Improving the efficiency of virtual insulin teaching for patients admitted to hospital through the COVID-19 pandemic: a quality improvement initiative

Jeffery Tong,1,2 Rebecca Meehan,2 Dane Iannicello,1 Raymond Li,1 Tisha Joy,1,2 Tamara Spaic,2,3 Tsan-Hua Tung,3 Kristin K Clemens1,2,3

ABSTRACT
Background Throughout the COVID-19 pandemic, many areas of medicine transitioned to virtual care. For patients with diabetes admitted to hospital, this included diabetes education and insulin teaching. Shifting to a virtual model of insulin teaching created new challenges for inpatient certified diabetes educators (CDE).

Objective We advanced a quality improvement project to improve the efficiency of safe and effective virtual insulin teaching throughout the COVID-19 pandemic. Our primary aim was to reduce the mean time between CDE referral to successful inpatient insulin teach by 0.5 days.

Design, setting, participants We conducted this initiative at two large academic hospitals between April 2020 and September 2021. We included all admitted patients with diabetes who were referred to our CDE for inpatient insulin teaching and education.

Intervention Alongside a multidisciplinary team of project stakeholders, we created and studied a CDE-led, virtual (video conference or telephone) insulin teaching programme. As tests of change, we added a streamlined method to deliver insulin pens to the ward for patient teaching, created a new electronic order set and included patient-care facilitators in the scheduling process.

Main outcome and measures Our main outcome measure was the mean time between CDE referral and successful insulin teach-back. Our process measure was the percentage of successful insulin pen deliveries to the ward for teaching. As balance measures, we captured the percentage of patients with a successful insulin teach, the time between insulin teach and hospital discharge, and readmissions to hospital for diabetes-related complications.

Results Our tests of change improved the efficiency of safe and effective virtual insulin teaching by 0.27 days. The virtual model appeared less efficient than usual in-person care.

Conclusions In our centre, virtual insulin teaching supported patients admitted to hospital through the pandemic. Improving the administrative efficiency of virtual models and leveraging key stakeholders remain important for long-term sustainability.

WHAT IS ALREADY KNOWN ON THIS TOPIC
⇒ The use of virtual tools to deliver healthcare can support outpatients with chronic disease when physical barriers exist. The efficiency of virtual insulin teaching for patients admitted to hospital remains unclear.

WHAT THIS STUDY ADDS
⇒ We successfully implemented a certified diabetes educator-led, virtual, insulin teaching programme for patients with diabetes admitted to hospital during the COVID-19 pandemic. While we were able to improve the efficiency of virtual teaching without adverse consequences, virtual processes appeared less efficient than in-person teaching.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY
⇒ Our project may help practitioners implement efficient virtual care models into their own practice. It stresses the importance of optimising the administrative components of virtual care and engaging key stakeholders in the development and delivery of programming.

INTRODUCTION

Problem description
Hyperglycaemia is extremely common in patients admitted to hospital.1 In a study of over 2000 adult patients admitted to a community hospital, hyperglycaemia occurred in 38% of patients, and just under one-third had no history of diabetes.2 Hyperglycaemia has also been associated with a higher risk of in-hospital mortality and longer hospital stays.2

Most clinical practice guidelines recommend insulin as first-line treatment for the management of inpatient hyperglycaemia.3 For those newly initiated on insulin or requiring a switch to a different insulin regimen (eg, basal insulin to multiple daily injections), related teaching is necessary.
In hospitals and community settings, certified diabetes educators (CDEs) play an essential role in insulin education. CDEs are skilled in not only teaching patients the mechanics of insulin injection, but they can educate patients about risks and side effects of therapy along with diabetes-related complications.1

Prior to the COVID-19 pandemic, insulin teaching at our centre was provided through an in-person CDE at the patient’s bedside. With the first wave of the pandemic, our hospital shifted to the provision of virtual models of care wherever possible. Virtual care via phone or video conference allowed us to minimise points of contact with patients, and the potential spread of the virus.

Shifting to a virtual insulin teaching model, however, created many new challenges for our diabetes education team. Patients required assistance with the necessary technology to conduct virtual visits, hospital wards needed insulin supplies (prefilled pens and needles) on site (educators could no longer bring supplies to the bedside), and patients needed to be able to show correct insulin administration for safety (ie, ‘teach-back’).5 There were also many administrative tasks required to set up the virtual consultation, new processes with data protection and privacy, and the changing of existing systems and workflows that are currently optimised for in-person patient care.6

In this quality improvement (QI) project, we aimed to improve the efficiency of successful virtual inpatient insulin teaching by 0.5 days during the COVID-19 pandemic.

METHODS
We used the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines 2.0 for the reporting of QI projects (online supplemental appendix table 1).7

Patient and public involvement
Patients or the public were not formally involved in the design, conduct, reporting or dissemination plans for our research.

Setting
We conducted this project in two large tertiary care hospitals in Canada (University Hospital and Victoria Hospital, London Health Sciences Centre). Before the pandemic, insulin teaching and education was provided to admitted patients in person, and could be coordinated and completed at the patient’s bedside within 1–2 days of referral. Our CDEs followed a teach-back approach; following insulin teaching, patients were asked to demonstrate how much information they learnt during their session.5

In March 2020, when the first wave of the pandemic hit our region, our team followed hospital and public health recommendations to urgently institute virtual care. The provision of virtual insulin teaching allowed us to limit patient contact and promote the conservation of personal protective equipment. Multiple services within the hospital made the same transition from in-person to alternative delivery services during this time.

Transitioning to virtual care, however, required a substantial change to existing workflow that was complex and inefficient (online supplemental appendix figure 1). For example, patients who met criteria for insulin teaching had to first be contacted during their admission, in order to determine the appropriateness of video conferencing (eg, access to technology, appropriate level of cognition to participate). Web links required circulation to patients by email, which they accessed through their personal devices using hospital internet (eg, phones and iPads). Personal phone numbers also had to be collected where video conferencing was not possible.

Moreover, admitted patients had to acquire insulin pens for physical teaching. This was necessary to demonstrate the patient’s injection technique, and to show that they have sufficient understanding of the education provided.5 Prior to the pandemic, pens were delivered to the bedside by the in-person CDE. The virtual model, however, required the most responsible inpatient physician to order the necessary insulin pens on the electronic medical record system. These pens then required delivery to the ward from pharmacy in advance of the virtual education session. Demonstration of injection technique then had to be shared with the CDE by video conference, or to the bedside nurse in the case of phone visits.

Collection of data
We assessed the ‘baseline efficiency’ of our virtual model as soon as it was implemented in April 2020 and we continued to collect data until June 2020. As we pivoted back to in-person insulin teaching between June 2020 and December 2020, we also captured efficiency information about our standard in-person model.

Aim
Our primary aim was to reduce the mean time between CDE referral to successful virtual insulin teaching by 0.5 days.

Root cause analysis
We used a cause-and-effect diagram to identify the root causes for inefficiencies with our baseline virtual model (online supplemental appendix figure 2). This analysis was conducted alongside key project stakeholders including endocrinologists, diabetes educators, patient care facilitators (PCFs), pharmacists and support staff.

Intervention
After reviewing our root cause analysis, stakeholders felt that major contributors to virtual inefficiencies were the need for multiple phone calls to set up a virtual teaching appointment (eg, ensuring access to smart phone or a touchscreen tablet and collection of email and phone numbers), as well as difficulty completing the teach due to patient readiness (cognitive barriers, lack of family member presence, etc). There were also notable delays in having insulin pens sent from pharmacy to the wards to be used for injection demonstration.

We decided to advance three tests of change over the study period using Plan-Do-Study-Act (PDSA) cycles.
First, we worked with inpatient pharmacists and pharmacy leaders to develop a method to improve the efficiency of insulin pen delivery to the ward for teaching. This included marking the delivery as a ‘high priority’ in the electronic record so that the pen could reach the floor as quickly as possible (PDSA-1). Second, we created a new electronic order set that included mandatory fields including consult priority (ie, anticipated discharge timeline), need for a non-English language interpreter and/or family member for the teaching, insulin types to be taught and used, and any other special considerations (PDSA-2). The intent of this new order was to ensure patient readiness for virtual teaching and to minimise time spent gathering information to conduct the teach. Lastly, near the end of the project we started to mobilise PCFs to help patients set up the technology needed for virtual teaching (PDSA-3). PCFs in our centre function as a liaison between the medical team and patients and their supports. They promote collaboration, communication and assist with discharge planning. We anticipated that the inclusion of care facilitators would reduce the burden of administrative tasks on the CDE and help us anticipate discharge timelines.

**Family of measures**

We captured all measures continuously over the study period. Our main outcome measure was the mean number of days from CDE referral to safe and successful insulin teach (ie, safe insulin ‘teach-back’ demonstrated by patient). Process measures included the percentage of successful insulin pen deliveries to the ward in advance of the teach. Our balance measures included length of hospital stay, percentage of patients with successful insulin teaching and 30-day readmissions for acute diabetes complications (hyperglycaemia and hypoglycaemia).

**Analysis**

We used descriptive statistics (means, medians, numbers, percentages) to summarise patient characteristics over the study period. To examine the impact of our intervention on outcome measures, we compared the difference in means between the two virtual periods (preintervention and postintervention). We also used run charts to descriptively present data over time using QI Macros.

**RESULTS**

We received a total of 414 referrals for inpatient diabetes education between April 2020 and September 2021. Of these referrals, 307 (74%) were for inpatient insulin teaching.

The characteristics of the 307 included patients are displayed in **Table 1**. There were no missing data. Mean age was 57 years and 63.2% were male. Most patients had type 2 diabetes (74.3%). A new insulin start was the most common reason for referral (88.9%). Mean haemoglobin A1c on referral was 10.1%.

**Table 1** Characteristics of 307 patients seen by CDEs for insulin teaching (April 2020–September 2021)

<table>
<thead>
<tr>
<th>Baseline characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)±SD</td>
<td>57±16</td>
</tr>
<tr>
<td>Sex (% male)</td>
<td>194 (63.2)</td>
</tr>
<tr>
<td>Diabetes type</td>
<td></td>
</tr>
<tr>
<td>Type 2 diabetes (n, %)</td>
<td>228 (74.3)</td>
</tr>
<tr>
<td>Type 1 diabetes (n, %)</td>
<td>35 (11.4)</td>
</tr>
<tr>
<td>Other (n, %)</td>
<td>44 (14.3)</td>
</tr>
<tr>
<td>New diabetes diagnosis (n, %)</td>
<td>116 (37.8)</td>
</tr>
<tr>
<td>New insulin start (n, %)</td>
<td>273 (88.9)</td>
</tr>
<tr>
<td>Mode of teaching</td>
<td></td>
</tr>
<tr>
<td>In-person education (n, %)</td>
<td>150 (48.9)</td>
</tr>
<tr>
<td>Virtual education—phone (n, %)</td>
<td>68 (22.1)</td>
</tr>
<tr>
<td>Virtual education—WebEx (n, %)</td>
<td>89 (29.3)</td>
</tr>
<tr>
<td>Mean A1C at admission±SD (%)</td>
<td>10.1±3.1</td>
</tr>
</tbody>
</table>

CDEs, certified diabetes educators.

**Implementation of intervention**

Over the study period, just over half of the consultations were done virtually with video conferencing being used 29.3%, and phone used in 22.1%.

We executed our first test of change using our virtual platform in December 2020 (PDSA-1), streamlining of insulin pen deliveries. This was followed shortly by the launch of our updated electronic order set (PDSA-2) and involvement of PCFs (PDSA-3) (January 2021).

**Outcome measures**

Our tests of change improved the efficacy of virtual insulin teaching by 0.27 days on average (**figure 1**).

**Process measures**

Although there was some month-to-month variability, there was a positive trend in the timely delivery of insulin pens to the ward (online supplemental appendix figure 3).

**Balance measures**

We did not identify any adverse consequences. There was no difference in the length of hospital stay of included patients (online supplemental appendix figure 4). A similar percentage had a successful insulin teach at that time, including a lack of corrective lenses, acute confusion and dexterity issues. Readmissions for hyperglycaemia and hypoglycaemia did not change over the study period.
DISCUSSION

Main findings

Virtual care can support patients with diabetes. Indeed previous studies have investigated its utility in outpatient insulin pump training, nurse case management and in the provision of outpatient diabetes consultations, including during pandemic times. To our knowledge, ours is the first QI project focused on improving the efficiency of virtual insulin teaching for patients admitted to hospital during the COVID-19 pandemic.

Our virtual care pathway and tests of change improved the efficiency of safe and effective virtual teaching. However, did not meet our goal of reducing teaching time by 0.5 days. We suspect that this is because of the ongoing administrative burden of virtual teaching that was difficult to address at the time of our study. We did not, for example, have access to an administrative assistant to help with scheduling. Moreover, many of our virtual tasks still required the support of inpatient care providers (eg, bedside nursing to facilitated insulin
In September 2021, we were not able to fully examine an efficient way to provide diabetes education, and since then, the project has been modified and virtual care under highly uncertain circumstances. We safely supported people with diabetes requiring insulin teaching, but overall, virtual care remained less efficient than in-person care. We were not able to examine if there was an improvement in outcomes between the types of virtual platforms used (eg, video conferencing vs phone). We suspect using video conferencing required more administrative preparation, but may have been more helpful to the CDE directly observe and interact with patients. Regardless, our study illustrates our clinical resilience to the pandemic and our ability to quickly pivot to and modify, virtual care under highly uncertain circumstances. We safely supported people with diabetes requiring insulin, and successfully provided virtual education in a timeline manner without unintended consequences. With the wide introduction of virtual tools in medicine and diabetes, our project highlights the importance of QI methods in healthcare delivery. It also provides a starting point for a virtual teaching framework that could be modified and tested in other healthcare settings.

Strengths and weaknesses
Throughout the height of the pandemic, we launched a rigorous QI study and engaged key stakeholders in its planning and delivery. In terms of limitations, it would have been ideal to capture more baseline data prior to the transition to virtual models in April 2020, but given we transitioned our processes very quickly, we were unable to do so. Also, given we shifted back to in-person care delivery in September 2021, we were not able to fully examine the utility of involving PCFs in the process (PDSA-3), or examine the utility of other tests of change that may have improved the efficiency of our virtual programme. For example, the engagement of bedside nurses, clinical administrators or pharmacists may have been helpful to streamline processes. Moreover, while we collaborated with patients with diabetes throughout this experience, unfortunately we did not have the bandwidth to formally survey them about their teaching experience during this busy time. We also were not able to examine if there was a difference in outcomes between the types of virtual platforms used (eg, video conferencing vs phone). We suspect using video conferencing required more administrative preparation, but may have been more helpful to the CDE directly observe and interact with patients.

Regardless, our study illustrates our clinical resilience to the pandemic and our ability to quickly pivot to and modify, virtual care under highly uncertain circumstances. We safely supported people with diabetes requiring insulin, and successfully provided virtual education in a timeline manner without unintended consequences. With the wide introduction of virtual tools in medicine and diabetes, our project highlights the importance of QI methods in healthcare delivery. It also provides a starting point for a virtual teaching framework that could be modified and tested in other healthcare settings.

CONCLUSIONS
We successfully implemented a CDE-led virtual insulin teaching pathway during the COVID-19 pandemic. With iterative tests of change, we improved the efficiency of insulin teaching, but overall, virtual care remained less efficient than in-person support. Our project serves as a strong foundation to further iterate should inpatient virtual care be needed again in the future.

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Contributors
JT contributed to the design of the project, collected and analysed data and drafted the manuscript. RM, DI, RL, TJ and TS helped to conceptualised the project, interpreted results and reviewed the manuscript. T-HT aided in the analysis and interpretation of findings and she reviewed the manuscript. KKC conceptualised and designed the study, helped to analyse and interpret results and developed the manuscript. KKC is responsible for the overall content and is the guarantor 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, conduct, or reporting, or dissemination plans of this research.

Patient consent for publication
Not applicable.

Ethics approval
This project was classified as a QI by our local research ethics board, and ethics approval was waived. Patient information collected for this study was kept confidential and protected.

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Data availability statement
Data are available on reasonable request.

Supplemental material
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ORCID iDs
Jeffery Tong http://orcid.org/0000-0003-4176-4827
Kristin K Clemens http://orcid.org/0000-0001-9636-5597

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