PUK3

Cost Consequence Analysis of Remote Monitoring with the Homechoice Claria® with Sharesource ® Platform for Automated Peritoneal Dialysis Patients in the Australian Setting

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INTRODUCTION

Background

The prevalence of chronic kidney disease (CKD) is 8% in people aged 55 to 64 years, 21% in people aged 65 to 74, and 42% in those aged 75 and over[1]. Diabetes, hypertension and obesity are all risk factors for CKD, and the prevalence of these conditions is increasing in Australia[2]. Together with the ageing of the Australian population, the increase in these risk factors is leading to an increase in the number of patients with CKD[2]. End-stage kidney disease (ESKD) is a severe form of CKD, and people with ESKD require either a kidney transplant or dialysis to stay alive. The number of new cases of ESKD in Australia in 2013 was about 5,100 but only about half of these patients received treatment. Of the 2,500 patients who received treatment in 2013, just under 900 received a kidney transplant and 1,700 started dialysis[3]. There are two approaches to dialysis: haemodialysis and peritoneal dialysis (PD), both of which can be done at home. Among newly diagnosed ESKD patients, about 40% choose to have PD. In 2018, 1,661 people were having automated PD (APD).

A recent study from Latin America found that among incident patients on APD therapy, those who were monitored using remote patient monitoring (RPM) had fewer hospitalisations than patients who did not have RPM[4] (see Table 1). Although the study was not randomised, the authors reported that, "employment of the RPM device was assigned to consecutive patients according to the (limited) availability of the device in the Baxter Renal Care Services (BRCS) clinics; there was no specific clinical criterion for the allocation of patients to the RPM program." Furthermore, analysis of the two clinical outcomes was adjusted for age, gender, educational level, city of residence, cause of CKD, ESKD comorbidity index, haemoglobin, phosphorus and albumin.

The RPM platform is monitored daily by a PD nurse, who checks the ultrafiltration profile, initial drainage, blood pressure, body weight, and the source of any alarm. A clinical team review all aspects of the patient care on a weekly basis. Therefore, there are several potential benefits of being monitored that could lead to these patients having fewer adverse outcomes, including:

1. **Identification of lack of adherence to treatment and therefore timely adjustment of treatment.**
2. **Early identification of increases in the patient's blood pressure or changes in their weight so that early intervention can occur.**

Table 1
Incidence and incident rate ratio (95% CI) for hospitalisation and hospital days over 12 months by treatment group

TREATMENT GROUP	HOSPITALISATION RATE (EPISODES PER PATIENT PER YEAR)	HOSPITAL DAYS PER PATIENT PER-YEAR†
Remote monitoring (incident rate (95% CI))	0.56 (0.34 to 0.78)	5.59 (2.36 to 8.82)
No remote monitoring (incident rate (95% CI))	0.92 (0.73 to 1.11)	12.16 (7.59 to 16.74)
Incident rate ratio (95% CI)	**0.61 (0.39 to 0.95)**	**0.46 (0.23 to 0.92)**

† Average number of hospital days is based on the full cohort, which means that patients who did not go to hospital are included in the calculation and contribute zero to the numerator.

The aim of this study is to estimate the benefit, in terms of reduced hospitalisations and reduced hospital costs, that could be achieved in Australia for each 100 patients undergoing APD at home. The benefit is based on the incident rate ratio reported by Sanabria et al. and costs derived from Australia's National Hospital Cost Data Collection (NHCDC).

METHODS

Estimate of reduction in cost

The method assumes that monitoring of patients who are having APD causes a reduced likelihood of being admitted to hospital. The magnitude of the reduced risk is based on the incident rate ratio of 0.61 (95% confidence interval (CI) 0.39 to 0.95). This ratio is derived from the estimated 12-month incident rates observed within each group (i.e. 0.56 [95% CI 0.34 to 0.78] in the monitored group and 0.92 [95% CI 0.73 to 1.11] in the group that were not monitored). The number of hospitalisations prevented is estimated by multiplying the incident rate within each group by 100 (the number of patients), and calculating the difference. To estimate the reduction in cost associated with reducing the number of hospitalisations, the number of hospitalisations prevented is multiplied by the cost of each hospitalisation, and then the cost of monitoring all the patients is subtracted from this total.

The reduction in hospital events reported were in a range of clinical areas (see Table 2). To estimate the total reduction in costs that could be achieved by preventing these hospitalisations, it was assumed that the distribution of events prevented is the same as the distribution of adverse events seen in the whole cohort. The cost associated with each of these hospitalisations is based on the 2016-17 results (Round 21) of the NHCDC, an annual Australia-wide data collection of hospital costs covering approximately 83% of hospitalisations in Australia. The NHCDC reports costs by Australian Refined Diagnosis Related Groups (AR-DRGs). AR-DRGs classify patients by the major procedure they had while in hospital (in the case of surgical and other major procedures such as endoscopies) or the major medical condition if no procedure was performed. The groups are then further split by the complexity of the patient's condition. It is not possible to determine the severity of the hospitalisations that occurred in the study reported by Sanabria et al., or the severity of hospitalisations that were prevented, so the costs assigned to each hospitalisation are those associated with the more complex category of the ADRGs. The weighted average length of stay associated with the more complex categories of the AR-DRG is 6.2 days, which is shorter than the average length of stay reported by Sanabria et al., even without removing the effect of patients who were not hospitalised. When the clinical category covered multiple AR-DRG, a weighted average of the costs was estimated with weights based on the number of separations within the AR-DRG category. The cost per AR-DRG used is presented in Table 3.

Table 2 –Range of adverse events resulting in hospitalisation.

ADVERSE EVENT	APD-RPM N (%)	APD-WITHOUT RPM[1] N (%)	TOTAL N (%)
Cardiovascular			
Hypertension	2 (2.7)	7 (4.4)	9 (3.8)
Hypotension	2 (2.7)	1 (0.6)	3 (1.3)
Volume overload	4 (5.5)	10 (6.3)	14 (6.0)
Other cardiovascular	11 (14.7)	11 (6.9)	22 (9.4)
Cerebrovascular	10 (13.3)	16 (10.0)	26 (11.1)
Peritonitis	4 (5.5)	13 (8.1)	17 (7.2)
Metabolic	9 (12.0)	12 (7.5)	21 (8.9)
Gastrointestinal	6 (8.0)	24 (15.0)	30 (12.8)
Other	27 (36.0)	66 (41.3)	93 (39.6)
Total	**75**	**160**	**235**

[1] The numbers in the APD-without RPM are for the 295 patients from the full cohort.

Table 3 – Australian refined diagnosis related groups (AR-DRG) and estimated cost

ADVERSE EVENT	AR-DRG	ESTIMATED COST
Cardiovascular		
Hypertension	F67 Hypertension	$AU 6,911.08
Hypotension	F75 Other Circulatory Disorders	$AU 7,519.44
Volume overload	L65 Kidney and Urinary Tract Signs and Symptoms	$AU 7,353.21
Other cardiovascular	All other 'F' (cardiovascular) medical AR-DRGs	$AU 9,079.64
Cerebrovascular	B70 Stroke and Other Cerebrovascular Disorders	$AU 23,190.55
Peritonitis	G70 Other Digestive System Disorders	$AU 5,610.33
Metabolic	K62 Miscellaneous Metabolic Disorders and K63 Inborn Errors of Metabolism	$AU 10,784.2
Gastrointestinal	All other 'G' (gastrointestinal) AR-DRGs	$AU 10,385.65
Other[1]	All other AR-DRGs	$AU 12,952.09

[1] The cost estimate for other is based on the weighted average of all other AR-DRGs.

Confidence interval for the total cost

In the calculation above, many of the values used are estimates of the true value, and to infer the results more generally, the precision of each estimate needs to be considered (see Table 1).

95% CIs for the number of hospitalisations prevented and the total cost saving can be calculated using simulation. In each iteration of the simulation, the number of patients who are hospitalised, within each group, is estimated from a binomial random variable with probability equal to the risk within the group. The risk is obtained by randomly selecting a value from a normal distribution with a mean equal to the log of the incident rate and standard deviation estimated from its 95% CI and then using the exponent of that value as the estimated risk. Once the number of events prevented is calculated, allocation of the events to clinical groups is done by distributing the events prevented across clinical categories assuming they have multinomial distribution equal to the distribution of clinical groups presented in Table 2. The events prevented are then multiplied by the cost associated with those events (shown in Table 3) and summed to give a total cost prevented. The total saving is calculated by subtracting the cost of monitoring the patients, assumed to be 2.95 per patient per day, from the total cost prevented by reducing the number of hospitalisations.

The 95% CI for the potential reduction of cost due to monitoring of patients is achieved by redoing the calculation outlined above 100,000 times, with the value for each of the parameters used in the calculation randomly selected from their distributions (rather than using the actual value). The upper and lower bounds of the middle 95% of the 100,000 estimates of total cost generated, are consider the 95% CI.

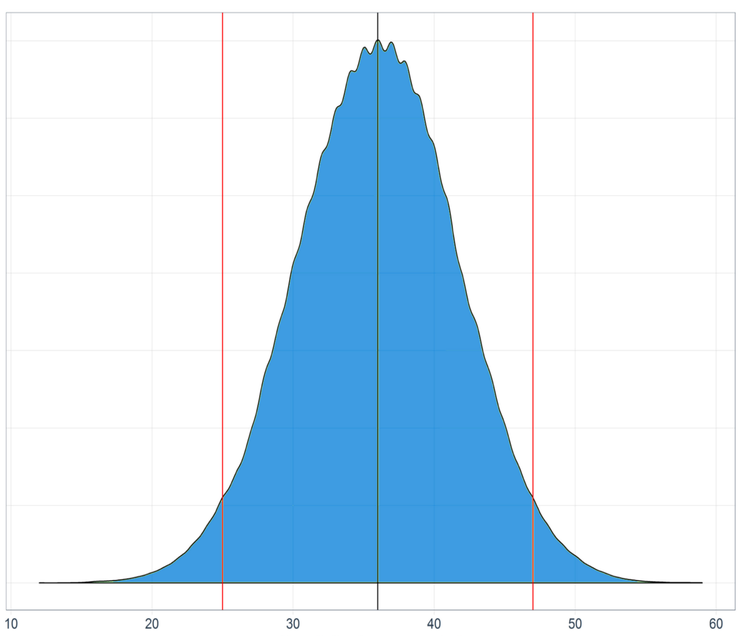
RESULTS

The estimated reduction in hospital episodes over a 12-month period for each 100 people who are continuously monitored by ShareSource while undergoing APD is 36 (95% CI 25 to 47) (Figure 1). The potential savings from monitoring the 100 patients is approximately $AU324,488 (95% CI $AU183,185 to $AU470,812) (see Figure 2).

Results from the sensitivity analysis using a weighted average of the costs associated with each AR-DRG rather than using the cost of the most severe AR-DRGs demonstrate estimated savings of $AU85,533 (95% CI $AU23,876 to $AU152,336) per 100 people undergoing APD.

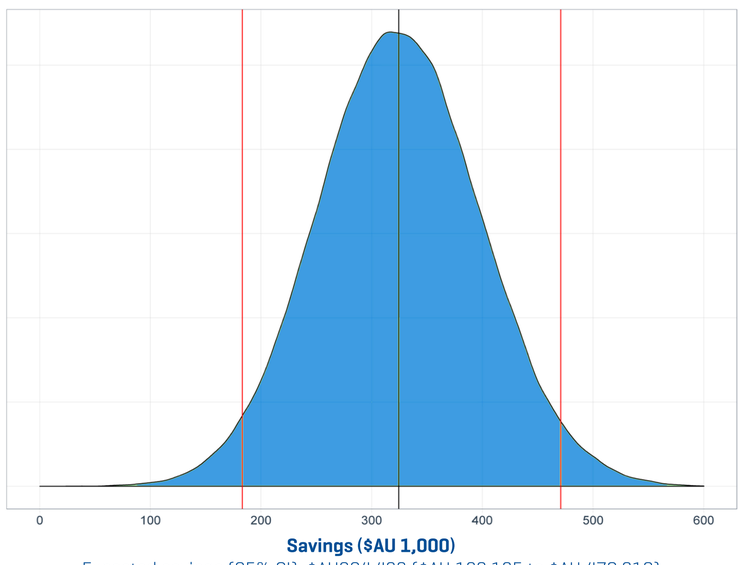
According to Australian and New Zealand Dialysis and Transplant Register (see: https://www.anzdata.org.au/report/anzdata-42nd-annual-report-2019/), there were 1,661 prevalent APD patients across Australia as at 31 December 2018. If RPM was used Australia-wide for all of these patients, there would be a total saving of about $AU5.4 million per year Australia-wide, or $AU1.4 million based on the figure from the sensitivity analysis,

Figure 1
Distribution (and 95% CI) of the estimated hospital events prevented



Hospitalisations prevented
Expected number of hospitalisations prevented (95% CI): 36(25 to 47)

Figure 2
Distribution (and 95% CI) of the estimated potential savings



Savings ($AU 1,000)
Expected savings (95% CI): $AU324,488 ($AU 183,185 to $AU 470,812)

WEAKNESSES

The main weakness of this study is the estimated lower risk of being hospitalised that was used in the calculation was obtained from an observational study and therefore there is the potential for the result to be the effect of selection bias or confounding. However, according to information provided by the authors, patients who were monitored were similar to those who weren't. Patients were not selected for this study based on clinical criteria. They received or did not receive the ShareSource platform depending on the availability of the device in the BRCS clinics. In addition, the authors used propensity score methods to adjust for the known potential confounders.

CONCLUSION

There is an increasing number of people in Australia with end stage kidney disease. Many of these people need dialysis and PD is often the preferred model of delivery in the home setting. Two-way remote monitoring of APD patients can lead to better outcomes and a substantial reduction in costs to health services.

References

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