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# Community-based integrated care versus hospital outpatient care for managing patients with complex type 2 diabetes: costing analysis\*

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# Abstract.

**Objective.** This study compared the cost of an integrated primary–secondary care general practitioner (GP)-based Beacon model with usual care at hospital outpatient departments (OPDs) for patients with complex type 2 diabetes.

**Methods.** A costing analysis was completed alongside a non-inferiority randomised control trial. Costs were calculated using information from accounting data and interviews with clinic managers. Two OPDs and three GP-based Beacon practices participated. In the Beacon practices, GPs with a special interest in advanced diabetes care worked with an endocrinologist and diabetes nurse educator to care for referred patients. The main outcome was incremental cost saving per patient course of treatment from a health system perspective. Uncertainty was characterised with probabilistic sensitivity analysis using Monte Carlo simulation.

**Results.** The Beacon model is cost saving: the incremental cost saving per patient was A\$365 (95% confidence interval –A\$901, A\$55) and was cost saving in 93.7% of simulations. The key contributors to the variance in the cost saving per patient course of treatment were the mean number of patients seen per site and the number of additional presentations per course of treatment associated with the Beacon model.

**Conclusions.** Beacon clinics were less costly per patient course of treatment than usual care in hospital OPDs for equivalent clinical outcomes. Local contractual arrangements and potential variation in the operational cost structure are of significant consideration in determining the cost-efficiency of Beacon models.

What is known about this topic? Despite the growing importance of achieving care quality within constrained budgets, there are few costing studies comparing clinically-equivalent hospital and community-based care models.

**What does this paper add?** Costing analyses comparing hospital-based to GP-based health services require considerable effort and are complex. We show that GP-based Beacon clinics for patients with complex chronic disease can be less costly per patient course of treatment than usual care offered in hospital OPDs.

<sup>\*</sup>This study was registered with Australian New Zealand Clinical Trials Registry (ID: ACTRN12612000380897).

What are the implications for practitioners? In addition to improving access and convenience for patients, transferring care from hospital to the community can reduce health system costs.

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# Introduction

Health systems internationally are promoting the benefit of delivering complex chronic disease care in the community rather than the hospital setting.<sup>1–4</sup> In Australia, the Common-wealth's 2016 review Better Outcomes for People with Chronic and Complex Health Conditions suggested that '… resources for some patients with chronic and complex conditions could be better targeted to improve quality of care and access, minimise waste and maximise appropriate use of available resources across the whole of the health system'.<sup>2</sup> Similarly, the National Primary Health Care Strategy explored expansion of opportunities for general practitioner (GP) special interest practice.<sup>5</sup> Despite growing government and community concern with budgets for chronic disease management and a growing focus on care close to home, few studies have examined the costs involved in transferring care from hospital to the community.<sup>4,6</sup>

The Beacon model is a fully integrated primary-secondary care model providing a comprehensive service for patients with complex type 2 diabetes (T2D). It was designed as an outpatient substitution model: an alternative for patients with complex diabetes requiring referral from their GP for specialist care in hospital-based outpatient services. A multidisciplinary team, made up of two GPs with a special interest (GPwSIs) and advanced training in diabetes, an endocrinologist and a diabetes nurse educator (DNE), is colocated in a community-based general practice that hosts 4-h weekly or fortnightly Beacon clinics for its neighbourhood. The model builds the capacity of primary care by allowing the GPwSIs and DNEs to work to their full scope of practice, with the single endocrinologist supervising and coconsulting with GPwSIs rather than seeing patients individually. GPwSIs undertake a 23-h online advanced diabetes care course, attend a 1-day workshop and complete a competency assessment. The DNE is specifically skilled in case coordination and comfortable working independently. In a non-randomised pilot study, the Beacon model achieved significant improvement in HbA1c and fewer potentially preventable diabetes-related hospitalisations.<sup>7,8</sup> A subsequent randomised control trial (RCT) found the Beacon model achieved clinical outcomes that are non-inferior to those with gold-standard hospital-based outpatient services without harm and with greater patient satisfaction.9-11

This paper reports a costing analysis comparing the costs of the Beacon model of care to usual care in hospital-based diabetes outpatient clinics. We hypothesised that the Beacon model of care would be cheaper than usual care. Furthermore, we aimed to detail important aspects of the costs of service delivery, including the resources needed to run each service, the main cost drivers and the productive efficiency of providing healthcare services in community and hospital settings.<sup>12–14</sup>

#### Methods

The costing analysis in this study uses the perspective of the health system and evaluates the resources and costs to deliver

equivalent services in the two settings. Because consistent diabetes care guidelines were used in both models, we assumed no difference between the two groups in terms of pharmaceutical, allied health referral or pathology costs. Equivalent pharmaceutical use is further supported by the finding of similar clinical outcomes and no significant difference between the two groups for insulin use.<sup>9</sup> Neither model promotes additional allied health referrals, such that usual care patients are referred internally to allied health and Beacon patients continue to rely on their regular GP to coordinate allied health referrals determined by team care arrangements. Finally, we did not expect any additional pathology costs because patients with poorly controlled diabetes are encouraged to have 3-monthly HbA1c tests to assess their progress, the Australian Government funds a maximum of four HbA1c tests a year through Medicare and any additional HbA1c tests would be rarely indicated given the test is a measure of glycaemic control in the preceding 3 months. Patient and carer costs were not considered.

Most cost data were gathered during 2015 and are reported in Australian dollars rounded to the nearest dollar.

The Human Research Ethics Committee of Metro South Health Service District (Reference HREC/12/QPAH/179) and the Medical Research Ethics Committee at The University of Queensland approved the study. This study was registered with Australian New Zealand Clinical Trials Registry (ID: ACTRN12612000380897).

# Study setting

Three general practices hosted the Beacon clinics (S1, S2 and S3), and usual care was delivered at diabetes outpatient departments at two hospitals (H1, H2). All sites were located within a single Hospital and Health Service (HHS) area in Brisbane, Australia.

Beacon clinics operated weekly at each site, or fortnightly if patient numbers were insufficient to operate weekly (all Beacon clinics were rostered in advance according to demand and endocrinology availability, thus no sessions were required to be cancelled due to insufficient numbers). Each Beacon clinic was 4 h in duration. The staffing protocol for a Beacon clinic included two GPwSIs, an endocrinologist, a DNE and appropriate administration staff (e.g. clinic manager, reception staff). Medical staff were present during the weekly clinic session only, with the DNE providing ongoing care coordination between 3 and 5 days per week. Room requirements to host a Beacon clinic are four consulting rooms for the duration of the clinic and the DNE's room in accordance with the fraction of their appointment. A typical pathway of care for a Beacon model patient involved: (1) the patient presenting for a 45-min screening appointment with the DNE; (2) a subsequent new patient clinic appointment ( $\sim$ 45 min) usually 1–2 weeks later at which the patient was assessed by a GPwSI, with the endocrinologist reviewing and endorsing a management plan and coconsulting with the patient and the GPwSI as required; (3) then, if necessary, referral to an insulin dose adjustment (IDA) service with the DNE for insulin titration or initiation; (4) medical reviews ( $\sim$ 30 min), usually 3-monthly over the course of treatment, conducted by the GPwSI and endocrinologist; and (5) patients discharged to their referring GP for ongoing diabetes management once individual clinical targets were met or at 12 months, whichever came first.

Beacon clinics were funded from several sources. The endocrinologist and DNE were funded by the state hospital, whereas the two GPwSIs and administration staff were remunerated by the general practice, which also covered overheads associated with the Beacon clinic. Beacon clinics received funding from the Australian Government for eligible services (fee for service) via Medicare for items included on the Medicare Benefit Schedule (MBS).

The two usual care sites were widely disparate: H1 was typical of a large metropolitan teaching hospital, whereas H2 hosted a considerably smaller diabetes outpatient department in an outer urban area. H1 alternated between three diabetes clinics in one week and two clinics in the second week, with a typical staffing profile of four endocrinologists and four nurses. H2 operated two clinics each week with two endocrinologists and one nurse. Although typical pathways of care differed between each hospital site, the DNEs at both H1 and H2 also consulted with patients outside of clinic hours for initial screening and follow-up. Hospital outpatient care included standard discharge letters sent from the specialist to the patient's GP. Funding for hospital-based outpatient clinics was from the HHS.

## Data sources

Site-specific data on resource use were collected for each treatment course at the participating sites. Costs were calculated using information from audited accounting data and interviews with clinic managers. Costs were derived from total resource cost per clinic and the number of patients seen in each clinic.<sup>15</sup>

#### Endocrinologist

Standardised unit costs were used for the endocrinology staff across all sites based on time spent per clinic and the hourly rate based on salary level. The cost of the endocrinologists' consultations at all sites were valued using wage rates collected from accounting data at H1, with the cost estimated for each site based on the purported staff mix and verified by observational site visits.

#### GPs with a special interest

GPwSI consultations were valued using clinic accounting data. GPwSI costs were different at each Beacon site because different reimbursement methods were used. GPwSIs at S1 and S2 were reimbursed via hourly wage rates, whereas GPwSIs at S3 were reimbursed 65% of MBS claims (all appointments were bulked billed: MBS Item 44 for new patients and Item 36 for review patients).

# Nursing staff costs

The nursing staff costs at the Beacon sites were valued using their respective wage rates from relevant Queensland Health pay schedules (April 2014 rates)<sup>16</sup> and their full-time equivalent

(FTE) appointment fraction. The DNE appointment fractions varied across the Beacon sites: 1.0 FTE at S1 and 0.6 FTE at both S2 and S3. The unit costs for nursing staff at H1 and H2 were extracted from the annual clinic expenditure on nursing staff attributable to the diabetes clinics using a top-down method from accounting data to ensure that on-costs (e.g. superannuation) were included.

## Administration staff and overhead costs

Routine cost-allocation methods were used for costing administration staff and overheads at the hospital sites<sup>17</sup> based on time allocation and space respectively. At H1, we consulted the clinic manager to determine the outpatient component of the annual departmental-level accounting costs. At H2, we consulted the business manager to determine the resource allocation for the two clinics held each week. We calculated the proportion of overheads based on the number of clinics per week at the hospital and intervention sites (relative to each site's total clinic capacity). Discounting was not required because all the service outcomes were measured during a 12-month period.<sup>18</sup>

#### Statistical analysis

The primary outcome of the analysis is the incremental difference in the costs per person course of treatment between the Beacon model and usual care. A course of treatment for the Beacon model of care is as per the typical pathway of care described above and is inclusive of the first screening appointment, the subsequent clinical appointment and all review appointments until the patient is discharged back to their usual GP. Similarly, a course of treatment for usual care is inclusive of the patient's first appointment and all review appointments until discharge back to their usual GP. We first estimated the average cost per occasion of service across Beacon and usual care sites, weighted by the number of services at each site for each model of care. The cost per occasion of service was then multiplied by the number of occasions of services for each model of care for treatment completion to derive the total cost per course of treatment.

Differences in the costs per person course of treatment between Beacon and usual care were estimated. Uncertainty in the cost difference was characterised using Monte Carlo simulation with a 95% credible interval (CI).<sup>19</sup> The difference in cost is estimated 50 000 times, drawing input values from their respective distributions. We assumed that site-specific nursing staff, administration staff and overhead costs, endocrinologist hourly wages and the mean number of patients per clinic followed a normal distribution with a standard deviation equal to 10% of the mean. Similarly, we assumed that the endocrinologist time per appointment at the usual care sites followed a normal distribution with a standard deviation equal to 10% of the mean. We based the number of occasions per treatment course for the Beacon model on the mean difference between the Beacon and usual care models and the respective standard deviations reported previously.9

# Results

The total cost per clinic varied almost fivefold across the sites (\$14213, \$2905, \$5646, \$4793 and \$5095 at H1, H2, S1, S2 and S3 respectively; Table 1), with notable differences

#### Table 1. Costs per clinic by model of care and treatment site

Treatment was provided across three general practices that hosted the Beacon clinics (S1, S2 and S3) and usual care delivered at diabetes outpatient departments at two hospitals (H1, H2), with all sites located within a single Hospital and Health Service area in Brisbane. GPwSIs, general practitioners with a special interest; DNE, diabetes nurse educator

|   | Hospital outpatient sites |      | Beacon sites |      |      |
|---|---------------------------|------|--------------|------|------|
|   | H1                        | H2   | S1           | S2   | S3   |
| Mean no. presentations per clinic             | 20.5                      | 7    | 14.5         | 14   | 10   |
| Mean no. hours per clinic                     | 4                         | 3.25 | 4            | 4    | 4    |
| Endocrinologists                              |                           |      |              |      |      |
| Consultant time (h)                           | 14.7                      | 3.3  | 4.0          | 4.0  | 4.0  |
| Consultant $cost^{A}(A\$)$                    | 2977                      | 660  | 811          | 811  | 811  |
| Registrars (h)                                | 9.34                      | 3.26 |              |      |      |
| Registrar cost <sup>B</sup> (A\$)             | 691                       | 241  |              |      |      |
| Residents (h)                                 | 5.33                      |      |              |      |      |
| Resident $cost^{C}(A\$)$                      | 261                       |      |              |      |      |
| Total endocrinologist cost (A\$)              | 3929                      | 901  | 811          | 811  | 811  |
| GPwSIs  |                           |      |              |      |      |
| GPwSI time (h)                                |                           |      | 9.0          | 8.0  | 8.0  |
| Total GPwSI cost <sup>D</sup> (A\$)           |                           |      | 1047         | 1299 | 650  |
| Nursing staff $cost^{E}$ (A\$)                | 3670                      | 1458 | 2772         | 1663 | 1663 |
| Administration staff costs <sup>F</sup> (A\$) | 2723                      | 223  | 383          | 120  | 540  |
| Overheads (A\$)                               | 3891                      | 323  | 633          | 900  | 1490 |
| Total cost per clinic (A\$)                   | 14213                     | 2905 | 5646         | 4793 | 5095 |
| Mean cost per patient attendance (A\$)        | 693                       | 415  | 389          | 342  | 509  |

<sup>A</sup>Based on A\$203 per h.

<sup>B</sup>Based on A\$74 per h.

<sup>C</sup>Based on A\$49 per h.

<sup>D</sup>Based on A\$116 per h at S1, A\$162 per h at S2 and A\$65 per attendance, on average, at S3.

<sup>E</sup>Based on 3.8 full-time equivalent (FTE) at H1, 0.5 FTE at H2, 1.0 FTE at S1, 0.6 FTE at S2 and 0.6 FTE at S3.

<sup>F</sup>Includes medical typists, reception staff and other administration staff.

(up to 10-fold) in the cost of overheads both between models of care and within models of care across sites.

The mean number of attendances per clinic at H1 and H2 was 20.5 and 7.0 respectively, compared with 14.5, 14 and 10 at S1, S2 and S3 respectively. The cost per patient attendance at H1 and H2 was \$693 and \$415 respectively, compared with \$389, \$342 and \$509 at S1, S2 and S3 respectively. The weighted mean cost per patient attendance for the Beacon model was \$403, compared with \$622 for the usual care model. On average, the proportional costs of nursing staff and GPwSI were higher in the Beacon model than usual care, whereas the proportional costs of the endocrinologist, administration staff and overheads were lower in the Beacon model than usual care.

The proportion of the total cost attributable to nursing staff was the most expensive resource at four of the five sites (Fig. 1). Other substantial resources (i.e. more than one-quarter of costs) were endocrinology staff at H2, GPwSIs at S2 and overhead costs at H1 and S3.

Although the mean duration of treatment was similar between the Beacon model (47 weeks) and usual care (44 weeks), the occasions of service differed. The higher number of doctor and DNE visits in the Beacon model reflected a more flexible approach featuring improved patient access and real-time follow-up.<sup>9</sup> The mean number of occasions of service at the hospital sites was 3.0 clinic visits and 1.8 DNE visits, compared with 4.1 clinic visits and 2.4 DNE visits at the Beacon sites (Table 2). The cost per patient course of treatment estimates for each site were \$3326, \$1992, \$2528, \$2223 and \$3308 at H1, H2, S1, S2 and S3 respectively. The weighted mean cost per patient course of treatment was lower in Beacon (\$2622) than usual care (\$2987) sites, demonstrating an incremental cost saving per patient course of treatment (i.e. the primary outcome) of \$365 (95% CI –\$901, \$55) for the Beacon model. The Beacon model was cost saving compared with usual care in 93.7% of simulations. The main drivers of uncertainty in the incremental cost saving per patient course of treatment were: (1) the mean number of presentations per usual care site (31.9% of the variation: H1 27.5%, H2 4.4%); (2) the mean number of presentations per Beacon site (27.8% of the variation: S1 11.3%, S2 11.1% and S3 5.4%); and (3) the additional number of Beacon presentations per course of treatment (15.2% of the variation: additional clinic visits 7.6% and additional DNE visits 7.6%; Fig. 2).

#### Discussion

The present study demonstrates that the costs of providing clinically equivalent (i.e. non-inferior) complex ambulatory care in community-based Beacon sites rather than usual care in hospital-based outpatient clinics can be cost saving. Overall, compared with usual care, the cost per attendance was lower on average for the Beacon model (\$403 vs \$622 for usual care). As expected, the composition of costs varied between the two models, with a lower proportion of costs attributed to administration staff, overheads and endocrinologists under the Beacon model compared with usual care, whereas there was a greater proportion of attendance costs attributed to nursing staff and GPwSI costs under the Beacon model. However, the total



**Fig. 1.** Proportion of costs (in Australian dollars) by resource type for each model per attendance across three general practices that hosted the Beacon clinics (S1, S2 and S3) and usual care delivered at diabetes outpatient departments at two hospitals (H1, H2), with all sites located within a single Hospital and Health Service area in Brisbane. GPwSIs, general practitioners with a special interest.

| Table 2. | Cost per patient course of treatment by site |  |
|----------|--|--|
| CI, crea | dible interval; DNE, diabetes nurse educator |  |

|   | Hospital outpatient | Beacon          |  |
|---|---------------------|-----------------|--|
| No. occasions of service per patient                            |                     |                 |  |
| Clinic  | 3.0                 | 4.1             |  |
| DNE   | 1.8                 | 2.4             |  |
| Total no. occasions of service per patient                      | 4.8                 | 6.5             |  |
| Cost per occasion of service (\$A)                              | 622                 | 403             |  |
| Total cost per patient course of treatment (\$A)                | 2987                | 2622            |  |
| Incremental cost (A\$) per patient course of treatment (95% CI) |                     | -365 (-901, 55) |  |

number of attendances per course of treatment was greater in the Beacon model than usual care (6.5 vs 4.8). Despite this, the total cost per patient course of treatment for the Beacon model was, on average, lower than usual care (\$2622 vs \$2987). The incremental cost saving of the Beacon model was \$365 per patient course of treatment.

Overwhelmingly, the largest factor contributing to uncertainty in the incremental cost-saving estimate was the number of patients treated per site. Specifically, both care models involve substantial fixed costs associated with operating a clinic. Although labour and other inputs may often be treated as short-term variable costs, these costs are essentially fixed for the kind of clinics evaluated here: a particular configuration of labour is required for each clinic, almost regardless of how many patients are treated by that particular clinic. Thus, the throughput of patients (the number of patients per clinic session) relative to the fixed costs associated with operating a clinic is a major driver of the per-patient cost in each model and, in turn, the incremental cost between the models of care.

Although for this trial a Beacon model can be considered cost-efficient overall, we note substantial variation in the costs within each model of care. For example, the mean cost per attendance varied between \$342 at S2 to as much as \$509 at S3. Indeed, if usual care comprised only of care delivery at H2 (\$415 per attendance) and the Beacon model delivered only at S3 (\$509 per attendance), the Beacon model would not have been



**Fig. 2.** Contribution to uncertainty in the incremental cost per patient course of treatment across three general practices that hosted the Beacon clinics (S1, S2 and S3) and usual care delivered at diabetes outpatient departments at two hospitals (H1, H2), with all sites located within a single Hospital and Health Service area in Brisbane. The length of the bar shown for each model input distribution is the amount of change in the output (cost per patient course of treatment) attributable to each input based on 50 000 Monte Carlo simulations. GPwSIs, general practitioners with a special interest; DNE, diabetes nurse educator.

cost saving. The specific drivers in the variation in cost structure within models include the leasing or rent arrangements (Appendix 1). The two hospital sites varied enormously in the scale of their operation and their concomitant leasing costs. Rental costs also varied across the Beacon sites, with S3 being the most expensive. GPwSI costs were lowest at S3, where GPwSIs were remunerated using a proportion of MBS billings, whereas GPwSIs were salaried at the two other sites. As such, the specific local context in which clinics, both usual care and Beacon models, operate can determine the overall cost efficiency of service delivery.

This work addresses a gap in the literature on this topic. The complex and time-consuming nature of the work required to properly understand and apportion costs across such varied settings may explain the paucity of existing evidence in the extant literature.

This study has several limitations. We were not able to collect data on referrals to other specialists because there were no cumulatively recorded data at the patient level. We used the number of hours per clinic to estimate endocrinology staffing costs at all sites, whereas an estimate based on administrative costs provided by the H1 Department of Endocrinology was considerably higher than this hourly estimate. However, we note that H1 consultant staff have additional administrative, teaching, research and inpatient responsibilities, accounting for the higher estimate. There were challenges in determining costs for administrative staff and overheads in settings of joint production (i.e. in settings where more than one 'output' is produced). Indeed, technically there is no theoretical basis upon which truly joint costs can be apportioned. Nevertheless, there are aspects of the production processes in both the hospital and clinic settings that are directly attributable to their clinical activities. We excluded cost data on consumables, radiology, pathology and medicines because their use was assumed to be similar across

both treatment arms, given an overarching common clinical protocol. Cost consequences from better control of HbA1c were also excluded from the analysis because the Beacon model was previously established to be non-inferior to that of usual care.<sup>9</sup> The assumption of equivalent allied health referrals was supported by findings from *post hoc* analyses showing no significant difference between the groups (Beacon 127 vs usual care 36; risk difference 3.6%, 95% CI -9.7%, 16.8%).

Studies of integrated care in the UK involving GPwSIs have been implemented at greater cost,<sup>20</sup> similar cost<sup>21</sup> or lower cost.<sup>22</sup> Coast *et al.*<sup>20</sup> found a GPwSI model of care in dermatology was more costly than hospital outpatients, driven mostly by patients in the GPwSI model being seen by a relatively costly GPwSI, whereas patients receiving hospital-based care were seen not only by consultants, but also by less-costly registrars or clinical assistants. Levy *et al.*<sup>22</sup> examined a primary care allergy service staffed with a specialist nurse and a GPwSI and estimated an overall saving to the UK health economy through reduced referrals to secondary care.

A recent systematic review of shared care across the primary–secondary interface showed patient direct costs, most notably travel costs, are lower with shared care than with hospital-based outpatient care, but evidence for other cost efficiencies is limited.<sup>6</sup> Indeed, economic evaluations of interventions at the primary–secondary care interface that take account of the health system perspective are uncommon and the completed studies report unclear results.<sup>4</sup> The recent systematic review highlighted the challenge of comparing the costs of models across different settings and contexts.<sup>6</sup> Similarly, we observed considerable variations in costs across sites within the present study. Yet, despite these variations, overall the Beacon model was a lower-cost alternative to usual hospital outpatient care. These findings are consistent with those of a UK study of specialist outreach clinics, where improved access

to specialist services and quality of health care were achieved but at a potentially higher cost depending on the number of patients seen.<sup>23</sup>

The effects of health service infrastructure and local contractual arrangements on costs in this study are consistent with what is known about assessing the cost-effectiveness of models that transfer care, or elements of care, from secondary to primary care.<sup>4</sup> Ultimately, these factors will vary considerably across Australian settings, thereby affecting the generalisability of the present study, and emphasising efforts to implement the Beacon model at other sites or at scale will need to consider local contexts. Importantly, the Council of Australian Government's 2016 statement identified the importance of shared jurisdictional commitment to pooled funding, enabling infrastructure and governance arrangements to deliver better outcomes for patients with chronic and complex conditions.<sup>24</sup> This agreement identified integrated service delivery models (such as Beacon) as priorities for the management of complex chronic disease nationally.

The Beacon model of care has been funded from both Australian and state and territory government sources, currently an uncommon arrangement for chronic disease management, but one gathering interest. Such joint funding approaches require the Commonwealth and states to coordinate to deliver what is most efficient overall, rather than focusing solely on individual perspectives from either health service delivery structure. The costing analysis in this study has taken a cost to health system approach, ensuring its delivery through private GP practices necessitates that clinics are reimbursed appropriately for the cost to deliver these services. Disparity between reimbursement and cost would undermine the ability to deliver. The model holds promise as a way to appropriately and costefficiently manage complex chronic conditions using existing community resources while freeing up resources in hospital settings to attend to acute and inpatient services.

## Conclusion

The Beacon model of integrated primary–secondary care for patients with complex T2D has delivered non-inferior clinical outcomes with greater patient satisfaction and, as we have now demonstrated, in a more cost-efficient manner. This has been demonstrated with a robust costing analysis approach that was supported by appropriate sensitivity analyses. This is the first study in the Australian context that we are aware of to compare, from a whole of health system perspective, the costs of integrated care compared with standard hospital outpatient care in the context of a randomised controlled trial with equivalent patient populations. This study further supports that complex T2D can be efficiently managed in an integrated care model.

# **Competing interests**

The authors declare that they have no competing interests.

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# Appendix 1. Detailed overhead costs per clinic by model of care and treatment site

Treatment was provided across three general practices that hosted the Beacon clinics (S1, S2 and S3) and usual care delivered at diabetes outpatient departments at two hospitals (H1, H2), with all sites located within a single Hospital and Health Service area in Brisbane. IT, information technology

|  | Hospital outpatient sites |      |      | Beacon sites             |      |
|--|---------------------------|------|------|--------------------------|------|
|  | H1                        | H2   | S1   | S2                       | S3   |
| Mean no. presentations per clinic                      | 20.5                      | 7    | 14.5 | 14                       | 10   |
| Mean no. hours per clinic                              | 4                         | 3.25 | 4    | 4                        | 4    |
| Overhead costs (A\$)                                   |                           |      |      |                          |      |
| Operating leases                                       | 3066                      | 100  | 182  | Consultation room        | 1200 |
| Room rental  |                           |      | 88   | charges inclusive of all | 95   |
| IT expenses  | 261                       | 44   | 20   | costs of \$100 per room  |      |
| Communication expenses                                 | 157                       | 32   | 60   | per session <sup>A</sup> |      |
| Electricity  |                           |      | 52   |                          | 60   |
| Cleaning   |                           |      | 3    |                          |      |
| Repairs and maintenance                                | 110                       | 24   |      |                          |      |
| Building services                                      | 3                         | 22   | 20   |                          | 15   |
| Postage  |                           |      |      |                          |      |
| Catering and domestic expenses                         | 92                        | 2    | 110  |                          | 120  |
| Stationery, printing and photocopying                  |                           |      | 3    |                          |      |
| Travel and motor vehicle expenses                      | 41                        | 33   | 5    |                          |      |
| Other supplies and services                            | 114                       | 53   | 99   |                          |      |
| Depreciation or non-capitalised asset-related expenses | 47                        | 12   | 182  |                          |      |
| Total overhead costs (A\$)                             | 3891                      | 323  | 633  | 900                      | 1490 |

<sup>A</sup>One room for five diabetes nurse educator (DNE) sessions, plus four rooms for one clinic session (DNE, endocrinologist and two general practitioners with a special interest).