might depend. With these insights in hand, further digital health contributions may be developed with more streamlined approaches, and issues which were resolved for one may be revisited and reapplied for another.

An example of the need for this arises from the recent appearance of *mobile phone tracking solutions* in many countries. Technically there are many similarities in the telecommunications and data management basis of their operation, with a degree of customisation needed for each countries “infrastructure” nuances. However, the dominant topic in discussion of these contributions has been around the sensitivity of individual health and location data and consequential privacy concerns for the citizenry.²⁰ The comparison with other mobile delivered services in the commercial sector has been well noted in public perception, such as the intrusion of advertising or recommendations based on individual access or location patterns.²¹ This is only one aspect and is not uniquely tied to this situation, as it has previously been exposed with reference to many other health and business digital applications. The more substantive issues of how data might be shared between these tracking solutions, or how the real-time prediction of infection outbreaks might be achieved by coordinating this information, are not matters of public discussion, yet are direct benefits from the tracking solution. A contextualising framework would enable us to present a more comprehensive and balanced description of this crucial digital health contribution. It would thereby help shape and pull together several facets of discourse and knowledge contributions that are currently occurring without substantial profile during the incremental development.

Another example is presented by the rapid *popularisation of telehealth consultations* in providing expedient ways to deal with many different kinds of patient-carer interaction needs in the pandemic. We have seen this in online primary

healthcare consultations and checking on patients, widescale surveillance, triage and health advice services, and delivery of clinic outreach or community care to persons at home for COVID-19 related needs.²² Associated electronic communication of test results, referrals, prescriptions and reports, while previously present in small footprints, have been accelerated over very short timeframes to national levels of penetration.

Both consumer and provider sentiment seems to anticipate that these types of innovations are here to stay,²³ despite the avoidance of normal economic modelling, evidence collecting, professional standards formulation, and interoperability assurances. Acceptance of this as normal practice is influenced by parallels in conventional business sector services through call centres and online conversational agents. If we had a framework to help us to identify those connected contextual aspects for these organically emerging services, we could more easily identify aspects contributing positively to the proper achievement of the intended clinical purpose, or the confounding and disrupting factors that need mitigation or workarounds. This wider perspective based on a more holistic contextualisation, would enable us to better accept a partial suspension of rigour in determining evidence-based practice and evaluation of outcomes or benefits, while reminding us that it may be necessary to revisit these factors in the future.

Digital Health Contextual Framework

The aspired framework structure therefore needs to provide us with a set of “lenses” which we would expect to be applicable in considering any digital health contribution. These lenses (which we will term “dimensions”) would not be expected to be unique to COVID-19 situations, but we are using this as the exemplar due to its currency and the aforementioned major impacts it is deriving from digital health. We assert that there are four broad and (almost) orthogonal dimensions that need to be considered, and within each there are numerous sub-dimensions (which we will term “elements”). In choosing these dimensions, we were guided²⁴ by the concept that the conventional health ecosystem triangulates the interactions between: healthcare professionals providing services which constitute the essence of care provision, the healthcare system entities and governance sector as the enabling and modulating environment supporting that service delivery, and the patients as individuals within society who are the recipients and respondents, and place expectations and pressures on the other two components. The involvement of physical infrastructure and associated technology including digital health spans all of these components and thus constitutes a fourth dimension.

First we need to define the purpose and fit of the contribution relative to underlying *clinical processes* or healthcare tasks from the set of care interventions which has become established as applicable for COVID-19. These would

address *direct care* elements such as infection detection and registration, response and progression to treatment variants, predicting health outcomes for at-risk or atypical cases. They may also extend to related *diagnostic* elements such as radiology and pathology, and *broader care* elements such as nursing support and aged care.

Second we should identify elements in the *health system* that are concerned with delivering services and taking overarching responsibility for managing healthcare environments, within which the contribution must be deployed. These include *sector* elements such as acute care facilities, primary care organisation, aged and community care, public health, and associated with them the *role* elements they discharge such as testing, quarantine, contact tracing, screening, symptomatic presentation, hospitalisation, intensive care. This dimension also extends to *background* elements behind the frontline of healthcare delivery, such as biomedical research activities to address unmet needs like new infection testing methods and vaccine development.

Third we must link our contributions with insights on the overall range of *stakeholders* who are impacted by the pandemic or involved in the response, and articulate considerations pertinent to each group. Elements of this dimension span clinicians and other healthcare professionals, healthcare administrators and policymakers, patients, carers, families, and citizens. Accordingly, under this dimension we must take heed of clinical college promulgated positions, government-led policy determinations, public health-instilled best practice principles, expectations and obligations for patients and carers, and acceptance of society in the large for the rationale and nature of any digital health contributions be these economic, ethical, legal, or political.

Fourth, we need to be aware of the underlying *technology* and related infrastructure, by means of which the contribution is realised. Elements in this dimension may include software and hardware systems, medical devices, networks, security mechanisms, and even built environment. In digital terms, whether we are relying on telecommunications facilities, telehealth systems, mobile or computational devices, intelligent software, systems architectures, electronic patient records, or digital data standards, there is an inherent interconnectedness of ICT elements that needs to be understood and respected. We cannot expect to develop successful digital health solutions with ad hoc attitudes to the technology fundamentals.

Application of the Digital Health Contextual Framework

The use of this framework can be illustrated by revisiting the above two examples. In each case we offer a commentary on the four dimensions of the framework which provides a more balanced consideration of the overall context. We also identify some follow-on issues which may be better addressed from the more informed standing derived from the contextualised appreciation given by the framework. We

argue that the framework provides a better basis for understanding the contributions of digital health solutions, than merely focussing on one prominent aspect as is often done.

Mobile phone tracking. Mobile apps to support tracking can be applied to assist several *clinical processes*, such as self-monitoring of symptoms, prior contact tracing for infected patients, and confirmation of recovered status. These roles intersect with major *health system* components in primary care, acute care and public health. Obtaining benefit from their usage depends on addressing several *stakeholder* issues, primarily widespread opt-in user adoption by consumers, and a data management regime that assures integrity of data access and privacy protocols. Novel *technology* considerations will be needed for numerous aspects: the estimation and provision of resources such as mobile network connectivity traffic, appropriate data standardisation and summarisation tools, prioritisation of processing to achieve rapid intelligence, and providing a technical basis for trust in the integrity and security of the underlying data transport network.

Telehealth consultations. In the case of Telehealth, *clinical processes* span a wider range, as digital solutions can be used either immediately (synchronously) to provide direct care or advice and education in the conventional direct consultation setting (e.g. telephone or video), or else in a messaging framework (asynchronously) to transfer information or instructions when those are generated, for a less conventional indirect consultation setting (e.g., email or website). Similarly Telehealth spans several different *health system* elements, predominantly primary care but also the circle of allied health and care support entities which supply services for consumers, such as pharmacy and pathology. The major *stakeholders* who need to master use of the solutions are the clinicians and other healthcare professionals who make direct use of them, and the patients who are the recipients of consultation interactions or messages, although wider acceptance may also be needed for some solutions. The *technology* in this case is well established with many vendor supplied solutions, and considerations of scaling and reliability have long been discussed for telehealth services, for which some stable standards and operational protocols already exist.

Conclusion

We have defined a high level contextualisation framework with four dimensions, encompassing clinical processes, health systems, stakeholders and technology. We have illustrated the applicability of the framework in describing two COVID-19 related cases, which also provided examples of sub-dimensional elements.

The proposed framework maps the context of any given digital health contribution to the COVID-19 response, and provides a viable and useful tool to chart the emergence of

future offerings. If new contributions are reported using this structure, and their usage is explained with reference to the contextual dimensions, then the framework can help to enhance coordination and cooperation between groups working independently. We will then collectively and rapidly gain structured insights to major contextual inhibitors and enablers, and leverage that knowledge to arrive at clearer perspectives to drive rapid policy realignments. We can also prospectively apply the framework to some of the background activities which are out of the public view but certainly crucial to winning the fight, such as biomedical research for vaccines or testing agents, laboratory systems control, personal protective device manufacturing, and big data analyses and reporting, all of which have aspects of digital solutions embedded in them and interface points with the conventional digital health substrate.

This moves us on from the often opportunistic and competitive position for digital health innovation based on “gap” analysis and its associated challenges,²⁵ and the frequently narrow uncontextualised approaches taken towards evaluation and validation of digital health interventions,²⁶ towards one driven more by broad principles of clinical applicability, health system needs, and public good.

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