Original Article

Diabetes Outcomes in Specialist and General Practitioner Settings in Singapore: Challenges of Right-Siting

Shiou Liang Wee,[1]*PhD*, Caren GP Tan,[2]*BSc*, Hilda SH Ng,[3] Scott Su,[4]*MSc, MBA*, Virginia UM Tai,[5]*BSc (Hons)*, John VPG Flores,[6]*MD, MSc*, Daphne HC Khoo,[7]*M Med (Int Med), FAMS, FRCP (Edin)*

Abstract

The Singapore public healthcare system has increasingly used the term "right-siting" to describe the principle that stable chronic disease patients should be managed in primary care rather than specialist settings. The majority of primary healthcare providers in Singapore are general practitioners (GPs). The aims of this paper were to measure the quality of diabetes care in specialist and GP settings, and assess right-siting efforts in a tertiary centre in Singapore. Three hundred eighty-three consecutive patients with type 2 diabetes referred to the Singapore General Hospital Diabetes Centre (SGH DBC) between January and March 2005 were analysed. At the first visit, 51 patients (13.3%) were classified as inappropriate referrals and discharged back to the referral source or to primary care. After 12 months, 136 patients (group A = 35.5%) remained on follow-up at SGH DBC. In these patients, significant improvements were seen in mean HbA1c but not blood pressure (BP) or low density lipoprotein-cholesterol (LDL-C). One hundred twenty-eight (group B = 33.4%) patients were discharged from DBC within the 12 months of the study period. Mean follow-up duration in group B was 5.5 months and HbA1c, blood pressure and LDL-cholesterol had improved significantly in these patients. Glycaemic control of group B patients at the time of discharge was significantly better than group A at 12 months (mean HbA1c = 7.15% vs 8.16%; *P* <0.001). More than half (55.6%) of group B patients achieved HbA1c targets compared to 32.4% from group A (*P* <0.001). Although mean BP and LDL-C levels fell in group B patients, the percentage of patients achieving BP and LDL-C targets did not improve significantly in both groups. From August 2005 to January 2008, GPs participating in SingHealth's Delivering on Target (DOT) programme enrolled 579 patients under their care for additional diabetic counselling by community nurse educators. Pre- and post-programme HbA1c results were submitted for 370 patients (64%). Mean HbA1c levels of these patients decreased from 8.23% to 7.32% (*P* <0.001). The proportion of patients who achieved HbA1c <7% increased from 26% to 51% (*P* <0.01). However, BP and LDL-C levels did not improve. It is difficult to base referral or discharge decisions solely on these indicators. Our studies show that both in the specialist and GP settings, significant improvements in HbA1c are seen. Results for BP and LDL-C, however, showed little improvement. Some degree of right-siting was seen at SGH DBC with discharged patients showing greater improvements than patients who were retained. However, >30% of patients remained in SGH DBC despite achieving HbA1C targets. Our results indicate the need for better strategies to address the underlying obstacles to right-siting. Of greater concern, the lack of improvement in BP and LDL-C indicates a high degree of clinical inertia to these issues among specialists and GPs treating diabetes in Singapore.

Ann Acad Med Singapore 2008;37:929-35

Key words: Clinical outcomes, Clinical quality, Glycaemic control, Integration and transfer of care

[1] Clinical Integration Projects
Quality Management Department, Singapore Health Services, Singapore
[2] Statistics
[3] Clinical Network
[4] Programme Development
[5] Cardiology Service Line
[6] Epidemiology and Health Outcomes
Quality Manager Department, Singapore Health Services, Singapore
[7] Department of Endocrinology, Singapore General Hospital, Singapore
Address for Correspondence: Dr Shiou-Liang Wee, Deputy Director, Sports Division (SD), Ministry of Community Development, Youth and Sports, 512 Thomson Road, #15-00 MCYS Building, Singapore 298136.
Email: WEE_Shiou_Liang@mcys.gov.sg

Introduction

The long lasting debate on the role of generalists and specialists in the management of diabetes is still ongoing. Nonetheless, the last 3 decades have seen the increasing shift of chronic disease management from specialist outpatient clinic-based to more general practice-based services. Censuses in the USA and the UK have shown the increasing role of generalists in diabetes care.[1-3]

In Singapore, the public sector provides approximately 80% of hospital care while private sector general practitioners (GPs) provide an estimated 80% of primary care. The last 5 years have seen an increasing shift in primary care patient load from private GPs to the public sector primary care (polyclinics). The market share of patient attendances in the polyclinics increased from 15% in 2001 to 22% in 2005.[4] This shift was particularly marked in patients with chronic conditions. Public sector doctors, while constituting 12% of the total pool of primary care physicians, managed a disproportionately greater share of chronic conditions (43%).[4] On average, polyclinic doctors saw twice the number of patients compared to private GPs (58 versus 30).[4]

It is now widely recognised that the imbalance in the share of chronic disease management in our primary care is a reflection of current funding policies. Since the latter part of 2004, the local healthcare community has increasingly used the term "right-siting" to describe the principle that chronic disease patients should be managed in primary care rather than specialist settings. Right-siting has become an increasingly urgent priority due to our rapidly ageing population, introduction of block government subsidies to the health clusters and rising patient loads at the public specialist outpatient clinics. Private GPs remained a relatively untapped pool of resources to be organised to deliver better care for our population, especially the elderly with chronic diseases. The MOH Chronic Disease Management Programme was launched in October 2006. This allows Medisave (compulsory national health savings account) to be used for part-payment of outpatient chronic care management for diabetes, hypertension, hyperlipidaemia and strokes.[5] A major aim of this programme was to increasingly involve private GPs in chronic disease management. At this point in time, the effect of the programme on clinical outcomes and patient preference for physician provider remain to be seen.

Singapore Health Services (SingHealth) is 1 of 2 clusters of public healthcare institutions in Singapore. Our members include 3 hospitals, 5 national specialty centres and a network of primary care polyclinics. Part of SingHealth, the Singapore General Hospital (SGH) is Singapore's oldest and largest acute tertiary hospital and national referral centre. The aims of this paper were to measure the quality of diabetes care at SGH Diabetes Centre (DBC) and the GP setting and assess right-siting efforts at SGH DBC. The results of 3 studies are documented. Study 1 assessed the quality and right-siting performance at the SGH DBC. Study 2 surveyed patients' perception towards discharge from SGH DBC. Study 3 documented the early result of the SingHealth Delivering on Target (DOT) GP education, community network and right-siting programme.

Quality of Diabetes Care

In 1997, the US Diabetes Quality Improvement Project (DQIP) introduced, for the first time, a set of national performance indicators for diabetes.[6] It is well-established that intensive glycaemic, blood pressure (BP) and lipid management in people with diabetes reduces the risk of microvascular and/or macrovascular complications.[7,8] Therefore, glycated haemoglobin level (HbA1c), BP and low density lipoprotein-cholesterol (LDL-C) are now commonly used as intermediate outcomes indicators of diabetes care as in line with DQIP's recommendation.[6]

However, to use these outcomes as comparator of care, patient case mix would need to be factored in and the patient population needs to be stable. The current Singapore DRG system is applicable only to in-patient care while diabetes care mainly takes place in an out-patient setting. In an environment of "right-siting", poorly controlled diabetics would continuously move into hospital specialist outpatient clinics (SOCs) while a constant stream of stabilised patients move out – the patient population becomes highly dynamic. Hence, in the absence of case mix corrected data and stable patient population, comparisons between centres remain difficult.

The recommended process measures for diabetes care are less uniform. The local diabetes guidelines recommended 9 process measures (e.g. frequency of measurement of HbA1c and LDL-C) to supplement the intermediate outcomes measures. However, process measures have been criticised as lacking strong links to outcomes.[9] In studies where the diabetes care process improved, there were no accompanying improvements in HbA1c and BP control.[10,11] A recent study reported that process measures for diabetes care were associated with improvements in LDL-C, patient satisfaction and self-rated quality of diabetes care but not other cardio-metabolic risk factors including HbA1c and systolic BP.[12]

While the role of GPs in diabetes care should and must increase in Singapore, a recurrent question is whether the quality of diabetes care will be compromised as the care of diabetes moves increasingly from specialist to primary level. Available studies in type 2 diabetes have found that although specialists tend to perform better in the process measures than the generalists,[13-16] there is no substantial

difference in terms of glycaemic and BP control outcomes, particularly after accounting for case mix and physician level clustering.[14,15]

Quality of Diabetes Care – International Benchmarks for Glycaemic Control

In NHANES 1999 to 2000, which comprised the nationally representative sample of the US adult civilians, non-institutionalised population (n = 441), 37% of individuals with diabetes achieved the target goal of HbA1c <7% and 37% had HbA1c>8%.[16] In total, 7.3% attained the recommended HbA1c level of less than 7%, BP less than 130/80 mmHg and total cholesterol level less than 5.18 mmol/L.

In comparison, an Italian study conducted at around the same period (1998 to 1999), which documented diabetes care provided by GPs and diabetes specialist outpatient clinics seemed to show better glycaemic control results.[18] About half (48% to 52%) of the studied patients (n = 3437) had optimal glycaemic control (HbA1c <7%) regardless of care setting. However, in the short-term, care provided by specialists was only associated with better total cholesterol but not HbA1c and BP control.[18]

In the DiabCare-Asia study of 12 countries in 1998, mean HbA1c of 24,317 patients from 230 diabetes centres was 8.6%; only 21% of the patients had HbA1c <7%, and 55% had HbA1c>8%.[17] All patients were managed at the respective setting for at least 12 months. In the same study, the Singapore cohort comprised of 1697 patients, of which 67% were managed at public primary care polyclinics and 33% from public hospitals diabetes specialist clinics.[18] Overall, 77% had HbA1c readings in their medical records (n = 1308) and 33% of these patients (of which 91% with type 2 diabetes) had HbA1c <7% at the time of the audit.[20] However, no data was available for patients who were managed by private GPs.

In the absence of case mix control, the diabetes care as represented by optimal HbA1c control (<7%) in these studies ranged from 21% to 52%.

Materials and Methods

Study 1

Study 1 was conducted to assess quality and right-siting performance at the SGH DBC. It is a retrospective cohort study of all consecutive new patients referred to the SGH DBC between January and March 2005. SGH Ethics Review Board's approval was obtained for this study. Out of the 409 consecutive new referrals, 383 individuals with type 2 diabetes were identified to comprise the study population. Through review of case notes undertaken between May and October 2006, patients were evaluated retrospectively for their initial medical entries and data were obtained until 12 months after the initial visit.

To assess the quality of care, we compared 1) changes in HbA1c, BP and LDL-C levels and 2) proportion treated to guideline recommended targets. To assess right-siting performance, we measured 1) differences in HbA1c, BP and LDL levels between the group on continued follow-up at SGH DBC after 12 months (Group A) and the group discharged within 12 months (Group B) and 2) proportion of patients retained at SGH DBC despite reaching targets. Clinical indicators between baseline and at 12 months/ point of discharge as well as between groups (following normal distribution) were compared using the Student's *t*-tests. The distribution of clinical indicators (% reaching guideline target) at baseline and 12 months/point of discharge as well as between groups were compared using the χ^2 test. Statistical significance was set at the 5% level.

Study 2

Study 2 is a structured survey on 252 individuals with type 2 diabetes and receiving outpatient care from SGH DBC to understand patients' perception towards discharge from a specialist outpatient clinic. Information on demographics, paying status, satisfaction level, discharge advice given by doctors, follow-up duration, willingness for discharge, reasons against discharge and preferred primary care providers were obtained.

Study 3

Upon discharge, DBC endocrinologists as with the practise of other specialists, typically refer patients to the polyclinics unless the patient was initially referred by a GP. This is frequently due to a lack of familiarity with specific GPs with expertise in diabetes management, an absence of a convenient alternative, and the perception or experience that most patients prefer polyclinics over GPs for long-term care due to cost concerns.

To address these issues, SingHealth's DOT GP programme for diabetes, hypertension and hyperlipidaemia was launched in August 2005. The programme comprises 3 components: 1) GP update in diabetes management, 2) GP-DSS collaborative care programme and 3) SHS-GP shared care programme.

Pre-selected GPs were directly engaged by a hospital representative and recruited to complete 4 educational modules update in diabetes management. Subsequently, these GPs enrolled at least 3 of their diabetic patients into a customised counselling programme conducted by a non-profit community group, the Diabetic Society of Singapore (DSS). Clinical outcomes (HbA1c, BP, LDL-C) of these patients were tracked over an average period of 6 to 12 months. Completion of the modules and audit of outcomes ensured confidence and competence in diabetes

management of subsequent patients discharged from hospitals (Fig. 1).

To facilitate right-siting to GPs, a pilot SHS-GP shared care project was launched in January 2007. In this pilot project, the discharge officer counselled patients certified fit for discharge from SGH DBC on discharge options.

Results

Study 1

Table 1 shows the characteristics of the patients at the point of entry to SGH DBC. Of the 383 patients, 35.5% (group A, n = 136) were still on follow-up at the DBC after 12 months, care of 179 (46.7%) were transferred to either a primary care setting (n = 149, 38.9%) or other specialist clinics (n = 30, 7.8%) while 63 (16.7%) were lost to follow-up and 5 (1.3%) had died. Of the 179 patients discharged, 51 (13.3%) were discharged from follow-up at the first visit on grounds that they had been inappropriately referred and did not require specialist care. The remaining 128 patients (patients discharged after ≤2 visits = group B) were discharged after a mean follow-up of 5.5 months after doctors assessed that patients were sufficiently stable and no longer required specialist diabetes care.

In group B, mean HbA1c, BP and LDL-C had improved significantly at the point of discharge compared to baseline (Table 2). Among group A patients, HbA1c improved significantly after 12 months, but not other clinical indicators. Glycaemic control of group B patients was significantly lower than group A patients (mean HbA1c = 7.15% vs 8.16%; P <0.001). The proportion of patients reaching optimal glycaemic control (HbA1c <7%) improved significantly in both groups (Table 3). More than half (55.6%) of group B patients achieved HbA1c targets compared to 32.4% from group A (P <0.001). There was no significant change in the proportion of patients reaching optimal BP or LDL-C target in both groups.

Legends refer to whether the GP clinic is participating in the Medisave outpatient chronic care programme at the time of print.

Fig. 1. Delivering on target GP network (Illustration only).

Study 2

Most (80%) of those interviewed had not been briefed by their specialist physician on the possibility of eventual transfer of care to a community setting. Forty per cent of patients surveyed were willing to be discharged when their conditions stabilised. Following adjustment of all other factors, positive predictors [RR (95% CI)] for this behaviour were Malay ethnicity [3.0 (1.2, 7.4)], non-government pensioners (Civil Service Card holders) [2.0 (1.0, 4.0)], follow-up duration ≤2 years [2.0 (1.2, 3.7)]. Not surprisingly, the preferred primary care provider upon discharge was polyclinics because of the perceived geographical proximity and low cost of care.

Study 3

As of December 2007, 65 GPs have completed the first 2 phases of the programme and 69 GPs were in the second phase. Cooperation had been strong in this otherwise unaffiliated tertiary-primary-community team. A total of

Table 1. Baseline Profile of Individuals with Type 2 Diabetes Newly Referred to SGH DBC (n = 383)

Population characteristics	N (%) or Mean ± SD
Gender	199 men (52.0%)
Age	57.5 ± 12.7 years (range, 16-82)
Weight	69.0 ± 35.7 kg
Body mass index (BMI)	26.1 ± 4.7 kg/m^2
HbA1c	8.43 ± 2.14%
Systolic blood pressure (SBP)	134.9 ± 21.0 mm Hg
Diastolic blood pressure (DBP)	77.6 ± 10.6 mm Hg
Fasting blood glucose (FBS)	9.3 ± 4.0 mmol/L
Random blood glucose (RBS)	12.1 ± 5.2 mmol/L
Total cholesterol (TC)	5.04 ± 1.23 mmol/L
High density lipoproteins (HDL)	1.30 ± 0.59 mmol/L
Triglycerides (TGL)	3.23 ± 15.99 mmol/L
Low density lipoproteins (LDL)	2.89 ± 1.05 mmol/L
Total cholesterol-HDL ratio	4.49 ± 3.66 mmol/L
Urine microalbumin	57.9 ± 162.7 mmol/L

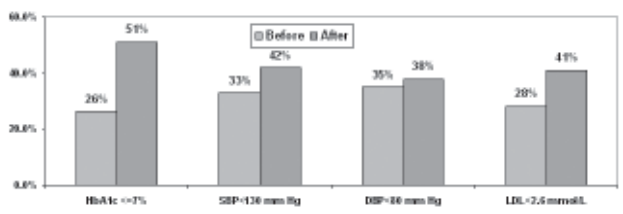

Fig. 2. Proportion of patients who reached optimal control before and after enrolment to DOT GP care – community counseling programme (P <0.001 for before and after HbA1c ≤7%).

Table 2. Comparison between Patients who Continued to be Followed-up at SGH DBC after 12 Months (Group A) and Patients Discharged from SGH DBC within 12 Months (excludes patients discharged at first visit) (Group B)-Clinical Outcomes

Indicator	Group A (n = 136) Mean values			Group B (n = 128) Mean values		
	At entry	At 12 months	Change [95% CI]	At entry	At discharge	Change [95 CI]
HBA1c	8.97	8.16	-0.81 [-1.16 to -0.46]	8.32	7.15	-1.18[-1.46 to -0.90]
SBP	134	134	0.07 [-3.77 to 3.91]	139	134	-4.38 [-8.27 to -0.48]
DBP	78	76	-1.93 [-4.01 to 0.2]	78	75	-3.09 [-5.41 to –0.77]
LDL-C	2.87	2.69	-0.18 [-0.43 to 0.08]	2.65	2.37	-0.27 [-0.51 to –0.04]
BMI	26.2	26.4	0.22 [-0.07 to 0.50]	26.3	26.5	0.20 [-0.06 to 0.47]

95% CI: 95% confidence interval; BMI: body mass index; DBP: diastolic blood pressure; LDL-C: low density lipoproteins-cholesterol; SBP: systolic blood pressure

Table 3. Comparison between Patients who Continued to be Followed-up at SGH DBC after 12 months (Group A) and Patients Discharged from SGH D B C within 12 months (excludes patients discharged at first visit) (Group B) – % Reaching Target Outcomes

Indicator	Targets*	Group A (n = 136)			Group B (n = 128)		
		Entry	12 months	*P* value	Entry	Discharge	*P* value
HbA1c	≤7	21.3%	32.4%	0.040	25.8%	55.6%	<0.001
BP	<130/80	25.7%	26.5%	0.890	21.9%	25.0%	0.555
LDL-C	<2.6	39.2%	50.5%	0.108	60.9%	64.1%	0.672
BMI	<23	25.2%	21.5%	0.493	24.8%	26.0%	0.839

BMI: body mass index; BP: diastolic blood pressure; LDL-C: low density lipoproteins-cholesterol

579 patients were recruited for the GP-DSS collaborative care programme. Pre- and post-programme HbA1c results were submitted for 370 patients (64%). For these patients, mean HbA1c at baseline was reduced from 8.23% to 7.32% (P <0.001, Student's paired t-test). Figure 2 shows the proportion of patients who reached optimal risk factor control. The proportion of patients who reached optimal glycaemic control (HbA1c <7%) increased from 26% to 51% (χ^2 test, P <0.01). However, the change in BP and LDL-C control did not reach statistical significance.

Of 181 stable diabetes patients recruited into the SHS-GP shared care pilot, 84 patients had subsequently consulted a DOT-certified GP. To date, 74 of these patients have remained on follow-up with DOT GPs for at least 3 months.

Discussion

Study 1

Information on duration of diabetes was not obtained in this study. However, according to the experience at SGH DBC, most of these patients are not likely to be newly diagnosed. The marked improvement in glycaemic control in both groups and BP as well as LDL-C control in group B showed the value of multi-disciplinary specialist service in treating more complex cases.

It is noteworthy that 13.3% of the new referrals were deemed unnecessary by the specialists at SGH DBC at the first visit. This is comparable to the 14.5% reported in a Singapore National Heart Centre (NHC) study on cardiology referrals.[19] The NHC study further reported that only 23.1% of the referrals were subsequently found to have significant or suspected cardiac abnormalities. While endocrinology is not an investigation-intensive specialty like cardiology, the results of these studies suggest that a clinical triage policy like that of the Accident and Emergency Department may be useful in improving the appropriate use of expensive specialist services.

About one-third (32.4%) of diabetic patients at target HbA1c levels remained on follow-up. The reasons for this are unknown but possibilities include non-achievement of other targets such as BP or LDL or other medical contraindications to discharge, physician factors and/or patient factors (non-medical). It should, however, be noted that a substantial percentage of patients in group B were discharged despite not having achieved targets in HBA1c, BP and/or LDL.

Therefore, right-siting was not apparent as there are equal odds of being discharged from specialist care regardless of whether clinical criteria are met or not. It has been difficult to base referral or discharge decisions solely on these indicators alone.

Study 2

The results of this survey suggest that there was significant

inertia in transferring of care from DBC to primary care and that the preferred primary care for the majority of patients is the polyclinics.

While Singapore's health financing emphasise individual responsibility and require patient co-payment, there is a lack of enforceable policy to further reduce the inappropriate use of expensive hospital resources. Furthermore, while the block hospital budget can restrain unnecessary volume, it does little to encourage hospital specialist departments to shift their current case mix towards more complex cases, passing the simple cases to the community general physicians.

In a caseload simulation study at SGH DBC, it was reported that the majority of cases seen are simple as opposed to complex cases that can be right-sited to the primary care.[20] Complex cases generated an average S$37 higher revenue compared to simple cases but require 5.5 minutes more consultation time. The replacement of simple with complex cases would have resulted in S$1.9 million decrease in revenue or 9339 fewer patients seen. Therefore, there is a significant financial inertia for hospital specialist departments to change their case mix towards more complex cases.

Patients need to have a polyclinic or public hospital emergency department referral in order to receive subsidised inpatient and outpatient care at the public hospitals. When they do get into the system, the reluctance to be discharged from specialist outpatient services could be a major obstacle against right-siting of care. The finding that follow-up of less than 2 years duration is a positive predictor of willingness to be discharged suggests that stable patients should be asked to discharge as soon as possible. The DOT shared care programme works on this premise.

Study 3

The results on glycaemic control achieved with DOT were comparable to figures attained by the Group B patients seen at SGH DBC over a similar treatment duration. However, due to not having a control cohort, this improvement cannot solely be attributed to the DOT programme.

More recently, the SHS-GP shared care phase of the programme has also included NHC patients with stable coronary heart disease. So far, the number of patients transferred from specialists to GPs is still small with relatively short duration of follow-up. Nevertheless, being in line with the national chronic disease management policy, the programme is set for further expansion, and will be improved accordingly as results and feedback from patients and partners are incorporated into future plans.

Conclusion

Our work shows that good and integrative diabetes care is possible. For the first time locally, this work documents that a group of local GPs who received training and community support were able to achieve significant improvements in HbA1c levels in their patients. However, improvements in BP, LDL-C and BMI levels of patients in both specialist and GP settings are needed. Obstacles to right-siting to GPs remain significant. The creation of innovative new models such as SOC discharge officers may increase the numbers of patients successfully transferred to GPs. To successfully facilitate large-scale transfer of patients to GPs, it is likely that major changes in pricing and funding policies will need to be implemented in tandem with incentives for physicians and hospitals to support right-siting.

REFERENCES

1. Leese B, Bosanquet N. Change in general practice and its effects on service provision in areas with different socioeconomic characteristics. BMJ 1995;311:546-50.
2. Goyer EC, McNally PG, Drucquer M, Spiers N, Botha JL. Shifting of care for diabetes from secondary to primary care, 1990-5: review of general practices. BMJ 1998;316:1505-6.
3. Woodwell DA, Cherry DK. National Ambulatory Medical Care Survey: Summary. Advance data from vital health statistics. Hyattsville, Md: National Center for Health Statistics, 2004. No. 346.
4. Integrated Health Service Division, Ministry of Health. Primary Care Survey 2005. Singapore: Ministry of Health.
5. MOH. Healthcare Financing-Medisave. Available at: http://www.moh.gov.sg/mohcorp/hcfinancing.aspx?id=328. Accessed 6 June 2007.
6. Fleming BB, Greenfield S, Engelgau MM, Pogach LM, Clauser SB, Parrott MA. The Diabetes Quality Improvement Project: Moving science into health policy to gain an edge on the diabetes epidemic Diabetes Care 2001;24:1815-20.
7. American Diabetes Association. Standards of Medical Care in Diabetes – 2007. Diabetes Care 2007;30:S4-S41.
8. Ministry of Health Clinical Practice Guidelines for Diabetes Mellitus. Available at: http://www.hpp.moh.gov.sg/HPP/MungoBlobs/517/391/2006%20Diabetes_Mellitus.pdf. Accessed 6 June 2007.
9. Kerr EA, Krein SL, Vijan S, Hofer TP, Hayward RA. Avoiding pitfalls in chronic disease quality measurement: a case for the next generation of technical quality measures. Am J Manag Care 2001;7:1033-43.
10. Campbell SM, Roland MO, Middleton E, Reeves D. Improvements in quality of clinical care in English general practice 1998-2003: longitudinal observational study. BMJ 2005;331:1121-5.
11. Saadine JB, Cadwell B, Gregg EW, Engelgau MM, Vinicor F, Imperatore G, et al. Improvements in Diabetes Processes of Care and Intermediate Outcomes: United States, 1988-2002. Ann Intern Med 2006;144:465-74.
12. Ackermann RT, Thompson TJ, Selby JV, Safford MM, Stevens M, Brown AF, et al. Is the number of documented diabetes process-of-care indicators associated with cardiometabolic risk factor levels, patient satisfaction, or self-rated quality of diabetes care? The Translating Research into Action for Diabetes (TRIAD) study. Diabetes Care 2006;29:2108-13.

13. Greenfield S, Rogers W, Mangotich M, Carney MF, Tarlov AR. Outcomes of patients with hypertension and non-insulin dependent diabetes mellitus treated by different systems and specialties: results from the medical outcomes study. JAMA 1995;274:1436-44.
14. Greenfield S, Kaplan SH, Kahn R, Ninomiya J, Griffith JL. Profiling care provided by different groups of physicians: effects of patient case-mix (bias) and physician-level clustering on quality assessment results. Ann Intern Med 2002;136:111-21.
15. De Berardis G, Pellegrini F, Franciosi M, Belfiglio M, Di Nardo B, Greenfield S, et al. Quality of care and outcomes in type 2 diabetic patients: A comparison between general practice and diabetes clinics. Diabetes Care 2004;27:398-406.
16. Saydah SH, Fradkin J, Cowie CC. Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. JAMA 2004;291:335-42.
17. Chuang LM, Tsai ST, Huang BY, Tai TY for Diabcare-Asia 1998 Study Group. Diabcare-Asia 1998 Study Group. The status of diabetes control in Asia-a cross-sectional survey of 24 317 patients with diabetes mellitus in 1998. Diabet Med 2002;19:978-85.
18. Lee WR, Lim HS, Thai AC, Chew WL, Emmanuel S, Goh LG, et al. A window on the current status of diabetes mellitus in Singapore-the Diabcare-Singapore 1998 study. Singapore Med J 2001;42:501-7.
19. Kwok B, Tang HC, Wee SL, Tai V, Tan C, Chua T. Pattern and outcome of subsidised referrals to cardiology specialist outpatient clinics. Ann Acad Med Singapore 2008;37:103-8.
20. Lim JFY, Tan DMH, Lee A. Consequences of right-siting of endocrinology patients-a financial and caseload simulation. Ann Acad Med Singapore 2008;37:109-13.