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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 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 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 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.

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248   **References**

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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 one 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					

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351

Tables

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 have someone who can help me after surgery if needed Response: "Some of the time or Not at all"	7 (8.5)	9 (50)	10.7 (3.2 to 35.8)	**<0.001**
I am worried about being a burden on my family or friends during my recovery Response: "Most or All of the time"	11 (13.4)	10 (55.6)	8.1 (2.6 to 24.9)	**<0.001**
I would prefer a therapist to supervise my exercises Response: "Agree or Strongly agree"	32 (39.0)	14 (77.8)	5.5 (1.7 to 18.1)	**0.005**
I would do best staying in a rehabilitation facility instead of doing my rehabilitation at home Response: "Agree or Strongly agree"	11 (13.4)	15 (83.3)	32.8 (8.0 to 129.9)	**<0.001**
I would have difficulties following a home-based exercise program after my surgery 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 have someone who can help me after surgery if needed *Response: "Some of the time or Not at all"*	6.3 (1.5 to 26.8)	**<0.001**
I would prefer a therapist to supervise my exercises *Response: "Most or All of the time"* *I would do best staying in a rehabilitation facility instead of doing my rehabilitation at home* *Response: "Agree or Strongly agree"* *I would have difficulties following a home-based exercise program after my surgery* *Response: "Agree or Strongly agree"*	*9.9 (2.6 to 37.9)	**<0.001**
P-value <0.05 statistically significant *When a patient "agreed" to at least 2 of the 3 statements		

360

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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