Enhancing early functional independence following cardiac surgery: a quality improvement programme

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ABSTRACT

Early mobility and activity programmes following cardiac surgery are vital for improved patient outcomes, as they accelerate the recovery of functional capacity and walking distance. We observed that only 5.3% of our patients achieved a Functional Independence Measurement (FIM) score of 80% or more by the third postoperative day (POD). Additionally, the average 6-minute walk distance achieved by the fourth POD was only 188 m. Therefore, a quality improvement (QI) project was implemented with the aim of attaining a FIM score of 80% by the third POD for more than 80% of patient underwent/undergoing cardiac surgery without complications. A model-for-improvement framework was used to drive continuous improvement. This project was implemented in February 2021. Baseline data were prospectively collected between November 2020 and January 2021 (preintervention). Outcomes were analysed using standard control chart rules to detect changes over time. Unpaired Student t-tests assessed significant differences in mean levels between two groups, (preintervention vs postintervention) χ² tests were conducted between the two groups according to gender and patient satisfaction scores. The percentage of patients who achieved a FIM score of 80% or more by the third POD gradually increased to 91.4% 5 months following programme implementation and was sustained thereafter. The mean patient FIM score significantly improved to 81.20±3.77 (p<0.001) by the third POD. Similarly, the mean 6-minute walk distance increased to 267.90±36.10 m (p<0.001) by the fourth POD. The percentage of patients who displayed the level of confidence needed to carry out activities of daily living (ADL) and exercises independently at home increased to 89.4% (p<0.001) by the fifth POD. No adverse events associated with the mobility and activity programme were reported.

This QI project demonstrated a substantial improvement in patient functional independence, walking distance and the level of confidence needed to independently carry out ADL and exercises following cardiac surgery.

BACKGROUND

Globally, cardiovascular disease (CVD) is a major cause of mortality, morbidity and economic loss. The overall number of cardiac surgical procedures is predicted to increase at a rate of approximately 5% per year, eventually reaching over 1.3 million in 2026. Cardiac surgery has been shown to minimise the risk of adverse cardiovascular events, enhance quality of life (QOL) and reduce the need for repeat revascularisation. The risk factors for cardiac surgery related postoperative problems remain significant. Pulmonary, cardiovascular and neurological issues are the most common complications in the early postoperative period, contributing to
delays in hospital discharge and functional recovery. Following coronary artery bypass graft (CABG), many patients experience depressive symptoms, which is linked to poor QOL. Furthermore, the effect of these complications can last more than a year after surgery as the postoperative period is relatively difficult for patients due to pain and restrictions on using their arms after a sternotomy. Mobility and activity programmes have, however, had a substantial impact in preventing or mitigating these complications. It has been shown that early mobilisation is a safe, feasible and effective intervention following cardiac surgery. However, despite supporting evidence, implementing a structured mobilisation and activity programme can be challenging due to barriers related to the patient, staff and/or the process.

Early mobility and activity programmes refer to those that are initiated when a patient has minimal ability to engage in therapy, but a stable haemodynamic status and acceptable oxygen levels. These programmes include gradual mobilisation from sitting upright in bed to standing, progressive ambulation, an active exercise programme, activities of daily living (ADL) training and breathing exercises. They accelerate the recovery of functional capacity and walking distance by improving cardiac function, ventilation and respiratory muscle strength. Moreover, early mobility interventions have been shown to reduce and prevent pain, pleural effusion, hospital-acquired infections, pressure injuries, blood sugar levels, surgical site infections and delirium, which eventually reduce the length of hospital stays and enhance patient satisfaction.

Thus, the implementation of a mobility and activity programme is essential following cardiac surgery.

**PROBLEM DESCRIPTION**

Early attainment of functional independence improves patient confidence in carrying out ADL, thereby reducing hospital readmissions and enhancing QOL. Baseline data collected from 75 patients revealed that only 5.3% had achieved a Functional Independence Measure (FIM) score of 80% or more by the third postoperative day (POD). In addition, the average 6-minute walk distance (6MWD) test achieved on the fourth POD was only 188 m. Patients also exhibited low level of confidence in carrying out ADL at the time of discharge. The baseline survey further revealed that only 21.4% of the patients were confident in carrying out ADL on the fifth POD. There was no standard mobility or activity programme for postoperative patients transferred to high dependency unit from the cardiothoracic intensive care unit (CTICU). This affected mobilisation and activity initiation time, progression of mobilisation and total mobilisation time. Furthermore, the level of functional independence and ambulation distance were not assessed at the appropriate time before discharge. Therefore, our team identified this as an improvement area and implemented a quality improvement (QI) programme to assist patients in achieving early functional independence.

**Settings**

Our high-dependency surgical unit has 20 beds that serve postcardiac surgery patients. Hospital performs surgeries on more than 500 patients per year. The surgeries include CABG, valve repair and replacement, aortic dissection, and implantation of mechanical and circulatory devices. Patients are transferred from the operating room to the CTICU where they receive a structured activity and mobilisation programme. Patients are then transferred to high-dependency surgical units once they are haemodynamically stable. This project was undertaken as part of a value improvement initiative.

**Rationale**

Functional independence can be defined as an individual’s ability to perform ADL. For this intervention, FIM used to identify disabilities in ADL during rehabilitation. These are considered a primary functional status measure in rehabilitation because of their relative objectivity, simplicity and relevance to patients. FIM analyse the effectiveness of independently performing daily routines rather than the ability to perform ADL. Functional independence has been linked to QOL and personal satisfaction, and the FIM is a validated tool used to assess functional independence.

Various studies have shown the significance of ambulation distance following cardiac surgery. Patients who walk less than 1308 steps per day at the time of discharge are 7.58 times more likely to require rehospitalisation than patients who walk more than 1308 steps per day. Early ambulation after valve replacement surgery appears to be associated with a higher functional status at hospital discharge. Moreover, patients who receive ambulation combined with other activities have shown greater improvement in functional capacity, pulmonary function and muscle strength than those who only performed inspiratory muscle training or did not undergo any intervention.

The QOL of post-cardiac surgery patients may deteriorate due to postoperative fatigue and pain, and functional capacity has been used to evaluate postsurgical recovery related to QOL. Walk tests are a simple and efficient method to estimate functional capacity. In particular, the 6MWD test can rapidly quantify postsurgical recovery. Depending on a patient’s capacity or inability to complete it, the 6MWD test has been used to predict the likelihood of postoperative problems and mortality in patients undergoing heart surgery. Distances ≥300 m covered during the 6MWD test are considered to be predictive of increased survival at 5 years of follow-up for elderly patients undergoing cardiac surgery. Hence, as a predictor of hospitalisation and death from cardiopulmonary diseases, the 6MWD test is a simple, safe, practical and validated sub-maximal exercise test for patients.
Aim statement
This QI programme aimed to attain a FIM score of 80% on the third POD for more than 80% of cardiac surgery patients without complications to the high-dependency surgical unit in our cardiac centre by December 2021.

*FIM score of 80%
► Modified independence (score of 6) in self-care (excluding bathing), sphincter control, mobility and locomotion (excluding stairs and wheelchairs)
► Complete independence (score of 7) in communication and social cognition

Objectives
Our objectives included implementing evidence-based mobility and activity practices in the high-dependency surgical unit with the involvement of staff, patients and their families and having patients attain more than 250 m in the 6MWD test on the fourth POD.

Inclusion and exclusion criteria
Inclusion criteria:
► All patients >14 years of age who underwent CABG and valve repair or replacement surgeries
► Patients having an uncomplicated postoperative course
► Patients without musculoskeletal or neurological complications that limited their mobility and activity
► Patients with no cognitive impairments
► Patients without postsurgical wound infections
► Patients without external devices
► Patients without persistent cardiac arrhythmias or haemodynamic instability that would prevent them from early mobilisation

Exclusion criteria:
► Patients who required more than 1 POD in the CTICU

METHODS
This QI project is reported using SQUIRE guidelines. After identifying issues related to mobilisation and activity practices following cardiac surgery, a detailed analysis was carried out by a team of cardiac surgeons, physiotherapists, nurses, occupational therapists and quality advisors. Significant practice gaps were identified during brainstorming. The team used fishbone diagram (figure 1) and Pareto analysis (figure 2) to identify the root causes of practice gaps and prioritise change ideas. A model-for-improvement framework was used to drive continuous improvement. This model recommends structuring an improvement programme by formulating an aim statement, defining measures to understand changes in the improvement, and an appropriate selection of changes to be tested. Subsequently, Plan-Do-Study-Act (PDSA) cycles were used to test changes. This project was implemented as a part of a Value Improvement Project.

Changes tested
A number of changes were tested using PDSA cycles. Our change ideas were based on the ‘4Is’, that is, involving the patient, family and staff; integrating the current evidence; informing the patient and staff; and; inspecting the programme outcome.

1. PDSA 1. Formulating a standardised mobility and activity programme. To ensure an appropriate progression of

![Figure 1](http://bmjopenquality.bmj.com/)

**Figure 1** Cause and effect analysis. FIM, functional independence.
activities and the mobilisation of patients, we formulated an evidence-based mobility and activity programme based on the day of surgery. This was developed using a systematic search for available evidence and expert consensus. Multidisciplinary expert panel was identified that included physicians, physiotherapists, occupational therapists and nurses. Several members of this expert panel had also been involved in developing (and subsequently publishing) an early mobilisation of patients in the cardiothoracic critical care units. The mobility and activity levels comprised progressive mobilisation and ambulation and education concerning energy conservation and sternotomy progression, which started on the second POD. This programme was initially piloted on four patients. Table 1 lists the mobility and activity programme.

2. PDSA 2. Enhancing staff knowledge: A multifaceted education programme that included PowerPoint presentations, hands-on workshops and disseminating information through emails, huddles and unit meetings was provided to all staff regarding mobility and activity levels. A teach-back method was used to assess the effectiveness of the education and staff knowledge.

3. PDSA 3. Appropriate documentation: Comprehensive documentation is essential for monitoring the progress and effectiveness of change ideas. As such, standardised documentation for patient medical records was implemented and compliance with documentation was monitored. The new documentation method ensured that the type of activity, frequency, distance and time of ambulation were recorded and readily available in the records. This PDSA facilitated adherence to and progression of the programme.

4. PDSA 4. Patient family education: Providing information and explanations regarding surgical procedures and expected recovery following surgery, as well as information concerning anticipated challenges, has been shown to reduce patient anxiety and improve their cooperation with various interventions. Before surgery, a physiotherapist and occupational therapist educated patients on the details of the activity and mobility programme, its effect on their recovery following surgery, the precautions that should be taken, and the anticipated pain and fatigue experienced during the early postoperative period. However, this strategy did not work well for patients admitted in the evenings as the physiotherapy and occupational therapy sessions were unavailable. To overcome this issue, the physiotherapist and occupational therapist educated the nursing staff on the preoperative programme, and the nurses educated patients admitted in the evenings. A checklist was created to ensure all necessary information was given to patients and their families. A teach-back method using a questionnaire was developed to assess the effectiveness of patient and family education. As our patient population comprised multinationals speaking different languages, an institution language bank was used to overcome language barriers.

5. PDSA 5. Visual clues: Visual feedback was used to remind the staff about the level of ambulation and the type of activities patients needed each day. This reminder also empowered and motivated patients to perform the desired activity and mobilisation.
Table 1  Mobilisation and activity programme

<table>
<thead>
<tr>
<th>POD 2</th>
<th>Chest physiotherapy</th>
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<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td></td>
<td>▶ diaphragmatic breathing exercise</td>
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<td>▶ triflow spirometer</td>
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<tr>
<td></td>
<td>▶ active cycle of breathing techniques</td>
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<td>AROM exercises</td>
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<tr>
<td></td>
<td>Ambulation with minimal assistance or contact guard assistance (minimum 30 m, two times per day)</td>
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<tr>
<td></td>
<td>Perform safe transfers</td>
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<td></td>
<td>Perform out of bed self-care activities</td>
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<td></td>
<td>Educate</td>
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<tr>
<td></td>
<td>▶ home exercise/activity programme</td>
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<td></td>
<td>▶ safe exercise progression</td>
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<tr>
<td></td>
<td>▶ application of energy conservation techniques</td>
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<tr>
<td></td>
<td>▶ sternotomy precautions</td>
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<tr>
<td>POD 3</td>
<td>Continue chest physiotherapy and AROM exercises</td>
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<tr>
<td></td>
<td>Ambulation with modified independence (minimum 80 m, three times a day)</td>
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<tr>
<td></td>
<td>Perform safe transfers</td>
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<tr>
<td></td>
<td>Perform out-of-bed self-care activities</td>
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<td>Educate/train</td>
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<td></td>
<td>▶ home exercise/activity programme</td>
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<td></td>
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<td>▶ application of energy conservation techniques</td>
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<td></td>
<td>▶ sternotomy precautions</td>
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<tr>
<td>POD 4</td>
<td>Continue chest physiotherapy and AROM exercises</td>
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<tr>
<td></td>
<td>Ambulation with modified independence (minimum 160 m, three times a day)</td>
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<tr>
<td></td>
<td>Stair climbing</td>
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<td></td>
<td>Monitor</td>
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<td></td>
<td>▶ patient performance on modified independence in safe transfers and self-care activities</td>
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<td></td>
<td>▶ application of sternotomy precautions</td>
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<td>▶ application of energy conservation techniques</td>
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<td></td>
<td>Reinforce/educate</td>
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<td></td>
<td>▶ home exercise/activity programme</td>
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<tr>
<td></td>
<td>▶ safe exercise progression</td>
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<tr>
<td>POD 5 until discharge</td>
<td>Continue chest physiotherapy and AROM exercises</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ambulation with modified independence (minimum 220 m, three times a day)</td>
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<tr>
<td></td>
<td>Stair climbing</td>
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<td></td>
<td>Monitor</td>
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<tr>
<td></td>
<td>▶ patient performance on modified independence in safe transfers and self-care activities</td>
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<td>▶ application of sternotomy precautions</td>
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<td>Reinforce/educate</td>
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<td></td>
<td>▶ home exercise/activity programme</td>
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<td></td>
<td>▶ safe exercise progression</td>
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</tbody>
</table>

AROM, active range of motion; POD, postoperative day.

PDSA 5a. Floor marking: A floor marking was placed every metre to calculate the distance of ambulation achieved by patients. This helped the staff to document the progression of the ambulation distance and motivated patients to achieve further distances each day.

PDSA 5b. Colour-coded flags: Colour-coded flags were fixed in the high-dependency surgical unit hallway and patient rooms. This reminded staff and patients about appropriate mobilisation practices.

PDSA 5c. Whiteboard: A whiteboard was placed in patient rooms where staff recorded the desired walking distance and the frequency of mobility and activity of each patient per day. Patients were also encouraged to record the distance and frequency of their mobility and activities per day. If they achieved the desired amount of exercise, a smiley face would be affixed to the board.

6. PDSA 6. Better pain control: Patient pain is a central barrier when implementing a mobility and activity programme. Pain may lead to a lack of patient participation and facilitate haemodynamic instability (eg, tachycardia, tachypnea and increased blood pressure).

PDSA 6a. Pain assessment: Mandatory pain assessment using a Numeric Rating Scale (NRS) was used before initiating activity or mobilisation to facilitate the need for appropriate pain control measures. Patients were mobilised when they had an NRS score of 3 or less. Appropriate pain medications were given if required. This practice ensured that patients were mobilised only when the test was adopted and the desired NRS score was achieved.

7. PDSA 7. Colour-coded risk categorisation system: A colour-coded risk categorisation system was used to facilitate the clinical decision-making process and to prevent potentially adverse events while implementing the programme. Three risk categories were included: green indicated low risk, yellow represented a potential risk and red indicated a significant risk. If the patient was in the red category, a physician’s advice was sought before initiating the programme.

Display of data
Data collected by the team were placed in run charts, displayed in the unit’s QI board and presented in weekly QI huddles. The data were also communicated to all members of the multidisciplinary team through emails. This was important for staff motivation and to increase team participation with new improvement ideas. It also encouraged staff to adhere to the programme.

Continuing education
Continuous in-service education regarding the programme was delivered during unit meetings of the multidisciplinary team. New staff was trained on the guidelines and protocols of early mobility. Updates on new techniques were addressed through the electronic circulation of recent, relevant articles.

Study of the intervention
Outcome measures
The outcome measures were the percentage of eligible patients who achieved a FIM score greater than 80% on the third POD and a 6MWD on the fourth POD. Each week, the data were gathered retrospectively.
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Process measures
The tested changes were assessed using both qualitative and quantitative measures. The compliance rates for FIM and the 6MWD were measured. Similarly, the feasibility and success of each change tested were assessed by collecting subjective impressions from front-line staff.

Balance measures
The balance measures used in this project were:
► The level of confidence to carry out ADL and exercises independently at home on the fifth POD. This was assessed using a questionnaire (online supplemental appendix 1) with a Likert Scale rating of 5 points (strongly agree to strongly disagree). To understand the level of confidence, we considered only the percentage of patients who rated strongly agree and agree.
► Adverse events associated with the mobility and activity programme. Adverse events were defined as a fall incident, cardiac arrest, new onset of cardiac arrhythmia, accidental removal of invasive lines and tubes, loss of consciousness or hypotension requiring an escalation of inotropes.

Statistical analysis
Project outcomes were analysed using standard control chart rules, which detect statistically significant changes in outcomes over time. Descriptive statistics for interval variables, including age, ejection fraction, FIM score and the 6MWD were calculated as means and SDs. Frequency distributions with percentages were used for categorical variables. Unpaired Student t-tests were used to assess significant differences in mean levels according to two groups (patients admitted between November 2020 to January 2021 vs February 2021 to March 2022). χ² tests were conducted between these two groups and gender and patient satisfaction scores. A p value of 0.05 (two tailed) was considered statistically significant. The SPSS V.28.0 statistical package (IBM, Armonk, New York, USA) was used for the analysis.

RESULTS
This programme was implemented in February 2021. There were 424 participants included in the programme between February 2021 and March 2022. Baseline data were prospectively collected from 75 patients between November 2020 and January 2021.

FIM score on the third POD
The percentage of patients who achieved a FIM score of 80% or more on the third POD in February 2021 (following implementation of the programme) was 53.85%, which gradually increased to 75% in May 2021. This increased to 91.4% by June 2021 and was subsequently sustained at that level (figure 3). The average percentage of patients who achieved a FIM score of 80% or more on the third POD was 5.3% before implementation of the programme and increased to 86% after implementation. The mean FIM score of patients on the third POD was 73.71±4.81 (preintervention) and 81.20±3.77 (postintervention) (p<0.001) (tables 2 and 3).

SixMinute walk distance
The mean 6MWD on the fourth POD was 188.23±48.65 m preintervention and 267.90±36.10 m postintervention (p<0.001). Only 54% of the patients were able to complete the 6MWD test before programme implementation, which increased to 91% after implementation (tables 2 and 3).

![Figure 3](http://bmjopenquality.bmj.com/)

**Figure 3** Run chart. CL, central line; FIM, Functional Independence Measurement; LCL, lower control limit; MAP, mobility and activity programme; UCL, upper control limit.
Balance measures

No adverse events associated with the mobility and activity programme were reported. The percentage of patients who showed the level of confidence needed to carry out ADL and exercises independently at home on the fifth POD was 21.4% preintervention, which increased to 89.4% post intervention (p<0.001) (tables 2 and 3).

DISCUSSION

This QI programme, based on the four pillars of Inform, Involve, Integrate and Inspect, significantly affected the attainment of early functional independence and improved the ambulation distance achieved by patients.

Our results suggest that educating patients and their families about surgery, the recovery process and the activity and mobility programme was helpful. Various studies have shown that patients experience anxiety and fear over surgical outcomes. This psychological reaction can negatively affect pain sensation and the level of participation in exercise programmes. Preoperative education is associated with improved functional capacity and slightly reduced hospital length-of-stay. Hence, both patient and family education are necessary for better surgical outcomes. Similarly, a lack of staff confidence and knowledge is a primary barrier to early mobility and activity programmes. The incorporation of a multimodal educational programme for staff may facilitate better cooperation, participation and a change of mind set.

When implementing a QI programme, involving patients and their families as members of a multidisciplinary team can empower patients, which is necessary for improved outcomes. We implemented floor markings, patient recordings of walking distances and their frequencies on whiteboards and used colour-coded flags to empower and motivate patients to perform appropriate activities and mobilisation. Moreover, multidisciplinary staff involvement was ensured during the preparation and implementation of evidence-based mobility and activity levels.

Integrating scientific evidence into QI is critical for maximising the effect of a QI programme. We formulated an evidence-based mobility and activity level that ensured the appropriate and safe progression of mobility and activity levels of the patients. Various changes were tested and implemented that were also based on the available evidence.

Continuous monitoring of trends and deviations of quality indicators is critical for accomplishing programme goals. In our programme, this was done using standardised data collection sheets, while the project outcomes were analysed using standard control charts. This helped us decide whether to adopt or abandon the tested changes.

This project focused on the early attainment of functional independence and improving ambulation distance. The attainment of early functional independence is a key factor in improving patient self-efficacy, confidence and QOL, while measuring ambulation distance is a reliable measure for understanding a patient’s functional capacity. Moreover, ambulation is considered the highest level of mobility. The current project uncovered a statistically significant improvement in the 6MWD after implementing the programme. It also showed that the mean 6MWD at the time of discharge was 267.90±36.10 m, which is similar to values reported in other studies. Improving walking distance can reduce postoperative complications following cardiac surgery. Therefore, this project had a substantial but not quantifiable impact on hospital costs.

This QI project included participants of different ages, and patients who underwent cardiovascular surgeries.

Table 2: Patient characteristics and outcomes

<table>
<thead>
<tr>
<th>Variables</th>
<th>Nov 20–Jan 21</th>
<th>Feb 21–March 22</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>52.2±8.3</td>
<td>51.8±9.5</td>
<td>0.76</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>74 (98.7%)</td>
<td>417 (98.3%)</td>
<td>0.84</td>
</tr>
<tr>
<td>Female</td>
<td>1 (1.3%)</td>
<td>7 (1.7%)</td>
<td></td>
</tr>
<tr>
<td>EF</td>
<td>50.19±7.12</td>
<td>50.01±9.34</td>
<td>0.89</td>
</tr>
<tr>
<td>FIM</td>
<td>73.71±4.81 (%)</td>
<td>81.20±3.77 (%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>6MWD</td>
<td>188.23±48.65 m</td>
<td>267.90±36.10 m</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Level of confidence</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>2 (2.7%)</td>
<td>115 (27.1%)</td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>14 (18.7%)</td>
<td>264 (62.3%)</td>
<td></td>
</tr>
</tbody>
</table>

EF, ejection fraction; FIM, Functional Independence Measure; 6MWD, 6-minute walk distance.

Table 3: Percentage of improvement

<table>
<thead>
<tr>
<th></th>
<th>FIM (%)</th>
<th>6MWD (%)</th>
<th>Level of confidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preintervention</td>
<td>5.30</td>
<td>54</td>
<td>21.4</td>
</tr>
<tr>
<td>Postintervention</td>
<td>86</td>
<td>91</td>
<td>89.4</td>
</tr>
</tbody>
</table>

FIM, Functional Independence Measurement; 6MWD, 6-minute walk distance.
including CABG, valve replacements and aortic dissections. No serious adverse events were reported during the programme. This suggests that an early mobility and activity programme is safe and feasible irrespective of age or the type of cardiac surgery being performed. Additionally, this programme improved patient confidence levels when carrying out daily activities.

LESSONS LEARNT AND LIMITATIONS

Limitations
Despite the significant improvements that were achieved, this project had some limitations. It was a single-centre project, and the results may not be generalisable. However, the standardised mobility and activity programme were formulated using a systematic search of available evidence and an expert consensus process. Moreover, the implemented PDSAs were evidence-based. We cannot be sure which tested change had the most impact and which had the least, as multiple interventions were tested concurrently. Furthermore, there was no control group. All eligible patients received the mobility and activity programme. It is also worth noting that the percentage of female patients included in this programme was only 1.7%. Compared with males, fewer female patients underwent cardiac surgery, and more of them required a stay longer than 1 POD in the CTICU, which was one of our exclusion criteria. Also, the survey tool used to measure levels of confidence was not validated. However, the tools used to measure the main outcomes (functional independence and ambulation distance) were validated. Lastly, the effect of this programme on hospital length of stay and cost was not analysed.

Lessons learnt
- An evidence-based QI programme is essential for implementing an early mobility and activity programme.
- Empowering patients is fundamental for facilitating their participation and overcoming patient-related barriers.
- Multidisciplinary collaboration is the cornerstone for creating and sustaining a culture of change.

CONCLUSION
A well-designed QI process is effective in implementing a mobility and activity programme in patients following cardiac surgery. This project facilitated the early attainment of functional independence and improved the ambulation distance of patients at the time of hospital discharge. Moreover, the programme positively affected the confidence level of patients needed to carry out ADL and independently perform home exercises following discharge. Informing and involving patients, their families and staff, along with integrating scientific evidence and monitoring progress, were the key factors for the success and sustainability of the programme. A continuous audit of the programme and training goals for new staff were implemented to sustain the improvement.

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Contributors
PJ: Conceptualisation (lead), methodology (lead); development of the mobility activity programme, supervision; writing—original draft (supporting), guarantor; PJS: Writing—original draft (lead); development of the mobility activity programme, conceptualisation (supporting); methodology (supporting); PG: Project administration (lead); review and editing; formal analysis (supporting); MM: Supervision of primary outcome assessment, development of the mobility activity programme; AA: Project administration (supporting), resources; SAM and HHS: Formulating change ideas at physician level; ALS, JU and GM: Implementing change ideas and data curation; RUAG and PT: Assessing the primary outcome and implementing change ideas; RS: Formal analysis (lead).

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Competing interests
None declared.

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

Patient consent for publication
Not applicable.

Ethics approval
Institutional review board review was not sought as all of the changes being tested were evidence-based and widely accepted internationally. There was no control group and, therefore, no randomisation to ensure that no patients would be denied a best practice intervention.

Provenance and peer review
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Data availability statement
All data relevant to the study are included in the article or uploaded as supplementary information.

Supplemental material
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program on cardiorespiratory fitness and walking endurance in functional independence after discharge from the intensive care unit. 


Patient Confidence to Perform Mobility /Activity: Survey

Please complete this survey as precisely as you can by ticking the answer. The results will help us understand your experience regarding mobilization practices in the unit and improve our service to you. Thank you for your feedback.

Questions

1. I am confident to do all my activities of daily living (bathing, dressing, cooking etc) and exercises at home independently and safely after my cardiac surgery.
   - [ ] Strongly Agree  [ ] Agree  [ ] Neutral  [ ] Disagree  [ ] strongly Disagree