Applying the lessons of design thinking: a unique programme of care for acutely unwell, community-dwelling COVID-19 patients

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ABSTRACT

Background The COVID-19 pandemic limited access to primary care and in-person assessments requiring healthcare providers to re-envision care delivery for acutely unwell outpatients. Design thinking methodology has the potential to support the robust evolution of a new clinical model.

Aim To demonstrate how design thinking methodology can rapidly and rigorously create and evolve a safe, timely, equitable and patient-centred programme of care, and to share valuable lessons for effective implementation of design thinking solutions to address complex problems.

Method We describe how design thinking methodology was employed to create a new clinical model of care. Using the example of a novel telemedicine programme to support acutely unwell, community-dwelling COVID-19-positive patients called the London Urgent COVID-19 Care Clinic (LUC3), we show how continuous quality outcomes (safety, timeliness, equity and patient-centredness), as well as patient experience survey responses, can drive iterative changes in programme delivery.

Results The inspiration phase identified four key needs for this patient population: monitoring COVID-19 signs and symptoms; self-managing COVID-19 symptoms; managing other comorbidities in the setting of COVID-19; and escalating care as needed. Guided by these needs, a cross-disciplinary stakeholder group was engaged in the ideation and implementation phases to create a unique and comprehensive telemedicine programme (LUC3). During the implementation phase, LUC3 assessed 2202 community-based patients diagnosed with acute COVID-19; the collected quality outcomes and end-user feedback led to evolution of programme delivery.

Conclusion Design thinking methodology provided an essential framework and valuable lessons for the development of a safe, equitable, timely and patient-centred telemedicine care programme. The lessons learnt here—the importance of inclusive collaboration, using empathy to guide equity-focused interventions, leveraging continuous metrics to drive iteration and aiming for good-if-not-perfect plans—can serve as a road map for using design thinking for targeted healthcare problems.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Telemedicine and virtual care are well-established tools for the management of chronic conditions and recently discharged patients. During the COVID-19 pandemic, numerous models of virtual care were evolved to support community-dwelling patients with COVID-19.

WHAT THIS STUDY ADDS

Our study is the first to present how design thinking methodology can be applied to the evolution of a robust and unique telemedicine clinic which coupled patient-directed pulse oximetry and a direct admission pathway for acutely decompensating patients. Through inspiration, ideation and implementation phases, we demonstrate how to create and optimise a safe, timely, equitable and patient-centred telemedicine care programme to serve acutely unwell patients.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

As other healthcare innovators envision new models of care aimed at reducing acute care utilisation for acute conditions (eg, influenza, acute exacerbation of chronic obstructive pulmonary disease), we present the following important lessons from design thinking methodology that can be applied in other contexts: the importance of collaborating widely, early and often, using empathy to drive equity-based interventions, continuously monitoring and integrating meaningful metrics, and aiming for good, instead of perfection.

INTRODUCTION

Background

In March 2020, curbing the spread of COVID-19 and conserving finite acute care resources necessitated re-envisioning healthcare delivery models and expanding the use of virtual care.1–4 While already a well-established component of managing many chronic diseases before the pandemic, the
safety and effectiveness of virtual care in managing acutely unwell patients in the community were not yet established.\textsuperscript{5,6} During times of volatility and uncertainty, design thinking is an approach to rapidly develop innovative solutions.\textsuperscript{3} Like quality improvement, design thinking uses iterative assessments from the perspectives of patients, providers and healthcare systems to drive continuous modifications with the aim of meeting end-users’ and stakeholders’ needs.\textsuperscript{8–10} Several design thinking frameworks have been published, including the Design Council’s 4-stage Double Diamond, the Hasso Plattner Institute of Design at Stanford University 5-stage process and IDEO’s 3-stage model.\textsuperscript{7,11,12} Inherent to all frameworks is the non-linear and iterative process of divergence and convergence that prioritises deep empathy for end-user desires, needs and challenges to understand how a problem is experienced in the context of people’s lives; this serves as the foundation for developing insights about opportunities for change, and ideas for potentially comprehensive and effective solutions which can be rapidly prototyped and tested.\textsuperscript{8} In this way, design thinking is an excellent tool for achieving human-centred quality improvement, to drive continuous modifications with the aim of meeting end-users’ and stakeholders’ needs.

We followed the IDEO framework of inspiration, ideation and implementation to create a unique telemedicine programme to care for acute, non-hospitalised COVID-19 patients called the London Urgent COVID-19 Care Clinic (LUC3). Here, a narrative review of the design thinking methodology used to create LUC3 is presented, as well as a demonstration of how continuous measures of safety, timeliness, equity and patient-centredness can be used to iteratively adapt a clinic to meet the evolving needs of an acutely unwell patient population.

Design thinking approach

Inspiration
A key principle of design thinking is building empathy for the end-user when determining a solution to the problem they face.\textsuperscript{7} While the physical burden of COVID-19 infection on hospitalised patients was well described,\textsuperscript{13–15} patients worried about managing their physical and psychological symptoms when not in hospital. Community-dwelling patients and community practitioners voiced similar concerns compounded by issues with accessing care supports (local and non-local experiences are summarised in figure 1). These perspective and stories were sourced by the physician team working directly with COVID-19 patients in the hospital, and by contacting community practitioners and patients. From these observations and end-user stories, four key needs of community-based COVID-19-positive patients were identified: self-monitoring COVID-19 signs and symptoms; self-managing COVID-19 symptoms; managing other comorbidities in the setting of COVID-19; and escalating care as needed. Based on these key end-user needs, the overarching question was: How might we support the medical needs of the community-dwelling patient diagnosed with COVID-19 while avoiding unnecessary use of hospital-based resources?

Ideation
Generation of potential solutions
Brainstorming sessions during which each key need was framed as a further ‘How might we …?’ question identified potential solutions to support end-user needs (figure 1). Each potential solution was assessed in terms of desirability, feasibility and viability, and those that met all four of the previously identified key needs while also prioritising end-user safety were considered most desirable. Solutions that could be rapidly implemented, scaled and sustained despite resource constraints of the pandemic were considered most feasible and viable. Ultimately, the potential solution identified was a telemedicine care programme that included a telephone assessment with a physician with follow-up calls as needed, a patient symptom self-monitoring protocol, an oximeter delivered free of charge to the patient and access to an on-call team that could escalate care as needed.

Stakeholder mapping to facilitate radical collaboration
No single discipline can effectively address all aspects of complex health problems because problems of this scale bridge multiple sectors.\textsuperscript{8} The care of community-based COVID-19-positive patients spanned the domains of public health, primary care, paramedic, emergency department (ED) and inpatient services, making these groups key stakeholders and prime targets for collaboration (figure 1). These stakeholders were keen to support an outpatient care model that lessened the burden on emergency and inpatient services. Stakeholders also identified barriers and constraints to the proposed solution. Collaboratively exploring these constraints led to modifications to the proposed solution leading to an improved prototype; for example, incorporating paramedic-transported direct admission to COVID-19-designated inpatient beds for acutely decompensating patients. Stakeholder-identified constraints and collaborative resolutions are summarised in online supplemental box 1.

Rapid prototyping
Guided by the principle that the best prototypes are those that ‘command only as much time, effort, and investment as are needed to generate useful feedback and ‘evolve’ an idea’,\textsuperscript{7} the LUC3 prototype was created and tested for a 2-week period in March 2020. Dcruz et al provide a detailed description of LUC3 and an overview is presented in figure 2.\textsuperscript{16} After positive feedback from stakeholders, LUC3 secured funding to support its ongoing operational costs from the local Centre for Quality, Innovation and Safety in April 2020.

Implementation and continuous evaluation
Once a prototype is implemented, design thinking dictates that evaluation is needed to ensure that the
solution meets the needs of the end-users. It is arguably equally important, however, to ensure that the prototype does not cause unintended negative consequences (called balancing measures in quality improvement literature). Given that the needs of the patients (and the healthcare providers (HCPs) serving them) evolved from wave to wave, the LUC3 physician leaders prioritised continuous evaluation of safety, timeliness and efficacy to ensure the needs of the end-users were being met. Patients’ experience of programme acceptability and patient-centredness were also longitudinally collected, and their feedback guided iterative changes in LUC3’s delivery of care.

METHODS
Setting
This work occurred in Middlesex County, Ontario, Canada, which has a population of 530,000. The only urban centre within the county is the city of London, which is home to 400,000 people; the remainder of the region consists of rural, mostly agricultural, communities. While this area is largely populated by people whose first language is English, it also has a significant population of new Canadians who speak exclusively or primarily Spanish, Arabic or Cantonese among other languages.

London Health Sciences Centre (LHSC) is a tertiary care centre with 952 adult inpatient beds across two sites. While both hospitals provided inpatient care to

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**Figure 1** Summary of inspiration and ideation phases of design thinking process resulting in the creation of LUC3. NYC, New York City; EMS, emergency medical services; HCPs, healthcare providers; LUC3, London Urgent COVID-19 Care Clinic; PPE, personal protective equipment.
COVID-19-positive patients, those enrolled in LUC3 who required escalation to hospital admission via paramedic transportation went to one site where they had dedicated COVID-19-positive inpatient beds within the Respiratory Unit.

Team
The LUC3 team initially comprised two respirologists, one infectious diseases physician, three general internists, one nurse and one administrative assistant. As the pandemic progressed and case numbers rose, the team expanded to 14 physicians, 5 nurses and 4 administrative assistants.

Patient population
LUC3 accepted referrals of all adults (age >18 years) with a positive SARS-CoV-2 nasopharyngeal swab from four sources: the local Public Health Unit, local family doctors, LHSC’s EDs and following discharge from the LHSC inpatient service (figure 2). At LUC3’s inception, a database was designed to retrospectively collect patient demographics, comorbidities and outcomes for 30 days after the first telephone appointment (FTA).

Methods to establish safety, timeliness and equity
To inform iterative changes in programme delivery, we performed monthly audits of (1) patient safety outcomes as measured by COVID-19-related and non-COVID-19-related admissions and deaths; (2) timeliness of care as measured by median number of days between receipt of referral and FTA; (3) equity of care as measured by (a) proportion of patients who met criteria and received delivery of a free oximeter and (b) whether patients were offered and used translation services if their primary language was not English.

Admissions and deaths were identified by review of the electronic medical record (EMR), and distinction between COVID-19 related and non-COVID-19 related was adjudicated by two independent, non-LUC3 Department of Medicine physicians who had experience caring for patients with COVID-19. To further limit bias, these adjudications were carried out separately and in instances where there was a lack of consensus, a third physician adjudicator was recruited to make the determination. For patients with no EMR documentation at/beyond 30 days, an obituary search was conducted.

Information on ED utilisation and hospital admissions—both LUC3 arranged and non-LUC arranged—was collected and will be reported separately; analysis of the cost–benefit of LUC3 has been previously reported.

Methods to establish patient-centredness
Consent was obtained at the conclusion of the FTA to contact the patient via telephone to collect feedback on their experience. A quality improvement coordinator, blinded to patients’ care plan, conducted a standardised telephone Patient Experience Questionnaire (PEQ) at 5 and 60 days following FTA unless the patient had declined to participate. If the initial call went unanswered, up to five attempts were made on subsequent days, after which the patient was not contacted further. Patients used 5-point Likert scales to answer questions related to their care and experience of LUC3, and were given the opportunity to respond to three free-text questions.

In response to the free-text questions, patient responses of ‘no’ or ‘nothing’ were removed from analysis, and the remaining responses were subjected to inductive (thematic) analysis. One coder reviewed all responses to each of the free-text questions and identified common themes that became the preliminary ‘codes’. These
preliminary codes were refined through repeat readings to form the final themes. A consistency check was performed by a second coder to ensure the reliability of these final themes. Inter-rater reliability was assessed by comparing the degree to which each of the two coders assigned patient comments to the same theme.

**Synthesis of end-user feedback to guide iterative changes**

The team of LUC3 physician leaders met biweekly throughout the project to evaluate patient and stakeholder feedback. Data, including end-user feedback, were routinely shared with stakeholders including hospital administration, pandemic leadership teams and local public health to help inform real-time decisions regarding delivery of care.

**Analysis**

All descriptive statistics were completed using SPSS software V.28.

**RESULTS**

LUC3 assessed 2202 COVID-19-positive patients between March 2020 and December 2021; 35% of these patients met criteria for higher acuity monitoring via the Yellow Flag monitoring system (figure 2) which included daily phone call check-ins from a nurse or physician. The median patient age was 48 years (34–60 IQR) and 56.3% were female. Patient demographics and comorbid statuses are summarised in table 1. Measures of safety, timeliness and equity are presented in table 2.

**Safety**

Within 30 days of FTA, 145 (6.6%) LUC3 patients required admission to hospital and, of those, 61 (42%) were directly admitted via the paramedic-transported escalation pathway. Proof of life or death was documented for 2150 patients; a total of 12 deaths occurred in hospital, 11 of which were COVID-19 related. Obituary searches were conducted for the remaining 52 patients who had no proof of life or death documented in the EMR, which identified two additional deaths in the community (causes were not documented). Death outcomes were unavailable for the remaining 50 patients.

**Timeliness**

Patients were assessed within a median of 2 days (IQR 2–4 days) of LUC3 receiving the referral. When routine review of wait times for FTA trended toward 3 days, administrative assistants identified that longer wait times occurred if a referral was received on a Thursday or Friday. LUC3 responded by adding a weekend clinic during waves with increased referrals, which maintained a median wait time of 2 days.

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**Table 1** Baseline characteristics of LUC3 patient population

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total population n=2202</th>
<th>Wave 1* n=117</th>
<th>Wave 2 n=926</th>
<th>Wave 3 n=923</th>
<th>Wave 4 n=236</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (IQR)</td>
<td>48 (34–60)</td>
<td>46 (34–57.5)</td>
<td>47 (32–60)</td>
<td>49 (36–61)</td>
<td>50 (38–64)</td>
</tr>
<tr>
<td>Sex female (%)</td>
<td>1239 (56.3)</td>
<td>74 (63.2)</td>
<td>532 (67.5)</td>
<td>501 (54.3)</td>
<td>132 (56)</td>
</tr>
<tr>
<td><strong>Referral source (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Public Health Unit</td>
<td>1455 (66)</td>
<td>92 (79)</td>
<td>779 (84.1)</td>
<td>471 (51)</td>
<td>113 (47.9)</td>
</tr>
<tr>
<td>Emergency department/urgent care</td>
<td>303 (14)</td>
<td>6 (5)</td>
<td>47 (5.1)</td>
<td>191 (20.7)</td>
<td>59 (25)</td>
</tr>
<tr>
<td>Hospital-based physician</td>
<td>279 (13)</td>
<td>11 (10)</td>
<td>61 (6.6)</td>
<td>169 (18.3)</td>
<td>38 (16.1)</td>
</tr>
<tr>
<td>Family physician</td>
<td>138 (6)</td>
<td>6 (5)</td>
<td>36 (3.9)</td>
<td>74 (8)</td>
<td>9 (1.3)</td>
</tr>
<tr>
<td>Other</td>
<td>24 (1)</td>
<td>0</td>
<td>3 (0.3)</td>
<td>18 (2)</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td><strong>Comorbidities (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>545 (25)</td>
<td>34 (29)</td>
<td>220 (24)</td>
<td>244 (26)</td>
<td>47 (20)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>344 (15.7)</td>
<td>17 (14.5)</td>
<td>144 (15.6)</td>
<td>143 (15.5)</td>
<td>40 (17)</td>
</tr>
<tr>
<td>Dyslipidaemia</td>
<td>299 (13.6)</td>
<td>11 (9.4)</td>
<td>134 (14.5)</td>
<td>129 (14)</td>
<td>25 (10.6)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>46 (2.1)</td>
<td>2 (1.7)</td>
<td>23 (2.5)</td>
<td>13 (1.4)</td>
<td>8 (3.4)</td>
</tr>
<tr>
<td>COPD</td>
<td>47 (2.1)</td>
<td>1 (0.9)</td>
<td>20 (2.2)</td>
<td>20 (2.2)</td>
<td>6 (2.5)</td>
</tr>
<tr>
<td>Asthma</td>
<td>268 (12.2)</td>
<td>14 (12)</td>
<td>115 (12.4)</td>
<td>100 (10.8)</td>
<td>39 (16.5)</td>
</tr>
<tr>
<td>Past or active malignancy</td>
<td>132 (6)</td>
<td>6 (5)</td>
<td>54 (6)</td>
<td>59 (6.4)</td>
<td>13 (5.5)</td>
</tr>
<tr>
<td><strong>Other (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smoker</td>
<td>173 (8)</td>
<td>7 (6)</td>
<td>58 (6.3)</td>
<td>77 (8.3)</td>
<td>31 (13.1)</td>
</tr>
<tr>
<td>If female, was pregnant (% of F)</td>
<td>60 (5)</td>
<td>2 (2.7)</td>
<td>17 (3.2)</td>
<td>35 (7)</td>
<td>6 (4.5)</td>
</tr>
</tbody>
</table>

*Dates of waves and predominant variant are described in online supplemental box 2.

COPD, chronic obstructive pulmonary disease; LUC3, London Urgent COVID-19 Care Clinic.
Equity

Most patients (65%) met the clinical criteria to receive an oximeter. All qualifying patients received a device via courier free of charge regardless of housing status, including those patients residing in public isolation spaces.

While majority of assessments were conducted in English, telemedicine translation services were available in all requested languages. Commonly requested languages were Spanish, Arabic, Chinese (Mandarin/Cantonese), Rohingya and Khmer. LUC3’s written resources were available in English, Spanish and Arabic.

Patient-centredness

Of the 1741 patients contacted via telephone to complete the PEQ, 1274 (73.2%) of patients completed the 5-day
post-FTA PEQ, and 991 (56.9%) completed both the 5-day and 60-day post-FTA PEQs. At 5 days post-FTA, most patients agreed/strongly agreed that the HCP was sensitive to their needs (97.6%), treated them with dignity and respect (99.5%), and that the encounter helped them feel less anxious (89.7%). At 60 days post-FTA, most patients agreed/strongly agreed that during follow-up appointments, the HCP was sensitive to their needs (95%), treated them with dignity and respect (96.4%), and that the encounter helped them feel less anxious (84.7%). When asked about communication with LUC3, most patients agreed/strongly agreed that the HCP gave clear instruction about what to do after the visit (95.7%) and they explained things in a way that was easy to understand (98.2%).

Patient responses to three free-text questions related to their experience with LUC3 were subjected to inductive qualitative (thematic) analysis. Inter-rater reliability across the three questions was 0.84 (good). The top three themes for each question were as follows:

**Question 1: Was there anything done particularly well?** A total of 567 responses were analysed for this question, of which 205 (36%) fell into the theme of ‘general appreciation’ which included expressions of appreciation and/or thankfulness for LUC3 or the overall experience with the clinic. Other significant themes identified were related to: the care that patients received/experienced (32%); patient appreciation of physicians, nurses and staff (28%); and effective communication (19%).

**Question 2: Was there anything that could be improved?** Of the 242 responses analysed for this question, 96 (40%) were related to ‘communication’ being an area for improvement with one-third of these (32 of 96) commenting on test results (eg, X-rays, pulmonary function, etc) not being communicated to the patient. Other significant themes identified included: the desire/suggestion for additional follow-up LUC3 appointments (18%), and that the first visit/appointment did not take place soon enough (10%).

**Question 3: Is there anything else that you would like us to know or share with us about the experience of your care?** A total of 229 responses were analysed for this question. Most responses (163, 71%) were encompassed in the ‘general positive comment’ theme which included such things as the helpfulness of the clinic, patient happiness and that LUC3 was ‘good’. A second theme identified was that of ‘appreciation/gratitude’ in which 36 comments (16%) specifically expressed gratitude and/or appreciation for the clinic, staff, process and/or experience.

### Iterative design changes based on continuous outcomes and end-user feedback

During biweekly meetings, LUC3 clinical staff reviewed continuously collected outcomes and end-user feedback. These data informed iterative changes to LUC3 practices to better meet the evolving needs of the end-users and stakeholders (examples shown in **table 3**).

### DISCUSSION

This is a unique example of using design thinking to develop a model of healthcare for acutely unwell, community-dwelling patients. While the innovation described here is specific for needs that arose during the COVID-19 pandemic, the principles of design thinking exemplified can be applied to other acute patient populations and are summarised as four key lessons:

**Lesson 1: collaborate widely, early and often**

While other telemedicine, remote patient monitoring and virtual care clinics were developed to support the needs of community-dwelling COVID-19 patients,18-21 the advantage of intentionally employing design thinking

### Table 3  Changes to LUC3 practice based on continuous data and end-user feedback

<table>
<thead>
<tr>
<th>Data point or end-user feedback</th>
<th>Timeline</th>
<th>Sphere of impact</th>
<th>Solutions and implementation plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for translated patient materials for non-English-speaking patients</td>
<td>Waves 1 &amp; 2</td>
<td>Equity, patient-centredness</td>
<td>Creation of written materials for Spanish and Arabic-speaking patients</td>
</tr>
<tr>
<td>Patient anxiety about timing of investigations</td>
<td>Waves 1 &amp; 2</td>
<td>Patient-centredness</td>
<td>Administrative staff notified LUC3 clinical staff of waiting times for pending investigations and staff communicated these proactively to address patient anxiety</td>
</tr>
<tr>
<td>Delayed or missed communication of test results</td>
<td>Waves 1 &amp; 2</td>
<td>Patient-centredness, safety</td>
<td>Creation of a call-back system for ordered test results</td>
</tr>
<tr>
<td>Underserved vulnerable communities (eg, unhoused) not receiving care</td>
<td>Wave 2</td>
<td>Equity, patient-centredness</td>
<td>Collaboration with local isolation spaces to provide care and oximeters to patients who were unhoused</td>
</tr>
<tr>
<td>Increase in average time between referral and FTA</td>
<td>Waves 2 &amp; 3</td>
<td>Timeliness, safety</td>
<td>Introduction of additional weekend clinics</td>
</tr>
</tbody>
</table>
is its emphasis on iterative adaptation to meet evolving patient and provider needs. Early engagement of a broad cross-disciplinary group of stakeholders invited critical review of the initial solution and allowed for problem-solving of identified constraints, thus generating a more robust prototype from the outset. This was exemplified by the initial plan to direct decompensating patients to isolation beds in the ED; however, stakeholders expressed concern that EDs were already overtaxed (online supplemental box 2). Collaboration with paramedic services and the inpatient Respiratory Unit then led to the development of a unique direct-admission pathway to the inpatient COVID-19 unit. Of the 145 LUC3 patients hospitalised within 30 days of their FTA, 61 were admitted via the direct admission pathway, thus avoiding 61 patient presentations to the ED. Furthermore, circumventing the ED decreased the risk of SARS-CoV-2 transmission among the ED patient population. During subsequent waves, changes to paramedic protocols necessitated several modifications to how the pathway was triggered, once again highlighting the importance of ongoing stakeholder collaboration to ensure LUC3 met the evolving needs of both the patients and collaborators.

Lesson 2: use empathy to drive equity
Aaronson et al stressed that the use of design thinking prioritises human end-users’ needs before those of the hospital and healthcare system. During the inspiration phase, admitted patients reported high levels of anxiety, fear and isolation after their COVID-19 diagnosis. Local physicians theorised that pairing pulse oximetry with daily access to an HCP would promote self-management of symptoms and reduce anxiety. PEQ data substantiated this theory as patients reported general appreciation for LUC3 and, in particular, LUC3 effectively communicated self-management strategies following clinic appointments and made them feel less anxious. A recent systematic review likewise concluded that remote patient monitoring programmes can positively impact anxiety in acutely unwell community-dwelling patients.

Community providers expressed concerns during the ideation phase about accessing supplies for isolated persons. LUC3 ensured that a pulse oximeter was delivered free of charge to 100% of patients who met criteria to receive one, including those experiencing homelessness. To ensure equitable access to pulse oximeters, LUC3 proactively partnered with the public health authorities and local community housing that had created an isolation space for people diagnosed with COVID-19 who were experiencing homelessness to arrange centralised delivery. Likewise, LUC3 coordinated with nearby Indigenous community organisations (Southwestern Ontario Aboriginal Health Access Centre) and farms where migrant workers were affected to arrange telephone assessments and delivery of oximeters.

Other patient populations that are often disproportionately impacted by disparate access to virtual care include: those with limited access to or familiarity with technology, elderly persons, those with cognitive, visual or auditory impairments, and non-native language speakers. At its inception, LUC3 adopted a telephone clinic model, circumventing the need for computers or smart phones. English and Spanish are primary languages in the local community; thus, LUC3’s written resources were prepared in both languages; written materials were later translated into Arabic in response to patient requests. Both administrators and HCPs used the institutionally endorsed translation service to book and conduct assessments, and no language requests went unmet. To ensure feedback was representative of the LUC3 population, patient experience surveys were also completed with translation services. When purposefully applied, empathy is an essential driver of designing innovative models of care that meet the needs of all patients.

Lesson 3: monitor meaningful metrics to inform iterative changes
An intentional and systematic approach to monitoring patient outcomes and feedback allows data-informed iterative changes, as opposed to reactionary responses to isolated events or experiences. A pragmatic example of managing timeliness in LUC3 was continuously monitoring the median wait times from referral to FTA. As caseloads increased in waves 2 and 3, administrative staff explored the root cause of this trend, found that this change was being driven by referrals received on a Thursday or Friday, and LUC3 responded by adding a weekend clinic during times of high referral rates to maintain the target median number of days to FTA. LUC3’s systematic approach to monitoring patient safety events was a team-based case review within 7 days of when patients were admitted to hospital or died with the goal of identifying modifiable factors. This practice identified increasing symptom burden and frequency of hypoxia during waves 2 and 3; LUC3’s solution was to recruit more physician, nursing and administrative support to ensure access to care 24 hours per day via the on-call physician.

LUC3 stakeholders recognised the importance of monitoring for unintended consequences of modifying elements of the programme. After the initial wave, for example, physicians became more efficient during telephone assessments; as caseloads increased, they reduced each FTA and follow-up appointment length by 15 min, thus allowing more patients to be assessed. To ensure this change did not negatively impact patient-centredness, PEQ data monitoring found that patients’ impressions of HCPs’ sensitivity to their needs and level of dignity and respect shown were unchanged. Furthermore, PEQ data did not indicate a negative impact on the HCPs’ delivery of self-monitoring instructions despite the reduced appointment time. Continuous evaluation of outcome measures and feedback was an essential part of LUC3 design thinking methodology and facilitated nimble adjustments in response to changing end-user needs.
Lesson 4: don’t let perfect be the enemy of good

A tenet of design thinking is that a solution does not have to be perfect to make a positive impact. After identifying a problem, ideating possible solutions, collaborating with stakeholders and continuously improving the solution, there may still be end-users who feel improvement is required. When this occurs, it is important to remain focused on the overall goal: improving the end-users’ experience by finding actionable items. In the case of LUC3, initial patient PEQ responses revealed that the design and execution of LUC3 were well received and overall well appreciated. However, when asked what could be improved, 40% of respondents identified communication as an area for improvement. This contrasted with the Likert scale responses that indicated that most patients agreed or strongly agreed that ‘things were explained in a way that was easy to understand’ and that ‘instructions were clear about what to do after the visit’. To find actionable items, further exploration of the thematic analysis showed that one-third of the comments about communication were related to waiting times for tests and results (eg, LUC3-ordered X-rays or pulmonary function tests). LUC3 responded to this concern by faxing test results to the patient’s family physician, or, if no family physician was available, communicating test results directly to the patient. This example highlights that while a solution may have gaps, it can still have a meaningful impact while these gaps are explored and resolved in real time.

Limitations

There was no pre-existing standard of care for managing patients affected by COVID-19 in the community, which confounded direct comparisons with LUC3. The mortality rate, for example, for hospitalised LUC3 patients was 8.2% as compared with the reported mortality rate of 19.9% for Ontario’s hospitalised patients with COVID-19; however, the LUC3 cohort did not include individuals from long-term care, making the mortality rate comparison difficult to interpret.

While there was heavy emphasis on patient stories during the inspiration phase and patient experience gathered through the PEQ to direct iterative changes to the design, no specific patient voice was included in the early ideate/prototype stage of the care programme. Had a patient stakeholder been involved earlier, some barriers and challenges may have been anticipated and circumvented prior to the implementation phase.

Conclusions

This paper provides a unique example of applying design thinking methodology to the creation of a telemedicine programme for an acutely unwell community-dwelling patient population. It demonstrates the value of engaging stakeholders across what are often siloed areas of healthcare including public health, community medicine, emergency medicine, paramedic services and acute care medicine. Empathy, radical collaboration and iterative assessment resulted in a safe, timely, equitable and well-received patient-centred model. The lessons provided here are an important road map for healthcare providers as they envision using virtual care for other acute conditions—particularly respiratory illness such as influenza or acute exacerbation of chronic obstructive pulmonary disease—in a similarly empathetic, thoughtful and rapidly responsive manner.

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Contributors

MKD and ES were responsible for study design. MKD, ES, MM, MN and JC were responsible for care programme design, evolution and implementation. YHK and JK were responsible for data collection. NM and MDR were responsible for data analysis. MKD and ES wrote the manuscript, and all authors reviewed the manuscript. MD and ES are the guarantors of this work.

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Competing interests

None declared.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication

Not applicable.

Ethics approval

This project was exempt from Research Ethics Board review, in accordance with the Government of Canada Tri-Council Policy Statement on Research Ethics.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data availability statement

All data relevant to the study are included in the article or uploaded as supplemental information. N/A.

Supplemental material

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REFERENCES


### Supplemental Box: 1: Barriers and constraints cited by stakeholders and the collaborative resolutions noted during the ideation and implementation stages of clinic development

<table>
<thead>
<tr>
<th>Constraints Cited</th>
<th>Collaborative Resolutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of funding source</td>
<td>• Initial investment from Department of Medicine’s <em>Centre for Quality, Innovation, and Safety</em> (C-QuINS)</td>
</tr>
<tr>
<td></td>
<td>• Overtime, a successful application to provincial government for ongoing funding support</td>
</tr>
<tr>
<td>Over-stretched emergency department resources</td>
<td>• Collaborating with stakeholders in paramedic, emergency medicine, and inpatient respirology, we designed a direct admission pathway to bypass the emergency department, and have decompensating patients admitted directly to the dedicated COVID respirology unit</td>
</tr>
<tr>
<td></td>
<td>• Protocols adjusted over the course of the pandemic to reflect changing resources and patient population demands</td>
</tr>
<tr>
<td>Concern for risk management and patient safety</td>
<td>• Development of clear and explicit protocols for escalating care to LUC3 physician, Paramedics, Emergency Medicine, and Inpatient Care teams</td>
</tr>
<tr>
<td></td>
<td>• 7 days a week call schedule staffed by specialists in Internal Medicine</td>
</tr>
<tr>
<td></td>
<td>• Creation of a database to track quality and patient safety outcomes</td>
</tr>
<tr>
<td></td>
<td>• Regular audits of quality and patient safety outcomes</td>
</tr>
<tr>
<td>Limited clinical staffing to provide timely service</td>
<td>• Ongoing staff recruitment of physicians to provide clinical care</td>
</tr>
<tr>
<td></td>
<td>• Addition of nursing team to help support daily phone calls</td>
</tr>
<tr>
<td></td>
<td>• Addition of increased administrative support to facilitate increased patient population in further waves</td>
</tr>
<tr>
<td>Accessing courier resources</td>
<td>• Courier services availability fluctuated throughout pandemic</td>
</tr>
<tr>
<td></td>
<td>• Team members identified as Supplier Leads</td>
</tr>
<tr>
<td>Limited access to pulse oximeters</td>
<td>• Rapid adjustment to identify new oximeter suppliers</td>
</tr>
<tr>
<td>Integration with changing Public Health testing and provincial pandemic response</td>
<td>• Ongoing collaboration, including regular meetings with local public health and provincial authorities to streamline process and ensure equitable care for the community</td>
</tr>
</tbody>
</table>
Supplemental Box 2: COVID Waves in London, Ontario

<table>
<thead>
<tr>
<th>Wave</th>
<th>Start Date</th>
<th>End Date</th>
<th>Variant most frequently identified if mutation testing was performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>February 26, 2020</td>
<td>August 31, 2020</td>
<td>Mutation testing not performed</td>
</tr>
<tr>
<td>2</td>
<td>September 1, 2020</td>
<td>February 28, 2021</td>
<td>Wild-type</td>
</tr>
<tr>
<td>3</td>
<td>March 1, 2021</td>
<td>July 31, 2021</td>
<td>Alpha</td>
</tr>
<tr>
<td>4</td>
<td>August 1, 2021</td>
<td>December 14, 2021</td>
<td>Delta</td>
</tr>
</tbody>
</table>


2. Data used for variants identified by waves are derived from local public health data publicly available online [here](https://www.healthunit.com/novel-coronavirus#COVID-19-Cases-in-Middle-Sex-London Accessed May 31, 2022.)

See below for Appendix Data.

https://app.powerbi.com/view/?r=eyJrIjoiMzE5MzJ0THOWE2ZS00MDNLTkNDEtMTcyYTg5OGFhMTFiwidC16ImRjNTYxMjk1LTdjYTtNDFhOS04M2JmLTUwODM0ZDZhOWQwZiJ9