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# Are the goals of the virtual exercise classes for musculoskeletal (MSK) conditions being met? A service evaluation

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**Abstract**

**Background:** The COVID-19 pandemic prompted a shift to virtual physiotherapy services in the UK, aiming for cost-effective and safe rehabilitation. This evaluation focused on the efficiency of virtual classes for managing non-urgent lower limb conditions amidst the gradual return of face-to-face (F2F) classes. As pandemic guidelines evolved, F2F exercise classes were re-integrated along with virtual exercise classes. At this time, virtual classes were thought to be essential to maintain patient treatment, but the service has not been evaluated concerning efficiency and (potential barriers affecting) patient uptake, also in light of the diverse community St. Mary's Hospital - Imperial College serves.

**Methods:** Forty-nine patient records were reviewed, assessing attendance, discharge rates, and outcomes. Virtual classes demonstrated good patient adherence (77%) and facilitated patient discharge (61%), reducing clinician time. However, missing data limited the assessment's comprehensiveness, notably regarding safety, barriers affecting class uptake, adverse events, and primary outcome measures like the Musculoskeletal Health Questionnaire (MSK-HQ; 98% missing).

**Results:** The findings support the efficacy of virtual classes but highlight the need for more rigorous data collection and documentation standards to ensure a comprehensive evaluation. Key recommendations include improving clinician documentation, tracking patient-specific benefits, and conducting audits for clinical oversight. These actions are crucial for maintaining physiotherapy standards and enhancing the effectiveness of virtual exercise classes.

**Conclusion:** Virtual classes demonstrate potential for managing lower limb conditions, showing good adherence and facilitating patient discharge. However, missing data underscores the importance of robust data collection and documentation. Future evaluations should focus on improving documentation standards and conducting audits for clinical oversight, essential for maintaining physiotherapy standards and optimising virtual exercise class outcomes.

**Keywords**
F2F, MSK- HQ, telerehabilitation, virtual classes, service evaluation

## Introduction

In response to the COVID-19 pandemic in the UK, many outpatient physiotherapy services quickly shifted from face-to-face (F2F) to remote delivery to comply with social distancing guidelines[1]. The pandemic accelerated the growth of remote treatment and diagnoses, a field that has expanded over the past 20 years due to technological advancements and improved remote patient-monitoring devices[2-3]. Telerehabilitation provides a viable alternative for patients awaiting in-person treatment and those facing logistical challenges in accessing centralised healthcare services, which can increase travel times[4-5]. The growth of this field necessitates defining these services for common usage. Medical or rehabilitative care provided via telecommunications or the internet is often termed 'telerehabilitation,' though 'telemedicine' and 'telehealth' are also used[6-8].

Brennan et al. (2010)[9] highlighted that telerehabilitation enables remote patient assessments, interventions, education, consultation, and counseling. Advances in communication technologies, pre- and post-pandemic[10], have facilitated the use of web and telephone-based applications in neurological[11-12],

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musculoskeletal[13-14], and post-operative conditions[15]. Heiskanen et al.[16] found that over half of 216 Finnish rehabilitation professionals used telerehabilitation with most clients during the first COVID-19 wave, with many planning to continue post-pandemic. Similar findings in the United States and Croatia[17] demonstrate the growing popularity of telerehabilitation services.

With telerehabilitation services becoming more common, increasing data supports their potential effectiveness[18]. A systematic review and meta-analysis by Wang et al.[19] evaluated the efficacy of telerehabilitation for patients after total joint arthroplasty, focusing on pain, range of motion (ROM), physical function, quality of life (QoL), satisfaction, and psychological well-being. The review included 11 studies of adults following primary total joint arthroplasty, excluding revision, unicompartmental, or bilateral replacements. The intervention and reported follow-up duration varied between studies, with three not establishing long-term follow-up- of participants. The authors found that telerehabilitation had similar effectiveness with F2F rehabilitation for the outcomes of pain, knee ROM, and patient-reported physical function. Additionally, a systematic review and meta-analysis by Jiang et al.[20] found that telerehabilitation led to significantly better extension range and quadriceps strength than F2F rehabilitation, which is crucial for post-TKR self-ambulation[21]. These improvements may be due to greater compliance, fewer barriers (i.e., no travel, easy access to equipment), and longer exercise duration in telerehabilitation compared to F2F physiotherapy[19,22]. Thus, telerehabilitation may offer comparable or better outcomes than F2F rehabilitation. However, more rigorous, long-term studies are needed.

To integrate telerehabilitation into standard care, it is crucial to consider its benefits, barriers, and comparability to face-to-face services[20,23]. Bennell et al.[24] conducted a mixed methods study using national online surveys to examine physiotherapists' and patients' experiences with videoconferencing during the COVID-19 pandemic. Patients reported positive experiences, citing benefits like exercising with others, feeling safe, and reduced transportation costs. However, physiotherapists reported barriers. Firstly, the lack of physical touch and inability to thoroughly assess or perform manual therapy was recognised as a limitation[25]. Secondly, more than half of participating physiotherapists lacked training in telerehabilitation at the onset of the COVID-19 pandemic, making them feel inadequately prepared to deliver these services[26]. Graham et al.[27] emphasised that most adults adopt telerehabilitation successfully, but technology coaching by healthcare providers (HCPs) in the early stages ensures successful navigation and engagement with the service. Despite being time-consuming, coaching could improve outcomes by enhancing both physiotherapists' and patients' ability to navigate the platform and fully participate in telerehabilitation services.

In May 2021, outpatient, physiotherapy telerehabilitation services were organised by St. Mary's Hospital- Imperial College; these consisted of two 6-week virtual exercise programmes for patients with non-urgent, early rehabilitation, lower limb needs (i.e., patients' post-fracture, post-arthroscopy, ligament pathology/repair, total joint replacement). Virtual exercise classes were considered as the best option to deliver these services at the time, due to benefits to telerehabilitation outlined above[19,22]. However, alongside these virtual classes, in the past two years F2F exercise groups have also been reinstated at St. Mary's Hospital- Imperial College. Hence, given the potential barriers associated with telerehabilitation i.e., no hands-on assessment, need to invest clinical time[25-27] there is a need to evaluate the telerehabilitation programmes offered at St. Mary's Hospital- Imperial College. In particular, this service evaluation aimed to determine whether virtual classes effectively manage patients with non-urgent, early rehabilitation, lower limb conditions and make specific recommendations for improving the service's uptake and efficiency.

**Methods**

A retrospective service evaluation of a 6-week telerehabilitation intervention was undertaken. Service evaluations seek to assess how well a service achieves its predetermined goals and is undertaken to benefit those using the healthcare service[28]. Thus, the results attained through a service evaluation can generate information that can be used to inform local decision-making. Services are under increased pressure to demonstrate the effectiveness and cost-effectiveness of provided services[29]. Therefore, service evaluations may demonstrate that healthcare resources are used most efficiently[30]. This evaluation involved a quantitative analysis of variables (Table 1) extracted from electronic records of a cohort of patients attending the service between August 20th, 2021 to June 18th, 2022.

**Table 1.** Data Extraction Table

| **Class Type** |
|---|
| Total Joint Replacement Class (TJC) |
| Early Lower Limb Class (ELL) |
| **Patient- specific demographics** |
| Age (in years) |
| Gender (i.e., male, female, or not documented) |
| Ethnicity (i.e., white, black or British black or African, Asian or Asian British, Other ethnic group, and not documented) |
| Diagnosis (i.e., fracture, arthroscope, TKR, THR, ligament repair, ligament pathology, tendon repair, tendon pathology) |
| Employment status (i.e., employed, unemployed, or not documented) |
| **Factors related to barriers and/or adverse events** |
| Barriers to class adherence |
| Adverse events reported during the classes |
| **Main and secondary clinical outcomes of interest** |
| Main outcome of interest- MSK- HQ |
| Secondary outcome of interest- RPE |
| **Efficiency of the service** |
| Class attendance rate |
| Classes not attended (DNA) |
| Classes unable to be attended (UTA) |
| **Potential discharge from outpatient physiotherapy services post- class** |
| Discharged |
| Not discharged and rebooked with physiotherapist |
| **Number of total treatment sessions undertaken** |

*Patient Population:*

The intervention was a 6-week, virtual exercise class, attended by physiotherapy patients treated through the St. Mary's Hospital - Imperial College, or London Charring Cross trusts. Following informed consent, patients were selected by their physiotherapists at either trust, into one of two virtual classes; the total joint replacement (TJR) and early lower limb (ELL) classes. Allocation was dependent on the patient's presentation. Patients who had undergone total knee replacement (TKR) or total hip replacement (THR) procedures were allocated to the TJR virtual class. Other patients' post-fracture, arthroscope, ligament repair, ligament pathology, tendon repair, and tendon pathology were assigned to the ELL class (Table 2).

*Exercise programmes*

Induction**:** Before starting the six weeks of allotted classes, patients attended a virtual induction meeting on MS Teams with a physiotherapist or physiotherapy assistant (Table 2). The rationale for this meeting is detailed in Table 2. The 6-week intervention is detailed in Table 3. The rationale for using a circuit training class structure was to offer a time-efficient, comprehensive, lower limb strengthening program to increase muscular strength and endurance while allowing for active recovery between sets with alternation of muscle groups trained, which is well supported in the literature[31-33].

**Table 2.** Virtual Exercise Class Induction Protocol

| |
|---|
| **Rationale -** These meetings were theorised to enhance patient competence in using the platform as several studies have highlighted that deficiencies in digital competencies among patients and health professionals can impede the effectiveness of services [41-43] |
| **1.** Description of factors related to safety (i.e., patient must have a contactable individual present during the sessions for safety concerns) |
| **2.** Identification of potential barriers to the uptake of classes (i.e., issues navigating the online platform, suitability of class start times, etc.,) |
| **3.** Online collection of the primary outcome measures utilised (i.e., **the Musculoskeletal Health Questionnaire- MSK- HQ**) |
| **4.** Explanation of the secondary outcome measure that would be taken intra-class (i.e., **Rate of Perceived Exertion- RPE**) |
| **5.** Establishing informed verbal informed consent from patients, ensuring they understood what their participation in the virtual classes would entail over the 6 weeks |
| **6.** Assistance in navigating the platform (i.e., screen- sharing, email- generated link to attend, consent to be on camera for safety concerns, etc.,) at the culmination of the induction to attempt to ensure they were best prepared for their first class. |
| **7.** Questioning on if patients had relevant equipment (i.e., TheraBand) to allow for progressive overload. Patients were also encouraged to acquire a step platform or dumbbell weights to allow for greater challenge and progression throughout the duration of the classes. |

*Data Extraction*

Forty-nine electronic medical records of patient notes were reviewed by two MSc (pre-registration) physiotherapy students as part of their final-year clinical placement.

**Table 3**: Six- week Intervention including structure, content, delivery method, information collected, and differences between classes

| **Virtual Class structure** |
|---|

| |
|---|
| Six-week intervention delivered 1x/week, in a 60-minute circuit training, exercise class format (detailed in Appendix 4). |
| **Shared class content** |
| 13/13 exercises were shared between classes and delivered in circuit-based fashion (Appendix 5).<br>13 exercises chosen were based on the F2F exercise classes offered by St. Mary's- Imperial College & London Charring Cross, with adaptations made for exercises that required costly equipment (ex. leg extension machine was changed to a TheraBand seated extension exercise) (Appendix 5). |
| **Delivery of classes** |
| All classes delivered through Microsoft Teams (MST).<br>Classes were led by physiotherapists, physiotherapy assistants, or physiotherapy students, depending on the availability of said practitioners and/or if instruction was delegated to said individuals by a physiotherapist. |
| **Info collected during sessions** |
| RPE (x2)<br>Post- class subjective thoughts (i.e., related to how they felt during the class, how they had been feeling after classes and/or in their everyday life, and if they had noted any changes or concerns that they wanted to review with their given physiotherapist)<br>Class number (/6). |
| **Key differences between the two classes** |
| The main differences between the classes related mainly to principles of progression, population demographics between classes, and judgement of the attending clinical staff (Appendix 4). |

*Data Analysis*

*Patient-specific Demographics*

Patient demographic data (age, gender, ethnicity, and employment status) were collected and analysed using Microsoft Excel. Age was summarised using central tendency and dispersion measures, while gender, ethnicity, and employment status were presented as percentages. Descriptive statistics summarised the demographic characteristics of the study population.

*Barriers and adverse events & referral to self-management support*

We reported the number of barriers, adverse events, and the proportion of patients offered self-management support, i.e., informed of available services (community gym, personal training, health applications) and how to progress their exercise program post-class. Self-management support should be provided in the final virtual class, so we examined documentation from the last attended class to see if these topics were addressed (i.e., yes, no, or unknown.

*Primary Clinical Outcome of Interest - Musculoskeletal Health Questionnaire (MSK-HQ)*

The primary clinical outcome of interest, the MSK- HQ (Hill, Kang & Benedetto, 2016), was to be collected and documented twice; initially during the patient's virtual induction or first virtual class on MSTeams and secondly on the patient's last virtual class. The questionnaire has 14 questions, which range from 0 to 56, with a higher score indicating a better MSK health status. The MSK-HQ summarises a person's musculoskeletal health at any given time, including pain, independence, physical activity, sleep, and social interaction. This enables progression monitoring over time and response to treatment[34]. MSK-HQ scores would be presented as mean (SD).

*Secondary Clinical Outcome of Interest - Rate of Perceived Exertion*

The secondary clinical outcome of interest, rate of perceived exertion (RPE), was taken by clinicians twice in each class 12 times for each patient over the six weeks of virtual classes. RPE is a patient-reported measure used to identify the intensity of exercise based on how hard the patient feels they are exerting themselves, with scores ranging from 6 to 20. A rating of 6 refers to perceiving "no exertion at all", and 20 is perceiving a "maximal exertion" of effort[35]. Patient RPE scores were taken once after the first circuit and secondly after the class culminated. Throughout the programme, we expect RPE to decrease from the first class to the last, as this would indicate decreased fatigue and could be a proxy for increased functional status. RPE scores would be presented as median (interquartile range).

*Efficiency of Service – Class Attendance, Discharge, Number of Sessions Delivered*

Data related to the efficiency of the services (Table 1) was extracted. We reported the proportion (%) of DNA/UTAs based on St. Mary's - Imperial College's pre-existing policy (see Appendix 1).

Discharge from physiotherapy services was determined at the last allocated virtual class (Figure 1), with clinicians required to document whether patients were discharged post-class. The researchers extracted this from electronic medical records to record discharge frequency (%); if the patient was discharged,

they were marked down as a 'yes', and if not, the patient was re-booked with their allocated physiotherapist and marked down as a 'no'.

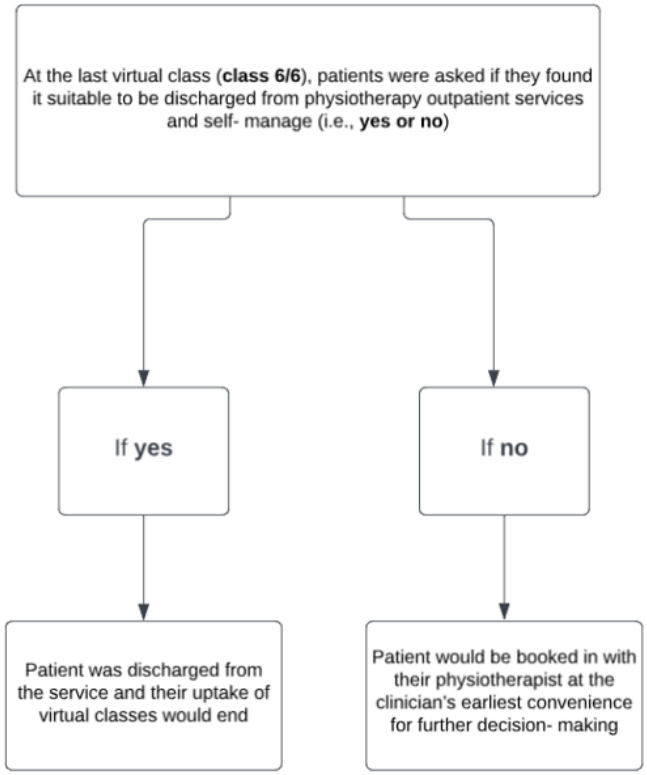


**Figure 1.** Decision making process to facilitate patient discharge from virtual classes

We reported the total number of treatment sessions patients engaged in before August 2022. A treatment session included any physiotherapy session the patient had undertaken at St. Mary's- Imperial College before beginning virtual classes, the number of virtual classes the patient had attended, and the number of sessions post-class (if they were not discharged). The virtual induction on MST was not included as a treatment session. We reported the median and SD of sessions for each of the above. Lastly, to explore reasons for DNA/UTA, and in light of the diverse community of patients, DNA/UTA rates were contrasted for the ELL and TJR classes, as well as concerning specific demographic characteristics like ethnicity and employment status.

**Results:**

*Patient population*

In total, we have data available for 49 patients. Of these, most had a TKR diagnosis pre-participation in the virtual classes (27%), closely followed by THR (22%). Fewer patients had a fracture (16%), ligament repair (14%), or ligament pathology (10.2%; Table 4). The population's median age was middle-aged (55 years), but patients' ages ranged age ranged widely from 25- 91. Most patients were female (61%), and less than half of the population had confirmed employment status (47%; Table 4). Patient ethnicity status was variably documented. In all, 43% of patients were classified as White, 12% as Black or British Black or African, 6% as Asian or Asian British, and 27% as belonging to another ethnic group, while no information was available for 16% of patients (Table 4).

**Table 4.** Patient characteristics, demographics, and classification of diagnosis

| **Baseline Patient Characteristics (N = 49)** | | |
|---|---|---|
| | **Median** | **Range** |
| **Age (years)** | 55 (17.6) | 25-91 |
| | **n** | **%** |
| **Gender** | **n** | **%** |
| *Female* | 30 | 61% |
| *Male* | 19 | 39% |
| **Employment status** | **n** | **%** |
| *Employed* | 23 | 47% |
| *Unemployed* | 17 | 35% |
| *Unknown* | 9 | 18% |
| **Ethnicity** | **n** | **%** |
| *White* | 21 | 43 |
| *Black or British Black or African* | 4 | 12 |
| *Asian or Asian British* | 3 | 6 |
| *Other Ethnic Group* | 13 | 27 |
| *Not documented* | 8 | 16 |
| **Classification of Diagnosis** | **n** | **%** |
| *Fracture* | 8 | 16.3 |
| *Arthroscope* | 5 | 10.2 |
| *TKR* | 13 | 26.5 |
| *THR* | 11 | 22.4 |
| *Ligament repair* | 7 | 14.3 |
| *Ligament pathology* | 5 | 10.2 |
| *Tendon repair* | 0 | 0 |
| *Tendon pathology* | 0 | 0 |

*Attendance and discharge rates*

Class attendance rates were high, with nearly 77% of all offered classes attended (Figure 2). Additionally, 61.2% of patients were discharged after completing the classes, not requiring follow-up with their physiotherapist (Table 5). However, it is notable that less than half of these discharged patients received information on self-management strategies. Additionally, 92% of patients were not informed about who in the expansive healthcare team to contact in the event of excessive pain and/or functional setbacks (Figure 3).

The discharge rate for the TJR classes was 57%, compared to a 43% discharge rate for the ELL classes, totalling 100%. When examining demographic data, Figure 4 illustrates that the employed subgroup had the highest rate of DNAs and UTAs across all groups, contrasting with the lower rates seen in the unemployed/not known subgroups. Table 5 further reveals that white individuals accounted for over a third of all DNAs (37%) and UTAs (58.3%). It's important to note that this observation alone may not offer a comprehensive understanding of the data. For instance, considering the relative proportions of each population (i.e., a higher number of white attendees) and the potential impact of repeat non-attendance would provide a more nuanced analysis and deeper insights into the patterns of absences within different demographic groups.

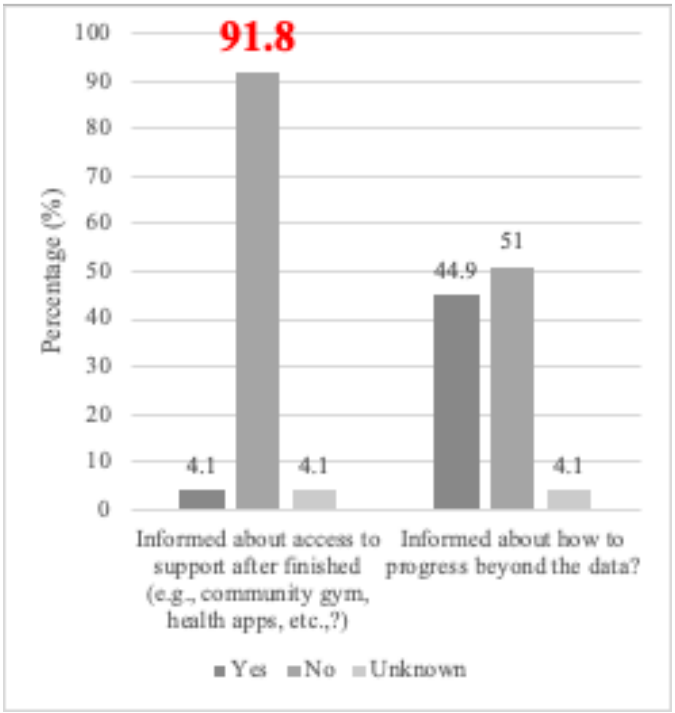


**Figure 2.** Percentage of Attendance

*Missing Data*

The research team encountered significant missing data regarding patient barriers and adverse events, descriptive data on the reasons for non-attendance, post-class completion education (i.e., provision of self-management strategies post-class), and the Musculoskeletal Health Questionnaire. This absence of data hampered the provision of reliable information on these variables. The list of missing data was presented to the wider team at the culmination of the service evaluation, highlighting areas for improvement and future research (Appendix 2).

**Discussion:**

This service evaluation assessed whether six weeks of virtual exercise classes efficiently managed patients with non-urgent, early rehabilitation, lower limb physiotherapy needs while simultaneously assessing patient-specific outcomes. The evaluation was theorised to inform decision-making about whether virtual exercise classes should be continued and/or modified for this patient group.

**Figure 3.** Self- Management Support (N = 49)

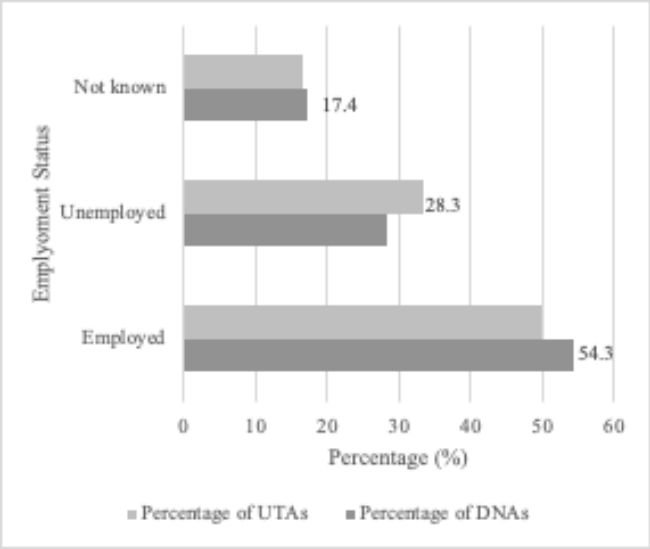


**Figure 4.** Attendance rates as a function of employment status

Despite missing data limiting analysis of pre-study metrics, notable benefits for patients and clinicians emerged regarding class efficiency. For example, 77% of all classes offered were attended, highlighting the efficiency of virtual classes in serving larger patient populations while allowing clinicians to delegate tasks to physiotherapy support personnel (such as assistants, technicians, and students) once they are deemed competent and safe, thus freeing up more one-on-one clinical time for critical tasks like initial assessments and evaluative components that require direct physiotherapy expertise. Studies undertaken in similar surgical populations have shown that telerehabilitation incurred similar costs and yielded comparable effects to traditional in-person care, significantly reducing the time burden for patients and carers. These findings underscore the potential value of telerehabilitation in implementing accessible and patient-centred rehabilitation services, particularly when comparing clinician time per patient pathway.

**Table 5.** Patient discharge class data and class attendance in relation to ethnicity

| **Discharge Class Data** | | | | |
|---|---|---|---|---|
| **Discharge from class?** | **n** | **%** | | |
| Yes | 30 | 61.2 | | |
| No | 17 | 34.7 | | |
| Unknown | 2 | 4.1 | | |
| **Class Ethnicity Attendance Demographics** | | | | |
| **Ethnicity** | **Number of DNAs from class** | **Percentage of total DNAs (%)** | **Number of UTAs from class** | **Percentage of total UTAs (%)** |
| White (n = 21) | 17 | 37 | 7 | 58.3 |
| Black or British Black or African (n = 4) | 6 | 13 | 0 | 0 |
| Asian or Asian British (n = 3) | 4 | 8.7 | 0 | 0 |
| Other Ethnic Group (n = 13) | 14 | 30.4 | 3 | 25 |
| Not documented (n = 8) | 5 | 10.9 | 2 | 16.7 |

Similar to previous findings[19, 36-38], clinicians at St. Mary's- Imperial College noted intrinsic advantages of virtual classes, such as larger class capacities that do not have to consider social distancing guidelines and the ease of accessibility of the classes from home. However, it is important to highlight that these findings are more speculative than conclusive, as they are based on clinician observations rather than robust study designs focused explicitly on aspects like decreased wait times to receive treatment due to clinician availability or other potential benefits. Future research should evaluate F2F and virtual classes in efficiency and time management, as these same benefits may occur at similar rates and are not exclusive to virtual classes.

The primary goal of this service evaluation was to assess the efficiency of virtual exercise classes and the potential improvements seen in patients during these classes. However, the lack of data on the primary outcome measure, the MSK-HQ, hindered thorough evaluation. Only 1 MSK HQ out of a possible 98

completed. RPE was highlighted as an outcome measure that was well-documented by clinicians, but RPE cannot be used as a replacement outcome measure for the MSK-HQ. Firstly, RPE is subjective and is not sensitive to assessing one's musculoskeletal health at any time. Secondly, the MSK- -HQ was designed to monitor patient progress & response to treatment across musculoskeletal care pathways, whilst RPE is conversely not. Therefore, using this outcome to assess whether virtual classes were effective overall is difficult. Based on the evaluation of these outcomes (and the incompleteness of the data), specific suggestions were formulated by the researchers and presented (below) to improve service delivery as well as allow a more comprehensive and reliable evaluation of the service's outcomes (Appendix 2).

First, a primary recommendation is integrating standardised note templates for each virtual class (Appendix 3). These templates ensure clinicians capture crucial information often missed in assessments. They include prompts for collecting the Musculoskeletal Health Questionnaire (MSK-HQ), reminders for providing self-management education, and DNA/UTA instances, offering insights into attendance barriers. A dedicated discharge status section aids clinical decision-making, prompting further assessment if discharge isn't achieved. Additionally, post-surgical patients participating in virtual classes could be re-referred to track functional setbacks, aiding decision-making and comparing outcomes with face-to-face patients. However, implementing these measures hinges on overcoming barriers physiotherapists face in implementing patient-reported outcome measures (PROMs). Literature cites time constraints, lack of knowledge, and administrative issues as common barriers[39-40]. Despite challenges, documenting these metrics enhances clinical reasoning and patient motivation. Considering the time-consuming nature of documentation, overcoming practical and organisational constraints is crucial. While initial efforts may strain resources, improved documentation can lead to long-term efficiency gains in service provision, highlighting the importance of clinician dedication to comprehensive outcome measurement and documentation standards.

Second, additional recommendations include strategic and long-term changes, including periodic class audits and documentation to assess if standards are being met. These audits would assess documentation standards for future service evaluation projects using similar clinician-collected outcome measures and highlight the crucial role of clinical oversight and governance in maintaining physiotherapy documentation standards. Further recommendations that would be beneficial but would take more time and effort (and resources) to integrate into practice include follow-up virtual appointments with patients to discuss how they were managing a set period after discharge (i.e., 3-6 months). These appointments could also be opportunities to re-take the MSK- HQ and compare it to previous scores to assess if patients maintained or declined in their musculoskeletal health post-intervention. However, these suggestions were posed on the condition that future service evaluations met documentation standards. More specific recommendations could be made with better documentation than those posed in this paper, which could drive service improvement.

### *Limitations and Future Directions:*

We acknowledge that ethnicity may only partially capture socio-economic status or community diversity. However, given the limitations in available data and the diverse community of patients, we used ethnicity as a proxy for exploring potential differences in treatment engagement among different cultural backgrounds. Future studies could delve deeper into socio-economic status, community diversity, and their impact on treatment attendance.

This present evaluation's limitations include the absence of benchmarking or comparison data with similar or non-digital groups, hindering a comprehensive evaluation. Additionally, missing data impacted the assessment of pre-study metrics. To address these limitations and improve future research, it is crucial to incorporate benchmarking data, compare with similar groups, and enhance data collection methods. Specifically, future studies should focus on developing robust measures of socioeconomic status to provide a more nuanced understanding of patient demographics and outcomes in virtual exercise classes. These enhancements will contribute significantly to the validity and reliability of service evaluations in similar healthcare settings.

### *Conclusion:*

Despite limitations in documentation and missing data, this service evaluation highlights positive findings regarding the effectiveness and efficiency of virtual exercise classes. The high attendance rate of 77%

showcases the capacity of virtual classes to serve larger patient populations while allowing clinicians to delegate tasks efficiently, freeing up valuable one-on-one clinical time for critical assessments and evaluative components. Virtual classes also show potential in facilitating patient discharge, reducing clinician time through dictation activities, and providing supplementary benefits. However, caution must be exercised when drawing conclusive outcomes due to missing data impeding a comprehensive service evaluation.

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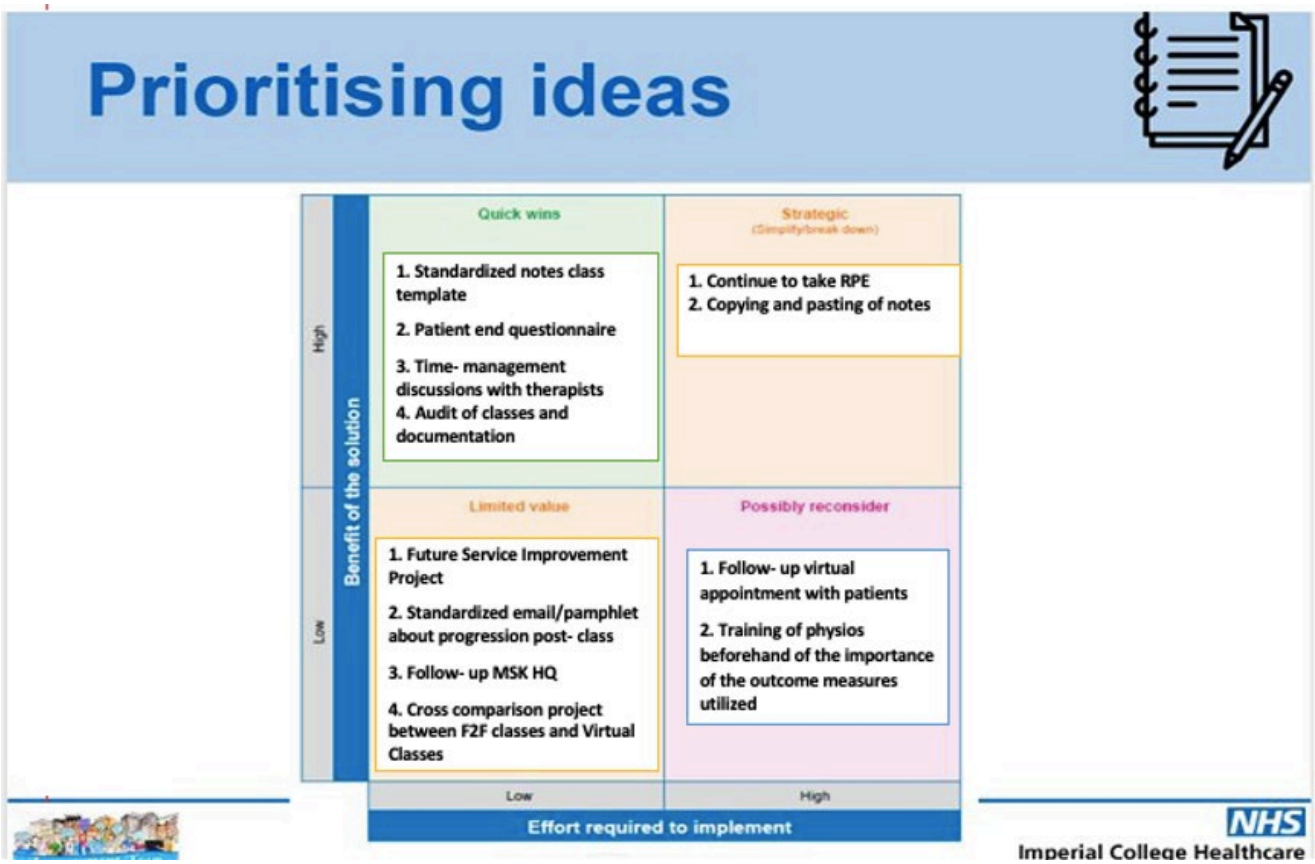
**Declaration of interest statement**
The authors state no conflict of interests.

**Appendix 1**

| **DNA/UTA definition and Discharge Policy for repeated DNAs** |
|---|
| **Class not attended (DNA):** Classes the patient did not attend without notifying or calling ahead to clinician staff at St. Mary's Hospital- Imperial College or Charring Cross. |
| **Class unable to be attended (UTA):** Classes the patient could not attend, but where clinical staff were notified that the patient would not be in the class. |
| **Discharge Policy:**<br>- Patients were allowed one DNA from a class that could not be made- up later<br>- If a patient had two consecutive DNA's, they would be discharged from the physiotherapy service (that includes virtual classes) and would have to seek re- referral from their general practitioner (GP).<br>- Patients were allowed multiple UTAs with said classes made up in the forthcoming week or later with allocated treatment times extended a week if required to allow patients to reap the full benefits of six-weeks of classes. |

**Appendix 2**




**Appendix 3**

| | |
|---|---|
| **Class Data**<br>Number of sessions before starting class:<br>Was induction completed prior to joining first class?: Yes or No<br>Was exercise safety discussed with the patient?: Yes or No<br>Factors that may limit engagement (i.e,. occupation): Yes or No, if yes explain | Additional comments: |
| **Subjective**<br>Pt attended _____ class via Microsoft teams from home<br>Class led by _____ and exercises demonstrated by _____<br>Patient consented to exercise session<br>Session Number:<br>Is this patients first or last class?: If yes → **COMPLETE MSK-HQ**<br>MSK-HQ score (for first/or last class only): | Additional comments: |
| **Objective:**<br>Please see exercise sheet for content<br><br>RPE round one:<br><br>RPE round two: | Progressions:<br><br>Regressions:<br><br>Adverse events:<br><br>How patient is currently managing: |
| **Analysis:**<br>Completed all exercises for both rounds | Diagnosis:<br><br>How patient is managing: |
| **Plan:**<br>Rebook for class __/6 next week<br>Class name: | Additional comments: |

| | |
|---|---|
| Re-book date:<br>Re-book time: | |
| ***If last class: **Self-management**<br>Discharge for class: Yes or no<br>Informed about access to support after class finished i.e., community gym: Yes or no<br>Informed to progress beyond the class: Yes or No<br>**MSK-HQ score:** | Additional comments: |

**Appendix 4**

| **Class Structure** |
|---|
| 1. The 1- hour, virtual exercise classes were delivered on their allotted dates by two class instructors that would facilitate and record the exercise component collaboratively. To help patients progress safely throughout the 60-minute classes, both class instructors would jointly monitor the exercise performance on MST, with each patient required to be on camera throughout the class duration |
| 2. One instructor would introduce (if it was a patient's first class) or re- introduce the class structure to each patient, as well as record patient- specific information intra- class (i.e., RPE scores at two pre- determined periods). |
| 3. The other instructor would perform the exercises alongside patients and would provide corrections, or adaptations, to the movements if required or requested by patients. |
| **Shared Class Content** |
| 1. The 13 exercises in both classes were delivered through a 'circuit- training' style where patients would perform each exercise once for 2 minutes, rest for 30s- 1 minute, and then move onto the next exercise led by the class instructor. |
| 2. Subsequently, the initial exercises performed at the beginning of the class would restart, providing 'two rounds' of exercise performance in totality by the end of the class. |
| 3. As the exercises remained the same throughout the six- weeks, patients were encouraged to progressively overload through increasing the load lifted and/or the number of repetitions performed each exercise.<br>- Patients were guided by principles including confidence in performing the exercise, ability to complete it at the current load, absence of excessive pain, and safety.<br>- Additionally, exercise complexity could also be progressed for several of the exercises (i.e., DL calf raise to SL calf raise; Table 4) |
| **Key differences between classes** |
| • The main differences between the classes related mainly to principles of progression, population demographics between classes, and judgement of the attending clinical staff. Most patients that undertook the TJR classes (and thus had a THR/TKR) were older adults, which mirrored population demographics with the average age for primary total hip arthroplasty (THA) and TKA recipients reported at 65 years[44] and 67 years[45] respectively. Thus, patients that undertook the TJR classes were older, more initially detrained, and progressed through the classes slower.<br>• In contrast, participants in the ELL classes were younger, had a higher fitness baseline, and often progressed faster.<br>• Thus, the two classes were organised in this way so that classes could contain like- individuals with like- problems that could be solved by the leading physiotherapy staff |

**Appendix 5**

| **Early Lower Limb Class and TJR Class Content** | | | |
|---|---|---|---|
| **Exercise** | **Regression** | **Progressions** | **Home equipment Needed** |
| March | | Jog on the spot | Chair |
| Sit to stand | | Squat | Chair |

| | | | |
|---|---|---|---|
| Calf raises | Seated calf raises | Single leg heel raise +/- heavy backpack | Heavy backpack |
| Single leg stand | Tandem stand – look left to right | Eyes closed | Single leg stand |
| Standing hamstring curl | | Standing knee bend with red t-band | Red t-band |
| Knee extension with red t-band | Without Theraband | | Red t-band |
| Step ups | | Step up with a weight | Step up on a small book or box<br>Red t-band |
| Deadlifts | | Deadlift with heavy backpack | Deadlifts |
| Wall slides | | Single leg 90/90 timed static wall squat= | Wall slides |
| Lunges | Step ups | Bulgarian split squat | Chair |
| Bridging | | Single leg bridge or hip thrust | n/a |
| Monster walks with red t-band | Monster walks without red t-band | n/a | n/a |
| Crab walks with red t-band | Crab walks without red t-band | n/a | n/a |