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Impact of a general practitioner-led integrated model of care on the cost of potentially preventable diabetes-related hospitalisations

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ABSTRACT

Aim: To estimate potential savings for Australia's health care system through the implementation of an innovative Beacon model of care for patients with complex diabetes.
Methods: A prospective controlled trial was conducted comparing a multidisciplinary, community-based, integrated primary-secondary care diabetes service with usual care at a hospital diabetes outpatient clinic. We extracted patient hospitalisation data from the Queensland Hospital Admitted Patient Data Collection and used Australian Refined Diagnosis Related Groups to assign costs to potentially preventable hospitalisations for diabetes.
Results: 327 patients with complex diabetes referred by their general practitioner for specialist outpatient care were included in the analysis. The integrated model of care had potential for national cost savings of $132.5 million per year.
Conclusions: The differences in hospitalisations attributable to better integrated primary/secondary care can yield large cost savings. Models such as the Beacon are highly relevant to current national health care reform initiatives to improve the continuity and efficiency of care for those with complex chronic disease in primary care.

1. Introduction

Potentially preventable hospitalisations are those considered avoidable if preventive care and early disease management in the community had been provided [1,2]. Diabetes-related hospitalisations contribute substantially to potentially preventable hospitalisations in Australia and include complications of diabetes and changes in glycaemia. In 2013–2014, 6.8% of preventable hospitalisations were related to diabetes complications [3].

Australia is a federation of six states and two territories and there are overlapping but separate responsibilities for health by the national government (often called the Commonwealth) and state and territory governments.

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Medicare is the national universal health insurance scheme which covers most of the out-of-hospital medical services costs, such as general practitioner (GP) visits and specialist consultations [4]. All permanent Australian residents are entitled to free public hospital care when admitted to hospital as public patients. Public hospital costs are the responsibility of state and territory governments, while most primary care services are funded by the national government. People with complex conditions often see a specialist as an outpatient in a public hospital (secondary care) and these specialists should work collaboratively with the person's GP in primary care [4].

We have advocated for an integrated GP-led model of care, the Beacon model, to manage chronic diseases including diabetes [5,6]. We compared this multidisciplinary, community-based, integrated primary-secondary model of care with usual hospital-based outpatient services for patients with complex type 2 diabetes mellitus (T2DM) referred by their usual GP for specialist review, and showed the effectiveness of the model on clinical outcomes as well as consumer satisfaction [7,8]. Moreover, patients receiving the model of care had fewer potentially preventable hospitalisations when the principal diagnosis for admission was a diabetes-related complication (PPH-D). Specifically, the average number of PPH-D in the usual care group was 0.35 per patient and in the intervention group was 0.19 per patient (crude incidence rate ratio 0.53, 95%CI 0.29, 0.96; $p = 0.04$) [9]. In this report, we aimed to estimate the cost savings associated with these reduced PPH-D in the integrated model of care.

2. Methods

We recruited 330 patients to a prospective controlled trial (August 2007–April 2008). Three patients were excluded from this analysis: two did not complete any assessments and one was in a psychiatric hospital for an extended period of time. The methods for the study have been described elsewhere [6,8] but, briefly, patients with complex T2DM referred by their GP for specialist outpatient care were invited to have their diabetes managed via our community-based integrated service where GPs with a special interest and advanced training in diabetes worked alongside an endocrinologist and diabetes educator. Patients were discharged back to their referring GP once clinical targets were achieved or after 12 months if it was felt no further improvement could be achieved. The study was granted ethics approval by the Metro South Brisbane Health Service District and linkage with hospitalisations data was approved under the delegation of the Director-General, Queensland Department of Health.

Hospitalisations data were originally obtained using ICD-10-AM codes and data linkage techniques to combine routinely collected hospitalisation data from the Queensland Hospital Admitted Patient Data Collection (QHAPDC) with the study's dataset [9]. For the analysis reported here we subsequently obtained the Australian Refined – Diagnosis-Related Group (DRG) for each hospitalisation. This is an admitted patient classification system that provides a clinically meaningful way of relating the number and type of patients treated in a hospital to the resources required by the hospital. We analysed costs for both PPH-D and non diabetes-related hospitalisations (nonDH) given that there were significantly more nonDH in the intervention than usual care group (crude incidence rate ratio 1.44 95%CI 0.94, 2.21; p = 0.09; adjusted incidence rate ratio 1.92 95%CI 1.20, 2.80 p = 0.01) [9]. The costs for the PPH-D and nonDH, based on DRGs, were extracted from online reports published by the Department of Health for each of the three corresponding financial years (2007–2008; 2008–2009; and 2009–2010) [10].

Our purpose is to estimate the savings associated with the reduction in PPH-D reported in the original analysis [9]. We determined the total cost of PPH-D (and nonDH) hospitalisations for each group by summing the DRG costs of each hospitalisation for both groups. The average cost per hospitalisation was calculated by dividing the total cost of hospitalisations by the total number of hospitalisations for each group separately. Assuming a national roll out of this model would achieve similar benefits, we estimated the national potential savings for PPH-D using 2013–2014 hospitalisation numbers as reported by the Australian Institute of Health and Welfare [11] and inflation adjusted average cost per hospitalisation in 2014 dollars. All calculations are in Australian dollars. The exchange rate averaged over the time period from July 2007 to June 2010 was AUD$1 = €0.5970 and AUD$1 = GBP£0.4919 [12].

3. Results

For the 327 patients, there were 85 PPH-D corresponding to 20 specific AR-DRGs. As noted previously, the average PPH-D hospitalisation rate was 0.35 for usual care and 0.19 for the intervention group over a 24 month period. The average cost per patient was calculated as the average cost per hospital admission multiplied by the average number of admissions per patient. It was less in the intervention group (AUD$1425) than usual care group (AUD$2527). There were 26,900 hospitalisations with T2DM recorded as the principal diagnosis in Australia for the fiscal year 2013–2014. Using the inflation adjusted estimate of $9608 per PPH-D hospitalisation in usual care, the cost would have been $258.4 million (2014 $AUD) in 2014 (Table 1). Assuming the 47% reduction in hospitalisations in the intervention group, the savings from potentially avoidable hospitalisations would be AUD$132.5 million in 2014 (€79.1 million, GBP£65.2 million).

There were 240 nonDH and the average hospitalisation rate was 0.59 for usual care (n = 85 events) and 0.85 for the intervention group (n = 155 events) over a 24 month period. The average cost per hospital admission was lower in the intervention than in the usual care group (usual care AUD$11,006; intervention AUD$7585; difference AUD$3422). There was little difference in the average cost per patient, AUD$6447 for the intervention group and AUD$6494 for usual care group, (a saving of $47 with intervention).

4. Discussion

Leveraging the quality and efficiency benefits of better integrated care is now a national priority for governments, consumers, and health care providers [13]. Integrated primary-

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Table 1 – Potentially preventable diabetes-related hospitalisations and costs by treatment group.

	Usual care (n = 145)	Intervention (n = 182)	Difference
Total number of PPH-D	51	34	
Average number PPH-D per patient	0.35	0.19	0.16[a] (47% reduction)
Total cost	$368,224	$255,189	$ 113,035
Average cost per PPH-D (range)	$7220 ($1817–$35,624)	$7505 ($1817–$34,257)	−$285
Average cost per patient[b]	$2527	$1425	$1,102
Extrapolation to national level			
Hospitalisation for T2DM as principal diagnosis 2013–2014	26,900[c]	12,612[d]	
Average cost per PPH-D 2014	$9608	$9988	
Estimated cost 2014	$258,469,119	$125,978,694	$132,490,425 (saving)

[a] Statistically significant at $p < 0.05$ as reported in Zhang et al. [9].
[b] Average cost per patient = average cost per PPH-D × average number PPH-D per patient.
[c] Australian Institute of Health and Welfare. Hospital care for diabetes. Canberra: AIHW, 2014 [11].
[d] 47% reduction from 26,900.

secondary care can reduce both the number and associated cost of PPH-D whilst preserving care quality [9,14]. If these savings from PPH-D are extrapolated to all similar hospitalisations in Australia then the savings are in the realm of AUD$132.5 million annually. The differences in hospitalisations attributable to specific interventions in primary care can therefore yield large cost savings and improve public health in the wider context. Building primary care capacity might be more important than care coordination for preventing hospitalisations in people with diabetes [15].

A limitation of our study is the non-randomised study design and the small numbers of patients and subsequent hospitalisations. The research team are currently conducting a randomised controlled trial with the aim of building on these findings [8]. Our original analysis reported a higher rate of admissions for non-diabetes related conditions among the Beacon model patients [9], which is consistent with a study of non-elective re-admissions to an acute hospital in the United Kingdom [16]. We argued that, in the absence of a biologically plausible explanation, more holistic models of care are likely to detect other conditions in this more socially disadvantaged group [17]. Furthermore, the identification of non-preventable conditions improves patient care and early identification might prevent more serious presentations. Indeed, in this study we costed the nonDH and found little difference in the average cost per patient for the intervention versus usual care. So, although there were more admissions in the intervention group, the costs per patient were similar and therefore no need to adjust our main PPH-D costing analysis.

Despite the estimated savings, we acknowledge the significant financial, structural and operational challenges if the Beacon model were to be implemented across Australia. It is now broadly accepted that the context in which health care innovations take place is hugely important to their success [18,19]. A 'one size fits all' approach to models of health care is unlikely to be appropriate in such diverse settings [20]. Instead, a small suite of evidence-based models of care that can be adopted by Hospital and Health Services and Primary Health Networks would provide local health care networks the flexibility to consider their local contexts. The Beacon model was designed as a small-scale, locally led and co-created innovation and this remains one of its strengths. It is now Queensland Health's preferred model for outpatient substitution, with communities adapting it to be locally fit-for-purpose [21].

We have demonstrated that, apart from its positive impact on clinical outcomes, the Beacon model also has potential to make significant savings for Australia's health care system through avoided hospitalisations. Such a model is highly relevant to current national health care reform initiatives in primary care, Medicare, and private health insurance, to improve the continuity and efficiency of care for complex chronic disease in primary care.

Conflict of interest

The authors state that they have no conflict of interest.

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REFERENCES

[1] G. Jackson, M. Tobias, Potentially avoidable hospitalisations in New Zealand, 1989-98, Aust. N. Z. J. Public Health 25 (2001) 212–221.
[2] S. Purdy, T. Griffin, C. Salisbury, D. Sharp, Ambulatory care sensitive conditions: terminology and disease coding need to be more specific to aid policy makers and clinicians, Public Health 123 (2009) 169–173.

[3] National Health Performance Authority, Healthy Communities: Potentially preventable hospitalisations in 2013–14, 2015.
[4] S. Duckett, S. Willcox, The Australian Health Care System, fifth ed., Oxford University Press, Melbourne, 2015.
[5] C. Jackson, J. Tsai, C. Brown, D. Askew, A. Russell, GPs with special interests impacting on complex diabetes care, Aust. Fam. Physician 39 (2010) 972–974.
[6] D. Askew, C. Jackson, R. Ware, A. Russell, Protocol and baseline data from The Inala Chronic Disease Management Service evaluation study: a health services intervention study for diabetes care, BMC Health Serv. Res. 10 (2010) 134.
[7] J. Hepworth, D. Askew, C. Jackson, A. Russell, 'Working with the team': an exploratory study of improved type 2 diabetes management in a new model of integrated primary/secondary care, Aust. J. Prim. Health 19 (2013) 207–212.
[8] A.W. Russell, K.A. Baxter, D.A. Askew, J. Tsai, R.S. Ware, C.L. Jackson, Model of care for the management of complex Type 2 diabetes managed in the community by primary care physicians with specialist support: an open controlled trial, Diabet. Med. 30 (2013) 1112–1121.
[9] J. Zhang, M. Donald, K.A. Baxter, R.S. Ware, L. Burridge, A.W. Russell, C.L. Jackson, Impact of an integrated model of care on potentially preventable hospitalizations for people with Type 2 diabetes mellitus, Diabet. Med. 32 (2015) 872–880.
[10] Department of Health, National Hospital Cost Data Collection; Public Sector Estimated Cost Weights. www.health.gov.au/internet/main/publishing.nsf/Content/health-casemix-data-collections-about.
[11] Australian Institute of Health and Welfare, Hospital Care for Diabetes, AIHW, Canberra, 2014, http://www.aihw.gov.au/diabetes/hospital-care/. (Accessed 20 September 2015).
[12] Reserve Bank of Australia, Economic and financial statistics: historical data, 2016 http://www.rba.gov.au/statistics/historical-data.html.
[13] Department of Prime Minister and Cabinet, Reform of the Federation White Paper. Roles and Responsibilities in Health. Issues Paper 3, Australian Government, Canberra, 2014.
[14] U. Sabale, J. Bodegard, J. Sundstrom, C.J. Ostgren, P. Nilsson, G. Johansson, B. Svennblad, M. Henriksson, Healthcare utilization and costs following newly diagnosed type-2 diabetes in Sweden: a follow-up of 38,956 patients in a clinical practice setting, Prim. Care Diabetes 9 (2015) 330–337.
[15] E.J. Comino, M.F. Islam, D.T. Tran, L. Jorm, J. Flack, B. Jalaludin, M. Haas, M.F. Harris, Association of processes of primary care and hospitalisation for people with diabetes: a record linkage study, Diabetes Res. Clin. Pract. (2015).
[16] S.M. Gillani, U. Aziz, D. Blundell, B.M. Singh, Non elective re-admissions to an acute hospital in people with diabetes: causes and the potential for avoidance. The WICKED project, Prim. Care Diabetes 9 (2015) 392–396.
[17] E. Kornelius, C.N. Huang, Y.S. Yang, Y.L. Lu, C.H. Peng, J.Y. Chiou, Diabetes-related avoidable hospitalizations in Taiwan, Prim. Care Diabetes 8 (2014) 330–337.
[18] R. Pawson, N. Tilley, An introduction to scientific realist evaluation, 1997.
[19] A. Tomoaia-Cotisel, D.L. Scammon, N.J. Waitzman, P.F. Cronholm, J.R. Halladay, D.L. Driscoll, L.I. Solberg, C. Hsu, M. Tai-Seale, V. Hiratsuka, Context matters: the experience of 14 research teams in systematically reporting contextual factors important for practice change, Ann. Fam. Med. 11 (2013) S115–S123.
[20] National Health Service, Five year forward view, 2014 https://www.england.nhs.uk/wp-content/uploads/2014/10/5yfv-web.pdf.
[21] Queensland Health, Integrated care innovation fund (ICIF), 2016 https://www.health.qld.gov.au/clinical-practice/innovation/integrated-care/default.asp.

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