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Which Patient Factors Best Predict Discharge Destination After Primary Total Knee Arthroplasty? The ARISE Trial

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1 **Which Patient Factors Best Predict Discharge Destination After Primary Total Knee**
2 **Arthroplasty? The ARISE Trial.**

3 **Abstract**

4 *Background*

5 The role of inpatient rehabilitation after total knee arthroplasty (TKA) remains uncertain,
6 with evidence suggesting no better functional outcomes for those who discharge to
7 rehabilitation to those who discharge home. The aim of this study was to develop and
8 implement a preoperative predictive tool, ARISE (Arthroplasty Rehabilitation Initial
9 Screening Evaluation), that incorporated psychological, functional, and socio-demographic
10 factors to determine discharge destination.

11 *Methods*

12 One week prior to TKA, the ARISE tool was administered to 100 patients, in addition to an
13 EQ-5D-5L survey and other demographic data being recorded. The primary outcome was
14 discharge destination. An enhanced recovery pathway, which included an anaesthetic
15 protocol designed to optimise early mobilisation, was utilised. Univariable and multivariable
16 logistic regression analysis was performed to determine the likelihood of discharge
17 destination.

18 *Results*

19 Patients in the rehabilitation group were, on average, 4.5 years older than the home group
20 ($P=0.036$). After multivariable regression, ARISE questions that were predictive of discharge
21 destination related to beliefs around the superiority of inpatient rehabilitation ($OR=9.9$ [2.6–
22 37.9]) and post-discharge level of support ($OR=6.3$ [1.5–26.8]). No question around self-
23 reported physical function was predictive.

24 *Conclusion*

25 Pre-operative patient beliefs regarding rehabilitation and future home support are highly
26 predictive of discharge destination after primary TKA. Pre-operative patient reported
27 functional status and demographic variables, with the exception of increasing age, were not
28 shown to be predictive. Predicting those that are most likely to discharge to rehabilitation
29 allows for early, targeted interventions to optimise resources and increase likelihood of home
30 discharge.

31 **Keywords**

32 Total knee arthroplasty (TKA); Rehabilitation; Discharge Destination; Predictors

33 **Introduction**

34 Worldwide rates of total knee arthroplasty (TKA) are expected to continue to rise [1-4] on the
35 background of an aging population and a global obesity epidemic [5-8]. The increasing
36 prevalence and cost of TKA will have significant economic implications which will lead to
37 greater emphasis on controlling expenditure without compromising patient outcomes [9].

38 Post-acute care comprises a significant portion of the costs associated with TKA, reportedly
39 being over one third of total episode of care costs [10]. One of the most substantial post-acute
40 care costs is discharge to inpatient rehabilitation, with those who do having a greater
41 associated cost burden when compared to those TKA patients that discharge to home [9, 11].

42 With this increased demand for arthroplasty there will be a coincidental increase in the
43 number of those discharging to inpatient rehabilitation after TKA. Currently, there is a
44 paucity of evidence supporting discharge to inpatient rehabilitation over discharge home after
45 uncomplicated, primary TKA, with the recommendation of home discharge being the primary
46 aim in this population [11]. Moreover, large unexplained regional variations in discharge
47 destination currently exist [12].

48 Predicting pre-operatively those patients with the greatest likelihood of discharging to
49 inpatient rehabilitation allows for early and targeted interventions designed to increase the
50 likelihood of safe discharge directly home. A tool which can effectively predict discharge
51 destination, prior to surgery also allows for the optimisation of resource allocation. The
52 preoperative organisation of home-based services or inpatient rehabilitation facility
53 admission allows discharge planning to be initiated prior to surgery. Additionally, identifying
54 those patients that have pre-operative concerns about returning directly to their home
55 environment after TKA provides opportunity for discussion and reassurance regarding the
56 objective measures the clinical team uses to assess readiness and safety for home discharge
57 from the acute hospital setting.

58 Previous tools designed to predict discharge destination have failed to demonstrate a high
59 level of accuracy in those TKA patients with a “medium” level of risk for a “non-home”
60 discharge, which includes inpatient rehabilitation [13-16]. This issue is further heightened as
61 the “medium” category is comprised of the largest number of patients, when compared to

62 those considered as “low” or “high risk”, for discharge to inpatient rehabilitation [13-16].
63 While, patient expectation of discharge destination has been shown to be the most predictive
64 factor of actual discharge destination, this component has not been included in the scoring
65 models of existing predictive tools [17]. Moreover, while the influence of patient expectation
66 on discharge destination after TKA has been reported, the reasons behind that expectation has
67 yet to be explored [14, 15, 17].

68 The aim of this trial was to develop and administer a questionnaire comprised of socio-
69 demographic, functional and psychological domains, the ARISE (Arthroplasty Rehabilitation
70 Initial Screening Evaluation) tool, to identify which patient factors best predict discharge
71 destination in a primary TKA population.

72 **Methods**

73 *Trial design*

74 This study was a prospective cohort trial, designed and reported in accordance with the
75 Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement
76 guidelines [18]. Institutional review board approval was obtained, and the trial was
77 prospectively registered at Australian New Zealand Clinical Trials Registry (Identifier
78 ACTRN12619001483145).

79 *Questionnaire design and development*

80 The construction of the ARISE tool was based on the International Association for Medical
81 Education (AMEE) guidelines for developing questionnaires, which is a systematic, seven-
82 step process for designing high-quality questionnaires [19]. A literature review of existing
83 tools was performed to establish the first version of the ARISE tool question items and
84 response categories were based on a Likert-style scale. Patient interviews were then
85 conducted to make further refinements. Expert validation was conducted through interviews
86 with independent orthopaedic specialists and physiotherapists before administering the fourth
87 and final version of the ARISE tool.

88 *Participants*

89 Patients of a high volume, multi-surgeon, elective arthroplasty hospital scheduled to undergo
90 unilateral primary TKA for a primary diagnosis of OA were eligible for inclusion. The only
91 exclusion criteria was patients who had received a contralateral TKA in the past 12 months.

92 Patients were enrolled one week prior to their scheduled TKA from November 2019 to
93 January 2020 and demographic variables, including age, gender, body mass index and the
94 American Society of Anaesthesiologist (ASA) score, were recorded. The ARISE tool was
95 independently administered in the week prior to surgery, as well as an EQ-5D-5L [20]. The
96 EQ-5D-5L is a validated survey for measuring health-related quality of life and it also
97 includes a visual analogue scale for self-rated health. Post-operatively, the EQ-5D-5L was
98 administered again on day of discharge from hospital. The length of stay, in number of days,
99 in the acute hospital setting was recorded along with any complication resulting in return to
100 theatre or hospital readmission. Discharge destination (home or inpatient rehabilitation) was
101 the primary outcome of interest. A sample size of 100 patients was estimated based on
102 previous published literature on developing pre-operative tools to predict outcomes after
103 TKA [21, 22]. The sample size was confirmed with a calculation using published TKR
104 private hospital procedure rates and the proportion of which discharge to inpatient
105 rehabilitation, using a confidence level of 95% and confidence limits of 10%, a sample size
106 of 92 was estimated.

107 *Perioperative protocols*

108 All patients received a cemented minimally stabilized total knee prosthesis with patella
109 resurfacing. The anaesthetic protocol included spinal anaesthesia, an adductor canal nerve
110 block, and a peri-articular/capsular injection of local anaesthetic to the operative limb. Post-
111 operatively, patients underwent an enhanced recovery pathway which included early
112 mobilisation and a three-exercise pedalling-based protocol which was supervised by a
113 physiotherapist twice daily until discharge [23]. The criteria for home discharge was
114 independent transfers and mobility with the walking aid to be used at home, stair climbing
115 practice, and knee flexion range of motion to 90 degrees.

116 *Statistical analysis*

117 Data were analysed using the Statistical Package for Social Sciences (SPSS version 26).
118 Descriptive statistics for continuous data are expressed as mean (SD) or median (range)
119 depending on data distribution, and statistical significance considered as P values < 0.05 .
120 Categorical variables were summarised using counts and percentages. Differences in
121 demographic variables between discharge groups were analysed by the chi-square test with
122 respect to categorical data. Normally distributed continuous data were analysed using an
123 independent samples t -test. The non-parametric Mann-Whitney U test was used when data

124 were not normally distributed. The relationship between each predictive variable and
125 discharge destination was assessed using the chi-square test or the Fisher's exact test.
126 However, since some cells had a low response count, prior to the main analyses, the Likert
127 responses were re-categorised to two levels. Univariable logistic regression analysis was
128 initially performed to determine the likelihood of discharge destination for each variable.
129 Predictor variables that were significant at the 0.1 were selected for potential inclusion in a
130 multivariable analysis and underwent backward stepwise logistic regression to determine the
131 model that best predicted inpatient rehabilitation discharge. A C-statistic was also generated
132 to assess goodness-of-fit and predictive accuracy of the final logistic regression model.

133 **Results**

134 *Baseline characteristics and discharge destination*

135 In total, 100 participants from four arthroplasty surgeons were enrolled. All 100 participants
136 completed the ARISE questionnaire and the patient characteristics are described in Table 1.
137 Of the 100 participants, 82 discharged home and 18 discharged to inpatient rehabilitation. On
138 average, patients in the rehabilitation group were 4.5 years older than those in the home
139 group ($P=0.036$), and of those who were aged greater than 75 years, a greater proportion
140 discharged to inpatient rehabilitation ($P = 0.030$). No differences between groups were found
141 in gender, body mass index, and comorbidity status.

142 *The ARISE tool*

143 The univariable results revealed 5 ARISE questions that were individually predictive of
144 discharge destination, they are listed in Table 2. The predictive questions related to the
145 patient's belief about their post-discharge level of support, their pre-operative beliefs
146 regarding the superiority of inpatient rehabilitation or their self-assessed ability to perform
147 self-directed home-based exercises. If a patient agreed or strongly agreed that they would do
148 best with inpatient rehabilitation, they were 33 times more likely to discharge to inpatient
149 rehabilitation ($OR = 32.8 [8.0 \text{ to } 129.9]$, $P < 0.001$) and if they were worried most or all of the
150 time about being a burden on their family or friends, then inpatient rehabilitation discharge
151 was 8 times more likely ($OR = 8.1 [2.6 \text{ to } 24.9]$, $P < 0.001$). A patient who did not have
152 someone, all or most of the time, who could help them after surgery resulted in an 11 times
153 greater likelihood of discharge to inpatient rehabilitation ($OR = 10.7 [3.2 \text{ to } 35.8]$, $P < 0.001$).
154 No question around physical function or living situation was predictive of discharge
155 destination.

156 In finalising the multivariable stepwise regression, and to avoid multicollinearity, the 3
157 questions around a patient's beliefs about the superiority of rehabilitation were combined to a
158 create new variable. The results show that if a patient agreed to at least 2 of those three
159 statements about rehabilitation, then the patient was 10 times more likely (OR = 9.9 [2.6 to
160 37.9]) to be discharged to rehabilitation. When this model was adjusted for age; a patient
161 aged 75 years and over was more than three and a half times more likely for inpatient
162 rehabilitation discharge (OR = 3.6 [0.9 to 13.6]). Not having someone to help after surgery
163 made inpatient rehabilitation discharge six times more likely (OR = 6.3 [1.5 to 26.8]) (Table
164 3). The final multivariable regression model produced a C-statistic of 0.84, demonstrating a
165 strong model with 84% correct predictivity.

166 *EQ-5D-5L and Length of stay*

167 Results of the EQ-5D-5L and length of stay are shown in Table 4. The self-rated global
168 health score, as measured by the EQ-5D-5L VAS, was 10 points (on a 100-point scale) better
169 for the home discharge group versus the inpatient rehabilitation discharge group, both pre-
170 operatively ($P = 0.043$) and on day of discharge ($P = 0.009$) from the acute hospital setting.
171 However, the EQ-5D-5L total showed no significant difference for discharge destination ($P =$
172 0.211). Length of stay for the rehabilitation group was one day longer, at 4 days, when
173 compared to the home discharge group at 3 days ($P < 0.001$). There were no reported
174 complications resulting in return to theatre or hospital readmission for either group.

175 **Discussion**

176 The most significant finding of this study was that discharge destination was predicted by a
177 patient's pre-operative beliefs and their age, rather than self-reported physical function,
178 helping to identify before TKA surgery the patients that are most likely to discharge to
179 inpatient rehabilitation. The early identification of patients that are most likely to discharge to
180 inpatient rehabilitation allows for methods to provide targeted post-operative care and
181 optimize resources.

182 The ARISE tool was designed to capture a patient's socio-demographic and functional
183 characteristics as well as include questions about their pre-surgical beliefs towards about
184 inpatient rehabilitation. Our results showed that the ARISE questions that were highly
185 predictive of inpatient rehabilitation were those that asked about a patient's beliefs about
186 rehabilitation. This finding is in keeping with the results of other predictive studies that
187 demonstrated a patient's "preferred discharge destination" was the most predictive variable of

188 actual discharge destination [14, 16, 17]. However, the ARISE tool goes further, identifying
189 potential reasons why a patient would prefer to discharge to inpatient rehabilitation.

190 There is existing research that older age is predictive of discharge destination after TKA [24-
191 29], which is consistent with our results suggesting that even when accounting for other
192 predictive variables, age of 75 years or greater resulted in a greater likelihood of inpatient
193 rehabilitation discharge. Prior reports of other demographic variables being predictive of
194 discharge destination after TKA, including female gender, increased co-morbidity and
195 obesity, was not replicated in this study [24, 25, 27, 28, 30, 31]. However, the ARISE cohort
196 demonstrated homogeneity across comorbidity and obesity scales, thus, a sample of size of
197 100 may not have been large enough to be sensitive to differences in these characteristics
198 between groups.

199 The ARISE tool has some similar features to the well validated EQ-5D-5L instrument, in that
200 it is a “domain-based” questionnaire and designed for self-completion, the ARISE tool also
201 utilises a 5-item response scale as does the EQ-5D-5L. However, where the EQ-5D-5L is a
202 standardised instrument for measuring generic health status, the ARISE tool has been
203 developed to also include a socio-demographic domain and to question a patient’s beliefs
204 around inpatient rehabilitation before they have had their surgery. Although the EQ-5D-5L
205 was not the primary outcome of interest in this trial, the lower score of the EQ-VAS in the
206 inpatient rehabilitation discharge group demonstrates that this group believed they were in
207 “worse health” both before and after their surgery than those who discharged home. Another
208 outcome assessed in the ARISE trial was length of stay, with those discharging to inpatient
209 rehabilitation staying one day longer than the control group. This result is difficult to interpret
210 as when awaiting discharge to inpatient rehabilitation often operational characteristics dictate
211 length of stay, such as bed availability.

212 A limitation of this study is its generalizability to other patients at other institutions. All
213 surgeries were performed by experienced arthroplasty surgeons at a single high-volume
214 institution. An enhanced recovery pathway, that included early mobilization was also utilized.
215 Also, the differences in reported rates of inpatient rehabilitation between the private and
216 public sectors is noted [11, 12], with patient preference likely carrying greater weight in the
217 private sector. Therefore, these results may not be transferrable when different regimes are
218 used or in patients who do not undergo elective primary TKA.

219 The results of the ARISE trial suggest that interventions to facilitate home discharge after
220 uncomplicated primary TKR may be best aimed towards modifiable factors such as
221 increasing access to home domiciliary services and addressing a patient’s pre-surgical beliefs
222 about the perceived challenges of completing their rehabilitation at home. Perioperative
223 advancements, such as multimodal pain management, blood management and early
224 mobilization protocols all contribute to a rapid recovery pathway which has been reported to
225 lower hospital length of stay (LOS) or same-day surgery without adversely impacting
226 postoperative complications or readmissions [32]. When these improvements in TKA
227 management are combined with a simple home rehabilitation program, lengthy and costly
228 inpatient rehabilitation may be able to be avoided in many circumstances.

229 **Conclusion**

230 Pre-operative patient beliefs regarding rehabilitation and future home social support are
231 highly predictive of discharge destination after primary TKA, while the only demographic
232 variable that is predictive is increasing age, and in particular, age 75 years and over. Self-
233 reported pre-operative physical function is not predictive of discharge destination. Patient’s
234 psychosocial status requires much greater pre-operative examination to avoid unnecessary
235 discharge to inpatient rehabilitation.

236

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239 commercial, or not-for-profit sectors.

240 *Competing Interests*

241 The authors have no competing interests to declare.

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341

342

343

344

345 **Figures**

346 Figure 1. The ARISE (Arthroplasty Rehabilitation Initial Screening Evaluation) tool.

Name:	Today's Date:	Surgery Date:
Phone: *Place Sticker Here*	Height:	Weight:
Date of Birth:	First Knee Joint Replacement? Yes or No	

347

Which of the following statements best describes your current living situation?	Tick <u>one</u> situation only
Someone else lives with me, and I take care of myself	
Someone else lives with me, and I need help taking care of myself	
I live alone, and I take care of myself	
I live alone, and I need help taking care of myself	

348

Can you tell us about your current situation?	Tick one response for each question only			
	All of the time	Most of the time	Some of the time	Not at all
I can walk without a walking stick or walker easily				
I can do my shopping easily				
I can bathe/dress myself easily				
I can drive myself to appointments on my own				
I am confident when I climb stairs				
I have someone who can help me after surgery if needed				

How do you feel about the following statements?	Tick one response for each question only			
	All of the time	Most of the time	Some of the time	Not at all
I am anxious about my upcoming surgery				
I am afraid of falling over				
I am worried about being a burden on my family or friends during my recovery				

349

How much do you agree/disagree with each of the following statements?	Tick one response for each question only				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I would prefer a therapist to supervise my exercises					
I would do best staying in a rehabilitation facility instead of doing my rehabilitation at home					
I would have difficulties following a home-based exercise program after my surgery					

350

351

352 **Tables**

353 Table 1. Patient characteristics and discharge destination

Characteristic	Home (n = 82)	Rehab (n = 18)	P-value
Age (yrs.), Mean (SD)	68.5 (7.8)	73.0 (9.5)	0.036
Age >75 (n = 29), n (%)	20 (24.4)	(9) 50.0	0.030
Gender, n (%)			
Male (n = 46)	39 (47.6)	7 (38.9)	0.500
Female (n = 54)	43 (52.4)	11 (61.1)	
BMI (kg/m ²), Mean (SD)	29.8 (4.9)	29.1 (6.6)	0.608
ASA, Median (Range)	2.0 (1.0 – 3.0)	2.0 (2.0 – 3.0)	0.558
P-value <0.05 statistically significant			

354

355 Table 2. ARISE questions predictive of discharge to rehabilitation after univariable logistic
356 regression analysis

Question	Home (n = 82) n (%)	Rehab (n = 18) n (%)	Odds Ratio (95% CI)	P-value
<i>I have someone who can help me after surgery if needed</i> Response: "Some of the time or Not at all"	7 (8.5)	9 (50)	10.7 (3.2 to 35.8)	<0.001
<i>I am worried about being a burden on my family or friends during my recovery</i> Response: "Most or All of the time"	11 (13.4)	10 (55.6)	8.1 (2.6 to 24.9)	<0.001
<i>I would prefer a therapist to supervise my exercises</i> Response: "Agree or Strongly agree"	32 (39.0)	14 (77.8)	5.5 (1.7 to 18.1)	0.005
<i>I would do best staying in a rehabilitation facility instead of doing my rehabilitation at home</i> Response: "Agree or Strongly agree"	11 (13.4)	15 (83.3)	32.8 (8.0 to 129.9)	<0.001
<i>I would have difficulties following a home-based exercise program after my surgery</i> Response: "Agree or Strongly agree"	6 (7.3)	6 (33.3)	6.3 (1.8 to 22.9)	0.005
P-value <0.05 statistically significant				

357

358 Table 3. ARISE questions predictive of discharge to rehabilitation after multivariable
 359 regression analysis

Variable	Odds Ratio (95% CI)	P-value
Age >75	3.6 (0.9 to 13.6)	0.030
<i>I have someone who can help me after surgery if needed</i> Response: "Some of the time or Not at all"	6.3 (1.5 to 26.8)	<0.001
<i>I would prefer a therapist to supervise my exercises</i> Response: "Most or All of the time"	*9.9 (2.6 to 37.9)	<0.001
<i>I would do best staying in a rehabilitation facility instead of doing my rehabilitation at home</i> Response: "Agree or Strongly agree"		
<i>I would have difficulties following a home-based exercise program after my surgery</i> Response: "Agree or Strongly agree"		
P-value <0.05 statistically significant *When a patient "agreed" to at least 2 of the 3 statements		

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361 Table 4. EQ-5D-5L and Length of Stay and discharge destination

Variable	Home (n = 82) Median (Range)	Rehab (n = 18) Median (Range)	P-value
EQ-5D-5L Score (Pre-operative)	11 (6 – 20)	12 (8 – 19)	0.211
EQ-5D-5L Score (Post-operative)	10 (6 – 18)	10 (7 – 18)	0.095
VAS Score (100-point scale) (Pre-operative)	82.5 (30 – 100)	72.5 (30 – 100)	0.043
VAS Score (100-point scale) (Post-operative)	80 (30 – 100)	70 (45 – 95)	0.009
Length of stay (Days)	3.0 (1 – 7)	4.0 (2 – 9)	<0.001
P-value <0.05 statistically significant			

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