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Clinical pathways in total knee arthroplasty: A New Zealand experience

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ABSTRACT

Purpose. To ascertain the effects of a clinical pathway in our institution.
Methods. This retrospective and comparative study was performed on all patients undergoing total knee arthroplasty over a 5-year period. This period covered the 30 months prior to the introduction of the pathway (group 1), and the 30 months following its introduction (group 2).
Results. There was a significant reduction in the duration of hospital stay of group 2 patients ($p<0.0001$), with 62.8% of these patients staying less than 8 postoperative days. There was a reduction in the number of patients with thromboembolic complications ($p<0.05$) and no increase in overall complications or readmission rate. There was a trend to increased use of rehabilitation services among group 2 patients.
Conclusion. Clinical pathway implementation resulted in a significant reduction in the length of stay, and achieved a more efficient management of hospitalised patients without compromising outcome.

Key words: *arthroplasty; clinical pathway; complications; length of stay; managed care; patient readmissions*

INTRODUCTION

Total knee arthroplasty (TKA) is performed at an increasing rate as a result of the increase of the mean age of the population. The number of primary TKAs performed in New Zealand during the year 2000 had a 23% increase compared with the previous year.[1] Such an increase drains the time and financial resources of the health care providers. Clinical pathways have been introduced in North America, Australia, and the UK, with the expectation of

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maintaining a high quality of care at a lower cost. Clinical pathways are standardised protocols for the management of patients with common conditions or those undergoing common surgical procedures. They are intended to cover all foreseeable aspects of care by all members of the health care team managing the involved patients. The objectives of implementing the protocols include the standardisation of care and the reduction of in-patient stay and cost without adverse effect on patient outcomes. In the literature there is evidence that the use of clinical pathways help reduce the length of stay (LOS)[2–9] and cost[4,6,8,10] without undesirable outcomes.[3,6,11] Most studies also show that after the implementation of a pathway, there is no significant change in postoperative complication and readmission rate.[3,4,7] We report our experience with a clinical pathway for TKA in a New Zealand public hospital.

METHODS

In July 1997 we introduced a clinical pathway for patients undergoing TKA. The pathway was developed by a multidisciplinary team of health care workers involved in the care of TKA patients. The team comprised an orthopaedic surgeon, the clinical care pathway coordinator, senior nursing staff, and

Total Knee Replacement Clinical Care Pathway

Patient Label

Day 2, DATE / /	C	Comment	*	Variation	/	N/A

Medical

M1	Medical assessment completed	
M2	Drains removed	
M3	No wound ooze	
M4	n/v status	
M5	Urine output within normal limits	
M6	No evidence of DVT	
M7	Blood results normal	
M8	Chest clear	
M9	X-Ray ordered	
M10	Analgesia effective - PCA/EPI/Fnblock	
M11	Leg position checked	
M12	Other: see variance	

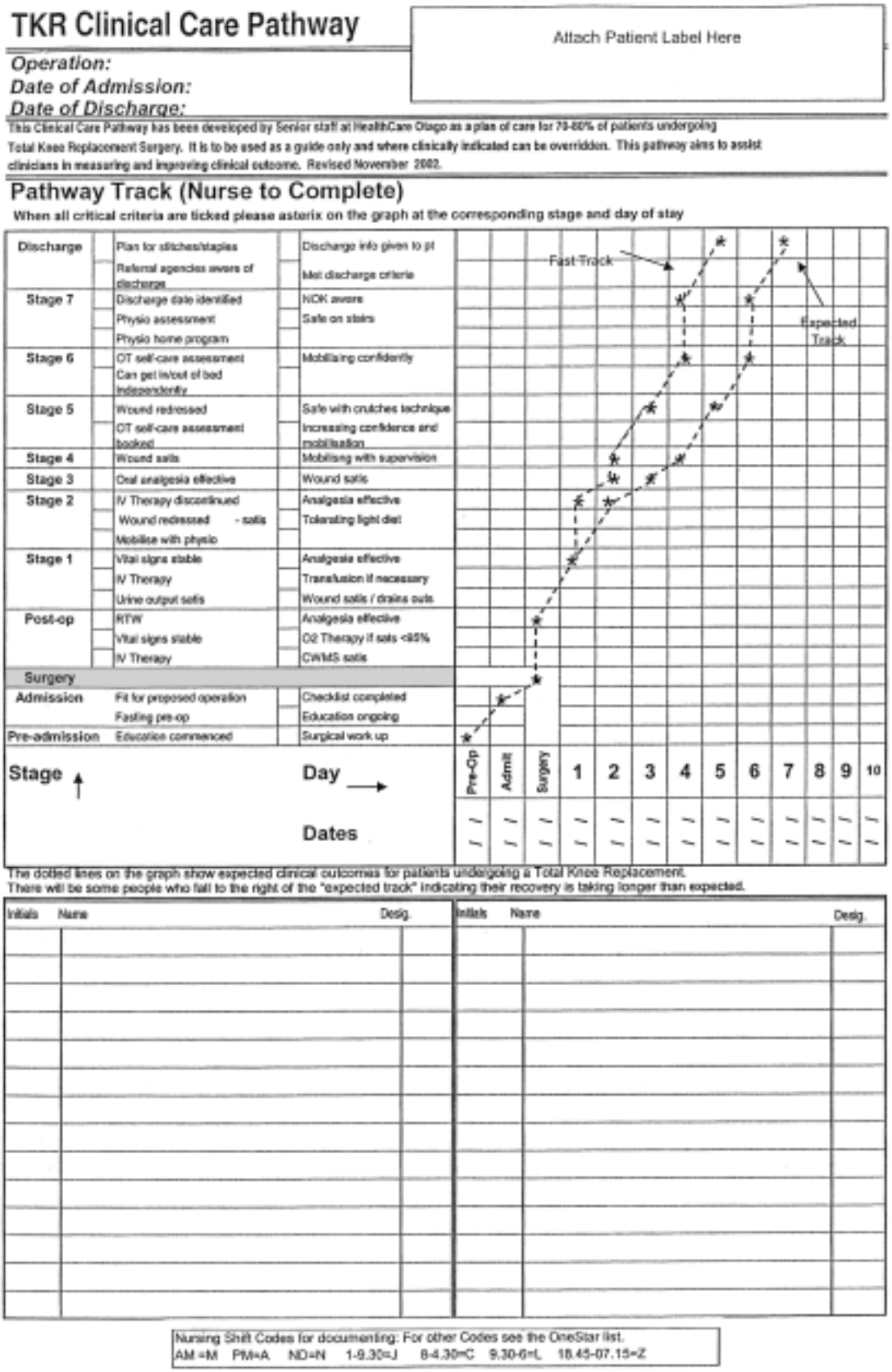
Nursing

Observations		M	A	N
N1	Obs within normal limits 4hrly QID (circle)			
Wounds & skin				
N2	Dressing changed signed & dated			
N3	Drains removed			
N4	PAC given			
N5	Pressure Sore Assessment <11 (give no)			
Treatments				
N6	TEDs insitu (if able)			
N7	DVT prophylaxis per guidelines			
N8	Leg exercises completed			
N9	Discontinue if O2 satn > 95%			
N10	Antibiotics stopped cont. oral (circle)			
N11	Coughing & deep breathing ex completed			

Nursing Continued...		M	A	N
N12	CWMS within normal limits			
Nutrition & Hydration				
N13	IV therapy cont. plugged out (circle)			
N14	Tolerating light diet			
Pain control				
N15	Analgesia effective/comfortable at rest			
N16	PCA / Epidural cont removed			
N17	Analgesia bolus given prn			
N18	Seen by Pain Team			
Elimination				
N19	Output satisfactory (IDC out Y / N)			
N20	Bowel function appropriate			
Hygiene				
N21	Full hygiene bedrest cares given			
Psychosocial				
N22	Mood and behaviour appropriate			
Activity & Rest				
N23	Sleeping/Resting adequately			
N24	Front graph completed			
N25	Other : see variance			

Physiotherapy		0800-12.30	1300-1700
P1	Leg mobilised on CPM ..... to ..... deg		
P4	Static quads Y / N SLRaise Y / N IRQ Y / N		
P8	Knee flexion active to 40 deg		
P6	Quads lag is		
P2	Leg in foam trough		
P7	Mob X's /frame bed-chair Scott brace removed		
P10	Other : see variance		

Figure 1 Day 2 total knee replacement clinical care pathway.



TKR Clinical Care Pathway

Attach Patient Label Here

Operation:
Date of Admission:
Date of Discharge:

This Clinical Care Pathway has been developed by Senior staff at HealthCare Otago as a plan of care for 70-80% of patients undergoing Total Knee Replacement Surgery. It is to be used as a guide only and where clinically indicated can be overridden. This pathway aims to assist clinicians in measuring and improving clinical outcome. Revised November 2002.

Pathway Track (Nurse to Complete)

When all critical criteria are ticked please asterix on the graph at the corresponding stage and day of stay

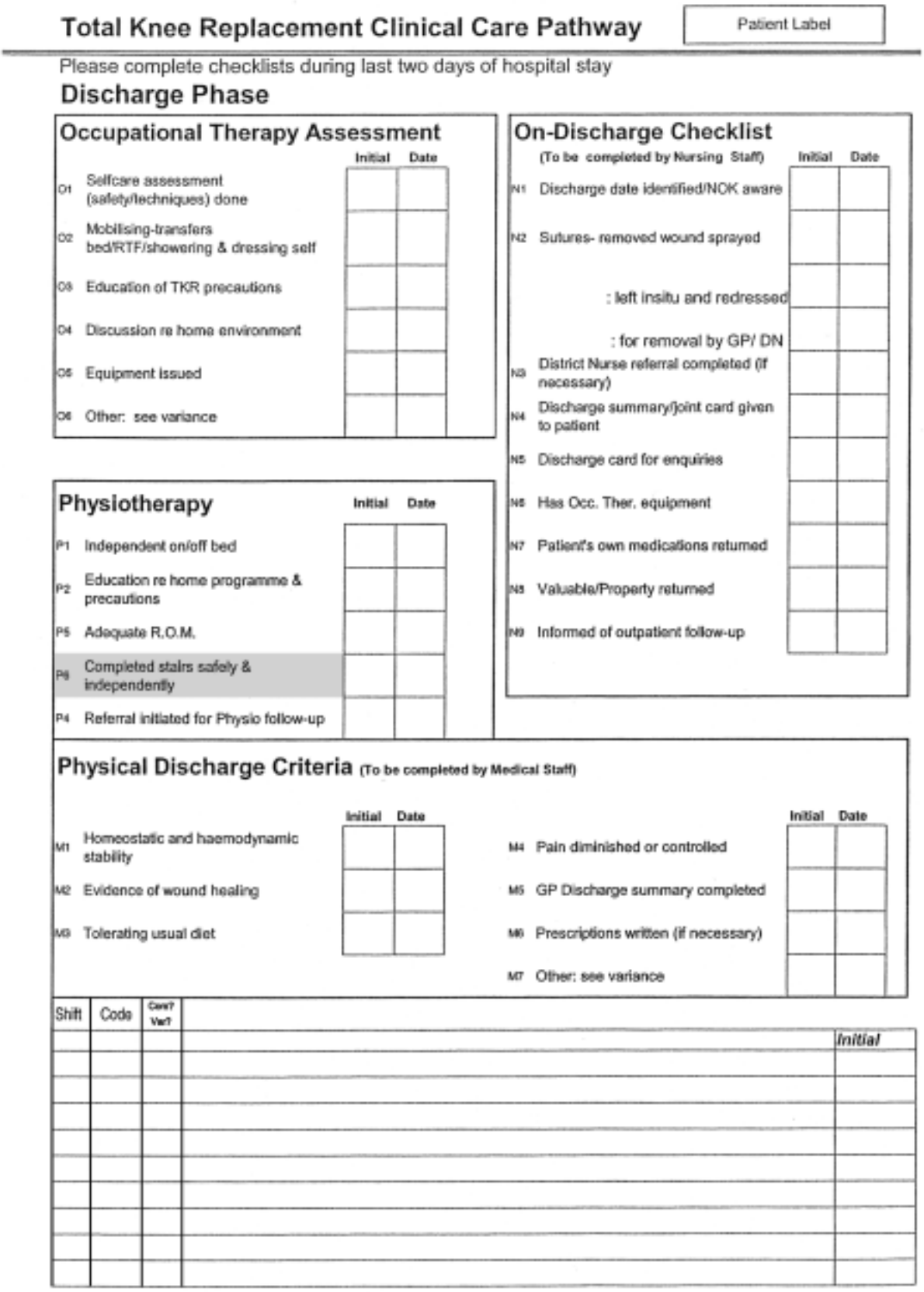
Discharge		Plan for stitches/staples		Discharge info given to pt
		Referral agencies aware of discharge		Met discharge criteria
Stage 7		Discharge date identified		NOK aware
		Physio assessment		Safe on stairs
		Physio home program		
Stage 6		OT self-care assessment		Mobilising confidently
		Can get in/out of bed independently		
Stage 5		Wound redressed		Safe with crutches technique
		OT self-care assessment booked		Increasing confidence and mobilisation
Stage 4		Wound satis		Mobilising with supervision
Stage 3		Oral analgesia effective		Wound satis
Stage 2		IV Therapy discontinued		Analgesia effective
		Wound redressed - satis		Tolerating light diet
		Mobilise with physio		
Stage 1		Vital signs stable		Analgesia effective
		IV Therapy		Transfusion if necessary
		Urine output satis		Wound satis / drains outs
Post-op		RTW		Analgesia effective
		Vital signs stable		O2 Therapy if sats <95%
		IV Therapy		CWMS satis
Surgery				
Admission		Fit for proposed operation		Checklist completed
		Fasting pre-op		Education ongoing
Pre-admission		Education commenced		Surgical work up

The dotted lines on the graph show expected clinical outcomes for patients undergoing a Total Knee Replacement.
There will be some people who fall to the right of the "expected track" indicating their recovery is taking longer than expected.

Initials	Name	Desig.	Initials	Name	Desig.

Nursing Shift Codes for documenting: For other Codes see the OneStar list.
AM =M PM=A ND=N 1-9.30=J 8-4.30=C 9.30-6=L 18.45-07.15=Z

Figure 2 Progress page of clinical care pathway.



Total Knee Replacement Clinical Care Pathway

Patient Label

Please complete checklists during last two days of hospital stay

Discharge Phase

Occupational Therapy Assessment

		Initial	Date
O1	Selfcare assessment (safety/techniques) done		
O2	Mobilising-transfers bed/RTF/showering & dressing self		
O3	Education of TKR precautions		
O4	Discussion re home environment		
O5	Equipment issued		
O6	Other: see variance		

On-Discharge Checklist

	(To be completed by Nursing Staff)	Initial	Date
N1	Discharge date identified/NOK aware		
N2	Sutures- removed wound sprayed		
	: left insitu and redressed		
	: for removal by GP/ DN		
N3	District Nurse referral completed (if necessary)		
N4	Discharge summary/joint card given to patient		
N5	Discharge card for enquiries		
N6	Has Occ. Ther. equipment		
N7	Patient's own medications returned		
N8	Valuable/Property returned		
N9	Informed of outpatient follow-up		

Physiotherapy

		Initial	Date
P1	Independent on/off bed		
P2	Education re home programme & precautions		
P5	Adequate R.O.M.		
P6	Completed stairs safely & independently		
P4	Referral initiated for Physio follow-up		

Physical Discharge Criteria (To be completed by Medical Staff)

		Initial	Date
M1	Homeostatic and haemodynamic stability		
M2	Evidence of wound healing		
M3	Tolerating usual diet		
M4	Pain diminished or controlled		
M5	GP Discharge summary completed		
M6	Prescriptions written (if necessary)		
M7	Other: see variance		

Shift	Code	Cont? Var?		Initial

Figure 3 Discharge phase of clinical care pathway.

physiotherapy and occupational therapy staff from both in-patient and out-patient / preadmissions areas. The pathway was a protocol that was translated into the backbone of the patient's medical chart. It commenced at the preadmissions clinic with the medical, anaesthetic, and physiotherapy assessment. The nursing assessment included a pressure score and falls risk score. The patient received an overview of both the in-patient and out-patient programmes. Medical, nursing, and physiotherapy tasks or goals were set for each postadmission day (Fig. 1). The medical chart, which was monitored daily, had points that were signed off by the relevant professionals until the day of discharge. Deviations from the expected progress were also recorded. The pathway was initially set for an 8-day postoperative LOS. An overview of progress was recorded on the front of the pathway chart (Fig. 2). Discharge criteria included active knee flexion to 90°, ability to walk with aids on stairs, independent showering, unaided transfers, and dressing, etc. (Fig. 3)

A retrospective and comparative study was performed on all patients undergoing primary TKA over a 5-year period from 1 January 1995 to 31 December 1999 in Dunedin Hospital, Dunedin. During the 30-month period prior to the introduction of the pathway, 181 TKAs were performed. This group of patients (group 1) became the control group in this study. In the consecutive 30-month period following its introduction, there were 261 TKAs performed. This group of patients (group 2) underwent the pathway. In both groups, we only studied cases of elective primary TKAs. Acute, revisional, bilateral, and unicompartmental procedures were excluded from both groups. Procedures were performed by, or under the direct supervision of, 6 consultant orthopaedic surgeons.

All group 2 patients were assessed at the preadmissions clinic for suitability for introduction to the pathway. Patients were not enrolled onto the pathway if they had significant concomitant medical or mobility problems that would affect a standard postoperative stay and recovery. These problems included severe multiple-joint involvement, severe cardiac or respiratory diseases, and potential intensive care or coronary care admissions in the immediate postoperative period. However, the patients excluded from enrolment onto the clinical pathway were included for data analysis in group 2 in order to prevent bias in the study, and to allow comparison with similar patient populations.

One group 1 patient and 2 group 2 patients died postoperatively. The 2 groups were comparable with respect to place of residence, age, sex, underlying diagnosis and co-morbidities (Table 1).

Outcome examined included the LOS, admissions on the day of surgery, complications, readmissions within 90 days, and discharge destination. Patients' daily performance and that at discharge were recorded for group 2 as part of the pathway documentation. During the period of the study, there was no change in the type of implant, operating theatre protocol, or physiotherapy technique used. Guidelines for referral to rehabilitation included poor progression along the pathway, general frailty, problems with activities of daily living, and poor support at home. Data were collected from the hospital's electronic patient administration database, the departmental audit system, the clinical pathway system, and the patient medical records.

Table 1
Demographic and clinical features*

Variable	Group 1 (n=181)	Group 2 (n=261)
Mean age ± standard deviation (years)	69 .8± 8.7	71 .2± 9.4
Sex		
Male	81 (44.8%)	102 (39.1%)
Female	100 (55.2%)	159 (60.9%)
Underlying disease		
Osteoarthritis	170 (93.9%)	232 (88.9%)
Rheumatoid arthritis	11 (6.1%)	29 (11.1%)
Place of residence		
Rural	79 (43.6%)	95 (36.4%)
Town	102 (56.4%)	166 (63.6%)
American Society of Anesthesiologists score category		
I	31 (17.1%)	15 (5.7%)
II	107 (59.1%)	184 (70.5%)
III	43 (23.8%)	61 (23.3%)
IV	0 (0%)	1 (0.4%)

* Data shown in No. (%) except otherwise stated

Statistical analysis

Chi squared and Fisher's exact tests were used to assess the differences between the groups for discrete variables. Student's *t* test was used for continuous variables. Any p value less than 0.05 was considered statistically significant.

RESULTS

Within group 2, 241 (92%) patients were accepted onto the pathway, of whom 209 (87%) patients completed the pathway satisfactorily. LOS was found to be significantly reduced for all patients in group 2 compared with those in group 1. The mean LOS was reduced from 12.9 days in group 1 to 10.3 days in group 2 ($p<0.0001$). The percentage of patients discharged within 8 postoperative days rose from 23.8% in group 1 to 62.8% in group 2 ($p<0.0001$). The rate of admission on the day of surgery increased from 2.2% in group 1 to 4.2% in group 2, but such difference was not statistically significant. There was also an insignificant increase in the rate of utilisation of the in-patient rehabilitation unit from 6.6% in group 1 to 11.9% in group 2. Those patients who required rehabilitation were transferred to the rehabilitation unit. The mean LOS for rehabilitation was 13.4 days in group 1, compared with 10.6 days in group 2 ($p<0.05$). The difference of readmission rate (12.2% for group 1 and 10.3% for group 2) between the 2 groups was not statistically significant either. The results are summarised in Table 2.

The overall rate of complications dropped from 32.6% in group 1 to 25.7% in group 2. In particular, the number of patients requiring manipulation under anaesthesia was reduced in group 2. There were also significantly fewer patients complicated with deep vein thrombosis or pulmonary embolism in group 2. Conversely, there was an insignificant increase in the rate of reported superficial wound infection from 5.5% in group 1 to 9.2% in group 2. There was neither a corresponding difference in the rate of deep wound or joint infection nor a significant increase in the rate of revision procedures between both groups. The results are summarised in Table 3.

Review of the prospectively gathered performance data for the patients in group 2 showed that by postoperative day 8, 89% of these patients attained 90° of knee flexion (93% of whom were further capable of mobilising independently and safely both on the flat and on stairs).

DISCUSSION

A care pathway integrates the routine aspects of a patient's care. Ideally it avoids delay in identifying potential problems and streamlines care accordingly. During the study period we accepted 92% of the patients onto the pathway. With increased experience we now find it extremely rare to exclude a patient from the pathway.

Table 2
Length of stay, admission day, and use of rehabilitation service*

	Group 1 (n=181)	Group 2 (n=261)	p value
Admission on day of surgery	4 (2.2%)	11 (4.2%)	0.296
Mean length of stay±standard deviation (days)	12 .9±4.7	10 .3±3.4	<0.0001
Patients discharged within 8 postoperative days	43 (23.8%)	164 (62.8%)	<0.0001
Patients transferred to rehabilitation unit	12 (6.6%)	31 (11.9%)	0.067
Patients readmitted within 90 days	22 (12.2%)	27 (10.3%)	0.551

* Data shown in No. (%) except otherwise stated

Table 3
Postoperative complications*

	Group 1 (n=181)	Group 2 (n=261)	p value
Patients with one or more complications	59 (32.6%)	67 (25.7%)	0.113
Type of complication			
Manipulation under anaesthetic required	10 (5.5%)	6 (2.3%)	0.074
Deep vein thrombosis/pulmonary embolism	7 (3.9%)	2 (0.8%)	<0.05
Superficial infection	10 (5.5%)	24 (9.2%)	0.154
Deep infection	0 (0%)	1 (0.4%)	1.000
Revision procedure	1 (0.6%)	3 (1.1%)	0.648

* Data shown in No. (%) except otherwise stated

There was a significant reduction in the LOS for patients admitted onto our pathway. Our reduction of 2.6 days was comparable to those of 2 days by Pearson et al.,[7] 1.5 days by Dowsey et al.,[3] and 3.6 days by Fisher et al.[4] Although Mabrey et al.[6] achieved a 6.2 days' reduction, their patient population had a mean age of 10 years less than that of our study. In contrast to Pearson et al.,[7] who admitted 75.6% of their patients on the day of surgery, our admission rate on the day of surgery was very low in both groups (2.2% in group 1, and 4.2% in group 2). Since 39% of our patients were from rural abodes, further measures can be implemented to increase the same-day admission rate, which helps to reduce the LOS.

We propose that different care pathways for TKA should have similar core components such as early discharge planning and in-patient physiotherapy; but we still have to be sensitive to institution-specific requirements. Our pathway emphasises early discharge planning, patient education, and early mobilisation with out-patient physiotherapy. We did not increase staff numbers or add services. Pearson et al.[7] set their LOS at 8 days, transferring patients from the acute ward to a convalescent ward on day 4. They also developed a structured approach to home physiotherapy. Mabrey et al.[6] set a 5-day stay with different discharge criteria, such as 65° active knee flexion and the ability to walk 50 feet with aids (stair climbing was not mentioned). In-patient rehabilitation was required for 20% of those patients and home physiotherapy for a further 17%. Dowsey et al.[3] routinely used community nurses for 3 weeks following discharge.

We found an insignificant increase in the rate of transfer to an in-patient rehabilitation facility in the pathway group. This did not account for the overall reduction in the length of patient stay. We believe that the increased and earlier utilisation of rehabilitation services is largely a result of the clinical pathway. This clinical pathway helps to identify those patients who will benefit from rehabilitation earlier, prompting timely referral.

While there may be concerns about the potential for adverse outcomes with early discharge of patients, our study shows that such concerns are not verified by empirical data. By day 8 of the pathway, 89% of the enrolled patients had over 90° of knee flexion, and 93% of whom were mobilising satisfactorily. These patients thus met the historical criteria for discharge, which were also applied to the patients in group 1. In addition, we found no increase in either postoperative complications or readmissions after the pathway implementation, which is consistent with other studies.[3,6,7] Furthermore, readmissions and most complication types (especially thromboembolic phenomenon) showed a downward trend.

There are inherent weaknesses in this retrospective study. It is difficult to confidently conclude that the improvements were mainly attributed to the introduction of the pathway. However, since the selected patients were from the same institution and were well matched with respect to age, American Society of Anesthesiologists score, sex, and diagnosis, it is highly probable that the use of a pathway was a major factor influencing the changes. Our tentative conclusion is also supported by the fact that there were no major changes in indications, staff, surgical technique or implants during the study period.

The pathway is also a useful audit tool. By analysing the variations recorded, we were able to identify potential complications such as wound oozing caused by the administration of low-molecular-weight heparin, and urinary retention following spinal anaesthesia. This early awareness can help us modify our practice accordingly.

CONCLUSION

This study adds to the growing evidence that the use of a clinical pathway can be an aid to streamline the care of patients with a consequent reduction in the LOS without detrimental effect.

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