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Development, implementation and evaluation of high-quality virtual preoperative anaesthetic assessment during COVID-19 and beyond: a quality improvement report

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ABSTRACT

Background Preoperative risk factor identification and optimisation are widely accepted as the gold standard of care for elective surgery and are essential for reducing morbidity and mortality. COVID-19 public health restrictions required a careful balance between ensuring best medical practices and maintaining safety by minimising patient face-to-face attendance in the hospital. Based on the successful implementation of telemedicine (TM) in other medical specialties and its feasibility in the preoperative context, this study aimed to develop, implement and evaluate a high-quality virtual preoperative anaesthetic assessment process.

Methods The three-step model for improvement was used. The specific, measurable, actionable, relevant, time aim (step 1) and measures for improvement (step 2) were defined at the onset of the project. The plan–do–study–act tool was used for the structured implementation of improvement interventions (step 3) in three phases. Data relating to virtual and in-person referrals, assessments, did-not-attend (DNA) rate, consultation time, day of surgery delays and cancellations, and service-user and provider experience surveys were recorded prospectively.

Results A total of 2805 patients were assessed in the preoperative anaesthetic assessment clinic between July 2020 and March 2021. The mean rate of virtual preoperative assessments was 50% (SD ±10) (1390/2805). 0.1% (30/2805) were inappropriately referred on the alternative pathway. The DNA rate was 0.4% (8/1398) and 3% (43/1458) for virtual and in-person pathways, respectively. The mean consultation times for virtual and in-person attendance were 19 (SD ±7) and 31 (SD ±13) min, respectively. There were five same-day surgery cancellations and one delay due to medical reasons. When asked about their experience with the virtual assessment, both service users and providers reported high satisfaction, minimal technical difficulties and shared concerns about limited opportunities for physical examination.

Conclusion This is one of the first implementational studies to comprehensively outline the feasibility of TM in preoperative anaesthetic assessment during COVID-19.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Preoperative identification and optimisation of risk factors are essential for reducing surgical morbidity and mortality. The COVID-19 restrictions for in-person hospital attendance require careful balance between ensuring best medical practices and maintaining safety by minimising face-to-face consultations.

WHAT THIS STUDY ADDS

⇒ This 9-month prospective project demonstrates a successful development, implementation and evaluation of a high-quality telemedical preoperative anaesthetic assessment pathway. It defines criteria for patient selection, referral, evaluation and escalation to in-person consultation.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of this study support future sustainability and scalability of telemedicine for preoperative anaesthetic assessment during COVID-19 pandemic and beyond.

INTRODUCTION

Problem description

Morbidity and inpatient mortality after non-cardiac surgery are currently estimated to be 16.8% and 0.5%%–1.5%, respectively.[1] Additionally, patients who survive postoperative complications commonly experience functional limitations and reduced long-term survival.[2–4] The identification and optimisation of preoperative risk factors during preoperative assessment (PA) process are essential for reducing morbidity and mortality and therefore are widely accepted as the gold standard of care for elective surgery.[5 6] During the COVD-19 pandemic restrictions, the curtailment of traditional face-to-face model of PA delivery led to exploration of telemedicine (TM).

The Coombe Women and Infants University Hospital, Dublin, is a tertiary referral maternal and gynaecological centre with over 7700 deliveries and 8700 elective and emergency inpatient surgeries in 2019.[7] Over 95% of all elective surgical admissions were preassessed in-person at the preoperative anaesthetic assessment clinic (PAAC) in 2019, with day of surgery admissions of >98% (national target>75%), did-not-attend (DNA) rate of <1% and day of surgery delays and cancellations of <1%.[8] With the outbreak of the COVID-19 pandemic, PAAC was required to continue the provision of safe and effective services within the constraints of on-going public health restrictions that demanded a minimisation of in-person attendances. This quality improvement project (QIP) explored virtual consultations as an alternative form of PA.

Available knowledge

TM has existed for decades and is well established in medical specialities such as emergency medicine; diabetic care; mental health; pain clinics; cardiovascular, respirator and gastrointestinal care; paediatrics; and cancer care.[9–12]

In 2004, Wong *et al* reported the use of TM exclusively in preoperative evaluation.[13] Current published data outline two types of technology and clinic set-ups. In the facilitated virtual visit (FVV) type, applicable mainly for patients in rural areas or as part of transcontinental research, two separate video-consultation clinics are connected through a videoconferencing link.[13–21]

In the second type, the video consultations are conducted through patients' personal digital devices (smartphones, personal computer and tablets) in non-clinical locations.[22–27]

Previous studies mainly enrolled adult subjects. However, two studies described the application of telemedical preassessment in paediatric populations, and one did so in obstetric populations.[14 27 28] Patients were scheduled for oral and maxillofacial surgery in three studies and for head and neck procedures in one study.[17–19 24] Mullen-Fortino *et al* expanded the focus to other surgical specialities.[23]

A limited number of studies have consistently compared the accuracy of video and in-person assessments and exams. In a retrospective study, Wood *et al* reported that 98% of virtually assessed patients had a sufficient medical and physical examination and that 95.9% had a sufficient diagnosis and treatment plan.[19] In a similar study, Rollert *et al* maintained that 100% of patients were assessed correctly and underwent uneventful general anaesthesia.[18] In one of the largest randomised studies to date, 155 patients were randomly assigned a face-to-face or virtual PA. The latter group experienced accurate examinations and superior documentation with a reported 98% concordance between the virtual and in-person lung and heart exam findings.[17] Additionally, Wong *et al* reported better airway examinations as a result of the illumination from the camera in virtual PA.[13] All four studies were designed as FVV. Only one case report described a successful use of a patient's smartphone for airway examination to facilitate further treatment.[24]

Evidence suggests improved resource use and theatre efficacy through enhanced access, while the rate of theatre cancellations remains similar to the one reported for in-person PA.[17 22 23 26 29 30] Improved time efficiency has been reported with shorter consultation and saved travel times.[23 31 32]

Cost reduction with virtual PA has been demonstrated for both patients and hospitals.[31] From an organisational perspective, the amount saved as a result of telemedical assessment and the elimination of in-office attendance was significant, even after accounting for the initial investment for equipment.[19]

In the first published study on TM for PA, satisfaction was high for patients, anaesthetists who performed the consultation and their colleagues who cared for the patients in theatre.[13] Later studies present similar results with satisfaction and perceived efficacy as high as 98% and 95%, respectively.[15 17 20 23 26 31] When surveyed after surgery, 97% of patients preferred virtual PA.[29] This high satisfaction level was independent of travel distance, American Society of Anaesthesiologists Physical Status score, duration of surgery and even dissatisfaction with anaesthesia. The reported high level of provider satisfaction was based on the ability to obtain history, discuss anticipated problems and provide instructions.[17] Three studies report notable dissatisfaction related to limited internet access, poor email usage and concerns with data security.[25 33 34] In a recent randomised controlled trial, comparing in-person and telephone PA, Gibas *et al* demonstrate no significant difference in patient anxiety level before and after the consultation in both groups.[35]

Rationale

The rationale for this project was to reduce in-person PAAC attendance during COVID-19 restrictions while maintaining a high-quality, effective and safe virtual PA process. PA is defined as a formal consultation by an anaesthetist, typically conducted days or weeks prior to surgery and in outpatient PAAC.[36] 'Virtual assessment' is defined as either conducted by phone or video. 'In-person' assessment is conducted face-to-face either as a 'walk-in' (on the day of surgical visit) or by 'appointment' (on a separate hospital visit exclusively for the purpose of PA).

A new pathway was introduced as an alternative to the existing in-person assessment for eligible patients. Once surgery was decided, the patients were screened at the obstetrics and gynaecology outpatient clinics for suitability for virtual assessment pathway. The obstetric and gynaecology teams were trained to use a specific decision tool to assign patients to either virtual or in-person PA.

'High-quality' was considered in the context of the six dimensions of healthcare quality.[37]

Specific aim

To serve a more practical purpose, a specific aim was defined using the specific, measurable, actionable,

relevant, time (SMART) framework.[38] The SMART aim was as follows: over 95% of all obstetric and gynaecology patients, suitable for virtual assessment, would be identified, referred and assessed through this pathway between July 2020 and March 2021.

METHODS

Context

To ensure a complete analysis of all relevant contextual factors in this project, the model for understanding improvement in quality (MUSIQ) framework was used.[39]

PAAC as a microsystem has a strong record of providing high-quality, safe and patient-centred perioperative care. The multidisciplinary quality improvement (QI) team (7 consultant anaesthetists, 16 trainees, a fellow in perioperative medicine, a clinical nurse manager, a staff nurse and a clerical support person) had attended various training forums and had completed several QIPs prior commencing this initiative.

Strong senior management commitment to TM initiatives and well-established governance structures to guide, support and oversee improvement efforts were identified as important organisational factors for this QIP. The project also aligned with the hospital mission to deliver 'excellence in the care of women and their babies'.[7]

While MUSIQ identifies external factors and triggers as only 'indirectly' influencing the success of QI, these factors played a central role in driving the project forward.[39] Before COVID-19, video anaesthetic consultations had been considered a possible alternative but had gained no external support. The pandemic catapulted TM to its current place. National and local governing bodies actively encouraged the implementation of virtual consultations by providing resources, staff teaching and training, software and equipment. As such, the public health restrictions, coupled with external and local support, played a direct role in this project's success, negating many previously reported challenges to improving quality, especially 'convincing people that there is a relevant problem and that the chosen solution is the right one'.[40]

Interventions

The model for improvement was the main method used in this project because it is well adapted for the dynamic nature of healthcare and helps the mind conceptualise these complexities with three focused questions.[41]

Once the SMART aim was selected, a flowchart (see 'Flowchart', online supplemental material 4) and a driver diagram (see 'Driver diagram', online supplemental material 3) were used to visually display the local PA process in three stages: referral from gynaecology or antenatal outpatient departments, assessment in PAAC and uneventful surgery in operating theatre (OT). The flowchart and driver diagram were also used as sources of ideas for interventions. Each intervention was assessed according to the Template for Intervention Description and Replication guide.[42]

Study of the interventions

Once the opportunities for change interventions were identified and discussed by the team, they were introduced into practice through small-scale tests called the plan–do–study–act (PDSA) cycles. Data and knowledge accumulated through one series of PDSA cycles generated new, more refined ideas, which instigated a new series of PDSA cycles. Therefore, the change interventions that started in one phase were often refined in the next through 'ramps of PDSA cycles'. The following interventions took place in the respected three phases of the project:

- *Phase 0 (preinnovation)*, March–June 2020.
  QI team formation and evolution through previously described stages.[43]
  Team meetings for idea brainstorming.
  Literature review.
- *Phase I (innovation)*, July–September 2020.
  Stakeholder identification trough power-influence grid. Individual interviews and focus group discussions were conducted.
  Decision-making (DM) tools for obstetrics (see 'Decision-making obstetrics', online supplemental material 2) and gynaecology (see 'Decision-making gynaecology', online supplemental material 1) enabled surgeons to screen patients for TM suitability and facilitated subsequent assignment on the appropriate pathway. In general, patients with no significant history of medical-related, surgical-related, obstetric-related or anaesthetic-related problems and/or conditions, body mass index (BMI) of ≤40, age ≤65 (gynaecology), major surgery and no language barrier were considered suitable for virtual assessment.
  Development and introduction of hospital 'virtual consultation' guide for anaesthetists, including a protocol for the video airway examination. The consent process was aligned with the hospital General Data Protection Regulation requirements.
  Written and video information for patients was designed for the hospital website. A link to this information was emailed to patients to prepare them for the upcoming consultation, including the airway examination.
  Hardware, software and infrastructure upgrade to meet the practical needs and legal requirements.
- *Phase II (pilot)*, October–December 2020. Video consultations were initially introduced for a small number of patients and gradually replaced the phone assessments.
  Staff training with the new video platform.
  A list of common technological troubleshootings was created to aid improved consultations.
- *Phase III (spread)*, January 2021–March 2021. In this phase, the new video pathway became the preferred virtual assessment mode due to the possibility to

examine the airway. Phone assessments were considered only when there was a problem with the video platform or internet access or for patient preference.

A 24-item online service user experience survey was included in the invite email to all video-assessed patients between 1 February and 31 March 2021 (full list of questions and patients' responses could be found in 'Video anaesthetic clinic–patients survey', online supplemental material 6). Using binary scale answers or Likert scale answers of 3–5 points, it aimed to assess patient perceptions in six domains: patient category, technical quality, readiness for video consultation, affective experience, perceived efficacy and patient preference.

An 18-item online service provider experience survey was distributed via email in the first 10 days of April 2020 to the 18 anaesthetists who conducted video consultations in PAAC (full list of questions and doctors' responses could be found in 'Video anaesthetic clinic–doctors survey', online supplemental material 5). The following five domains were assessed using either binary or 5-point Likert scale-level of anaesthetic experience, estimated number of independently performed video consultations, technical quality, familiarity with the clinic guide for video consultations, degree of support received, affective experience and perceived efficacy.

Measures

The three measure types, their role in the project and specific measurements are listed in table 1:

Analysis

Microsoft Excel V.16.43 and Socscistatistics software (www.socscistatistics.com) were used to record and analyse quantitative and qualitative data in traditional parametric and non-parametric methods. Means and SD were reported unless outliers were identified, in which case medians (IQR) were reported. Comparisons were made with a χ^2 test for two unpaired samples, and p values of <0.05 were considered statistically significant.

Qualitative methods such as group and individual interviews with doctors, nurses and patients; Gemba walks; and surveys were employed to gain insight into and generate hypotheses about the causative or moderating forces in the QIP, including how they contribute to actual improvement.

RESULTS

Outcome measures

Number of patients assessed in each pathway and their evolution over time

A total of 2805 patients were assessed in PAAC between July 2020 and March 2021. 1,390/2,805 attended the virtual pathway, which accounts for 50% (±10) of all cases.

Table 1 Measures (outcome, process and balance) and measurements

Measure	Measurements
Outcome measures (aligned with the aim and monitored for the duration of the project) Source of data: hospital electronic booking system	► Primary referrals. Percentage of suitable patients identified, referred and assessed weekly through the virtual pathway. ► Secondary referrals. Percentage of patients incorrectly referred to PAAC through the virtual pathway but requiring an additional in-person assessment due to medical-related, anaesthetic-related or surgical-related issues. Percentage of patients unnecessarily referred for in-person assessments but having no contraindications for virtual PA.
Process measures (reflecting factors in the system that might cause unplanned variation in the outcome throughout the project)	► Number of patients not referred to PAAC was recorded manually and reported monthly by the OT manager and CNM2 based on the number of patients who arrived in OT without PA. ► Number of patients who were referred to and received an appointment for PA consultation but DNA for each pathway was extracted from the hospital electronic system weekly. ► Number of patients whose surgeries were delayed or cancelled due to incomplete PA was recorded manually by the CNM2
Balance measures (not directly related to the aim and occurred when changes designed to improve one part of the system introduced unwanted changes elsewhere, that is, time, staff and resources allocation and satisfaction)	► Service user and provider experience surveys. ► Cost-effectiveness analysis. ► Mean time for virtual and in-person consultations was measured during the last 4 weeks of the project. ► PAAC capacity use was expressed as actual activity (number of patients assessed per day) and theoretical (maximum) capacity (number of new and return patients PAAC can assess per day provided all agreed rules and assumptions are adhered to in terms of clinic times, staff rostering, equipment, etc).[45]

CNM2, clinical nurse manager; DNA, did not attend; OT, operating theatre; PA, preoperative assessment; PAAC, preanaesthetic assessment clinic.

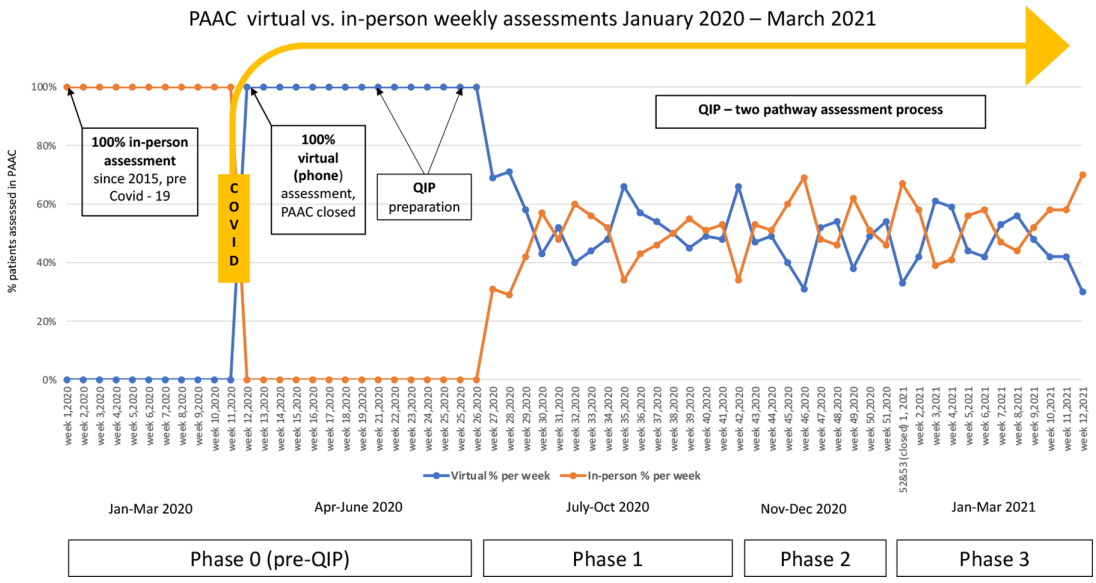

Figure 1 Run chart of preoperative assessment over time, run chart. The run chart presents 15 months of PAAC attendance both pre-implementation and postimplementation of the virtual pathway. PAAC, preoperative anaesthetic assessment clinic; QIP, quality improvement project.

Both pathways were further split into two forms. The ratio between in-person attendance on the day of surgical outpatient visit (walk in) and scheduled primary appointment on a different day remained stable for the duration of the project with 46% (650/1415) and 52% (737/1415), respectively. In contrast, the virtual assessment gradually transitioned from 100% phone to 87% video platform over time.

The run chart in figure 1 illustrates the contextual elements and their interaction with the interventions over time.

The run chart in figure 2 focuses on the weekly variation in percentage of virtually assessed patients between July 2020 and March 2021 with a median rate of 49% (IQR 42–54). The two trends are circled in red (weeks 35–39, 2020, and weeks 8–12, 2021)

Secondary referrals

Of the referred patients, 0.1% (38/2805) could have been referred through the alternative pathway (secondary appointments). Ten patients had no contraindications precluding them from virtual assessment but chose in-person attendance regardless. The remaining 28 virtually referred patients required secondary appointments for in-person assessments due to issues identified from the medical records or during the virtual consultation. The reasons for these secondary in-person consultations were medical condition(s) (14/28), anaesthetic-related

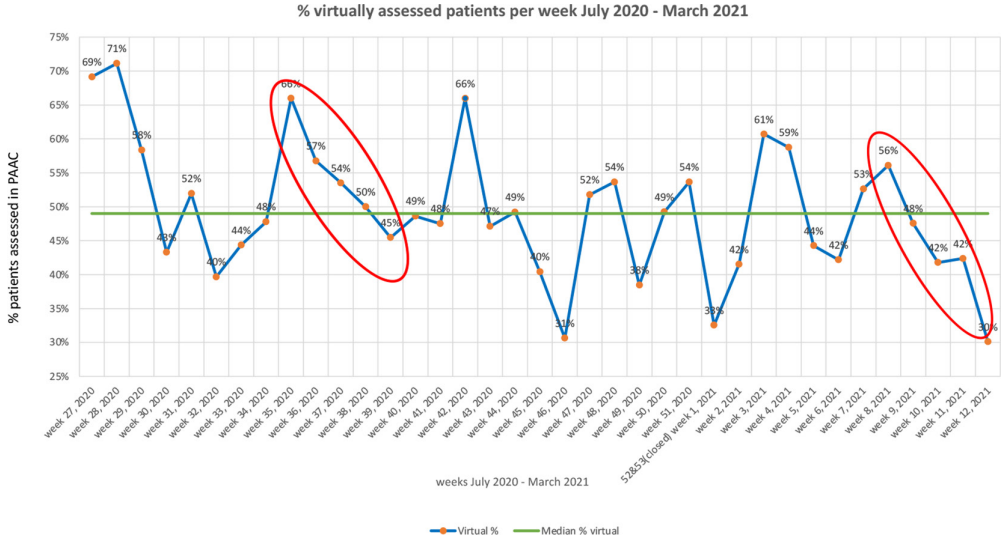

Figure 2 Run chart of virtual assessment attendance by week. The two trends, circled in red, are suggestive of special cause variation in the virtual assessment attendance during these weeks. PAAC, preanaesthetic assessment clinic.

problems in the past (8/28), major surgery (1/28), language barrier (1/28) or a combination of them (4/28).

Process measures

DNA rate

The total PAAC *DNA rate* was 1.8% (51/2856), with 0.6% (8/1398) and 3% (43/1458) for the virtual and in-person pathways, respectively.

A χ^2 test of independence was performed to examine the relation between assessment pathway and DNA. The relation between these variables was significant (χ^2 (1, n=2856)=22.1992, p<0.00001).

Patients not referred to PAAC

We failed to consistently record the number of patients not referred for assessment due to COVID-19-related intermittent service closures, unrecorded number of patients assessed on the day of surgery and staff relocation.

Day of surgery cancellation or delay

Five gynaecological patients were *cancelled on the day of surgery* due to incomplete PA (two virtual and three in-person). One obstetric patient, who was assessed in-person, was delayed due to lack of medical reports from other hospitals. The latter was contacted over the phone and the case proceeded to uneventful delivery.

Balance measures

Service user experience survey

Patient response rate was 38% (72/189). Of the patients who competed the survey, 19% (13/72) received obstetric care and 81% (58/72) received gynaecological care. Ninety-six per cent reported no technical difficulties, and 85% had read and watched the suggested information prior the consultation. Patients reported an overwhelmingly positive affective experience. One hundred per cent (72/72) strongly agreed or agreed that the explanations about anaesthetics were clear and that they felt listened to. Ninety-nine per cent (71/72) strongly agreed or agreed that the consultation time was sufficient, that they were actively invited to ask questions and that the consultation met their needs. Ninety-six per cent (69/72) strongly agreed or agreed that their concerns about anaesthetics were addressed. Ninety-three per cent (67/72) strongly agreed or agreed that they felt involved in the DM process regarding the best anaesthetic option for them.

Ninety-nine per cent (71/72) and 96% (69/72) agreed that the video consultation saved them time and money, respectively. Although 100% reported that they 'would be happy to use this form of consultation in the future', 19% (13/69) would prefer an in-person consultation due to concerns with the airway assessment or lack of previous experience with video platforms.

Service provider experience survey

The response rate for anaesthetists was 61% (11/18). While all were of opinion that the platform was easy to operate, 9% highlighted instances of technical challenges. Of the 91% who were familiar with the virtual assessment guide, 73% strongly agreed or agreed that it was easily applied in practice. Although 100% strongly agreed or agreed that the camera did not affect their ability to perform the consultation, 18% had concerns that the video platform might hinder them from formulating a safe anaesthetic plan. Of the respondents, 100% were positive about the potential of TM to transform the practice of perioperative medicine in future.

Cost effectiveness

Although the initial investment for hardware and software was available for calculation, a complete cost-effectiveness analysis was not conducted due to lack of clarity regarding hospital monetary benefit as a result of reduced footfall to the clinic. Patients were not asked to report direct (travel) and opportunity costs (childcare, time off work, parking fees, etc).

Mean time for virtual and in-person consultations

The mean times for virtual and in-person consultations were 19 (SD ±7) and 31 (SD ±13) min, respectively. When additional times for documentation, review of ECG, blood results, teaching, training and communication with primary teams were taken into account, the average time per consultation in PAAC was estimated to be 45 min.

Capacity use

Sixteen patients were referred on average per day (demand), which accounted for 720 min (actual activity). Theoretical (maximum) capacity was calculated at 840 min/day. Therefore, following the implementation of the virtual pathway, PAAC capacity use was 86%.

DISCUSSION

This project set out to develop, implement and evaluate a high-quality, effective and safe virtual PA process in the context of the COVID-19 pandemic. A total of 1390 of 2805 gynaecology and obstetric patients were identified, referred and assessed virtually prior to their surgery, which led to 50% (±10) reduction in the patient footfall to PAAC. The new pathway was associated with reduced DNA rates and no increase in OT delays, unanticipated change in the planned anaesthetic and/or cancellations. Both service users and providers reported high satisfaction with the TM service.

With 99.9% of suitable patients correctly identified, referred and assessed on the virtual pathway, the *project aim* (>95%) was successfully achieved. As a result of the reduced footfall to PAAC, the capacity for walk-in consultations increased by 130% (from 20% to 46%), therefore negating the need for an additional trip to the hospital for these patients.

The observed *weekly variations* in the percentage of virtually assessed patient were random and caused by patient-specific factors (comorbidities, age, BMI >40), which indicated in-person attendance. They were

non-modifiable in the immediate preoperative context and could not be predicted. The two trends, which suggest a special cause variation, could be explained by the reopening of elective gynae surgery due to reduced public health restrictions and proportionally higher number of patients, that had previously been postponed, were now assessed.

The DNA rate for PA in outpatient settings is poorly reported, likely due to variations in the process and system set-up. The comparison with local prepandemic data indicates that, although the DNA rate for the video pathway was further reduced by 40%, the DNA rate for in-person assessments during COVID-19 has doubled (200%). The video pathway therefore improved the safe access to PA in times of public restrictions.

The observed difference between the *mean time* for video consultation in this study (19±7 min) and previously reported times (31±7 min) could be due to the additional time taken to set up the remote and consultation sites and the use of a digital stethoscope in Wong *et al*'s study.[13]

It is important to note that the demand did not exceed the *capacity* and therefore the new pathway did not require additional resources (staff, time and space).

The 5/2805 cancellations and 1/2805 delays recorded in this study indicated that the new TM assessments did not hinder the high institutional standards.

A comparison between the two feedback *surveys* revealed that both *service users and providers* experienced minimal technical difficulties, were highly satisfied and shared concerns about limited opportunities for examination and data safety. This study confirms previously reported high levels of patient and staff satisfaction and the perceived efficacy of virtual assessment.[15 17 20 23 26 31] While previous studies have reported specialist comfort, privacy concerns and comfort with the camera as reasons for dissatisfaction, patients in this study were primarily concerned with the possibility of omissions in virtual as opposed to in-person consultations.[14] However, the different designs of previous studies limit the generalisability of these findings.

The *strengths* of this study are its 9-month prospective nature; scientific QI methodology; large sample size; inclusion of previous training in QI; Multi-disciplinary team (MDT) and service user involvement in the design and implementation of the new virtual pathway; and selection of quantitative and qualitative measures to assess its outcome, process and balance. This project also defines criteria for patient selection, referral, evaluation, airway assessment and escalation to in-person consultation.

This project had several *limitations*. First, the generalisability of this study's findings is limited by its specific structure and the high-volume of low-risk patient population of a stand-alone maternal/gynaecological hospital. Replication of this study's results may also be hindered by a lack of personnel, support from the hospital administration and internet access, and limited device availability or platform use.

Second, the acceptability, sustainability and scalability of virtual PA must be analysed in light of the COVID-19 pandemic.[44] TM had limited application for PA before the global pandemic. Recent increase in patient familiarity with virtual operations (banking, schooling, etc), coupled with the safety concerns related to travel restrictions, shifted the risk–benefit balance towards virtual attendance. However, using TM in the wider perioperative context for activities such as surgical schools, prehabilitation consultations, antenatal classes, MDT discussion forums, etc, is likely to be guided by future research evidence.

Third, the study contains some design imperfections that have resulted in limited internal validity. Physical examinations that focus on the airway as well as investigations (ECG, blood tests, etc) will remain a challenge when patients' personal devices are used. Local arrangements for alternative methods of acquiring this vital information are needed. For example, in this project, virtual patients requiring blood tests were directed to phlebotomy on the day of their COVID-19 preoperative test, without the need to attend PAAC.

Fourth, this study is limited by current gaps in technology, privacy and safety in data sharing, the availability of encrypted platforms and internet protections.

Finally, the conceptual difference between QIP and scientific research is also a limitation. This study would have been more scientifically robust if it was designed to evaluate the same cohort of patients through virtual and in-person consultations and compare selected parameters of quality, safety and effectiveness. In this case, the patients would have been their own controls and with previously established inter-rater variability. Such a controlled randomised study would have contributed more precise evidence-based knowledge. It would have also been beneficial to randomly assign eligible patients to virtual or in-person assessment.

CONCLUSION

This is one of the first implementational studies to use a sample of over 2800 patients to comprehensively demonstrate the feasibility of TM in PA. This project achieved its aim of developing, implementing and evaluating a high-quality, safe and effective virtual PA during the COVID-19 pandemic. Future controlled trials are needed to determine the optimal place, role and method of TM in the wider context of preoperative patient evaluation and optimisation.

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Patient consent for publication Not applicable.

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Provenance and peer review Not commissioned; externally peer reviewed.

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