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ABSTRACT

Aim: To characterise drug-related problems (DRPs) among patients with diabetes in Hong Kong and their clinical significance and to explore pharmacists' role in the multi-disciplinary diabetes management team by evaluating the outcome of their clinical interventions.

Methods: An observational study was conducted at the Diabetes Clinic of a local public hospital from October 2012 to March 2014. Following weekly screening, selected high-risk patients were interviewed by a pharmacist prior to doctors' consultations for medication reconciliation and review. DRPs were identified and documented by the pharmacists, who presented clinical recommendations to doctors to optimise patients' drug regimens and resolve or prevent potential DRPs.

Results: A total of 522 patients were analysed and 417 DRPs were identified. The incidence of patients with DRPs was 62.8% with the mean number of DRPs per patient being 0.9±0.6. The most common DRP categories were related to dosing (43.9%), drug choice (17.3%) and non-allergic adverse reactions (15.6%). Drugs most frequently involved targeted the endocrine and cardiovascular system (CVS). The majority (71.9%) of DRPs were of moderate clinical significance and 28.1% were considered minor problems. DRPs were totally solved by doctors' acceptance of pharmacists' recommendations (50.1%), partially solved (11.0%) or received acknowledgement from doctors (5.5%).

Conclusions: Pharmacists, in collaboration with the multi-disciplinary team, demonstrated positive impact by identifying, resolving and preventing DRPs in patients with diabetes. Further plans for sustaining a pharmacy service in the Diabetes Clinic would enable further studies to explore pharmacists' long-term impact on improving patients' clinical outcomes in diabetes management.

New knowledge added by this study:

Studies have demonstrated pharmacists' important contribution to the identification, resolution and prevention of drug-related problems through medication reconciliation and review. Most of the identified problems were related to dosing with moderate clinical significance according to Dean and Barber's validated scale for scoring medication errors. Over half of pharmacists' clinical interventions were accepted or acknowledged by doctors to improve medication management.

Implications for clinical practice or policy:

Collaboration between pharmacists and other healthcare professionals is valuable for the improvement of medication safety in the management of diabetes.

TEXT

Introduction

Diabetes mellitus (DM) is a prevalent chronic disease worldwide.[1] Patients with diabetes often require complex medication regimens and are likely to develop multiple irreversible complications, which significantly worsen their quality of life.[2] Effective DM management requires collaboration among healthcare professionals (HCPs) in a multi-disciplinary diabetes management team (DMT), where pharmacists are well positioned to optimise pharmacological treatment, educate patients on diabetes management and promote medication adherence.[3]

Pharmacists' major roles in DMT is to conduct medication reconciliation (MR) and medication review. MR is the process of comparing patient's prescriptions with all their usual medications and to identify the most complete and updated medication history.[4] Medication review aims to check patients' past medical and drug history, assess current prescriptions and ascertain their drug knowledge and adherence.[5] Through these processes, pharmacists can effectively identify drug-related problems (DRPs), which are events or circumstances involving drug therapies that either actually or potentially interfere with optimum health outcomes of specific patients.[6, 7] People with chronic diseases usually require polypharmacy (concurrent use of multiple medications), from which DRPs can easily arise.[8, 9] These DRPs might be overlooked by prescribers and could interfere with diabetes management. From several overseas studies, pharmacists have implemented timely interventions to resolve or prevent DRPs by offering recommendations to prescribers, with an acceptance rate over 60%.[10-13]

The positive impact of pharmacists on improving diabetes management or its comorbidities has also been recognised by interventional and controlled observational studies worldwide, which demonstrated greater overall improvement in glycosylated haemoglobin (HbA1c), fasting plasma glucose (FPG), blood pressure (BP), most cholesterol components, renal outcomes and medication adherence in patients who received pharmacist-led diabetes services compared to standard care.[12, 14-30] However, only a few studies were conducted in Hong Kong (HK).[16, 29] In a view of inadequate available data and potential for expansion of local pharmacy services, more studies are required to investigate the development of future sustainable diabetes service provision by pharmacists.

Our study aimed to characterise DRPs among Chinese diabetic outpatients, define their clinical significance and outcomes of pharmacists' interventions, thereby highlighting their contribution to the detection, resolution and prevention of DRPs for improving medication safety and diabetes management.

Materials and Methods

Study design and setting

An observational study was conducted weekly, in the Diabetes Clinic at Queen Mary Hospital (QMH) from October 2012 till March 2014. The study protocol was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster.

Inclusion/Exclusion criteria

Patients were included if they were at "high risk" due to their multiple disease state and complex drug regimen fulfilling each of the following criteria:

- Aged ≥65 years
- Taking five or more medications including all routes of administration, or over the counter (OTC) medications (regular or as needed)
- Taking medications with a low therapeutic index or require monitoring
- Attending multiple specialist clinics

Nursing home residents were excluded due to their relatively low risk for non-adherence and DRPs, compared to community dwelling elderly patients.

Procedure and materials

Day before the clinic, two researchers screened the past medical history (PMH), previous consultation notes, current medications and latest laboratory results of Chinese adult patients attending the weekly clinic to select high-risk patients. Selected patient's records were printed and prepared for quick reference during the medication interview. To facilitate the data collection, a memo was attached with the patient's records to notify nurses for patient selection.

Two pharmacists from QMH and one from University of Hong Kong (HKU) attended the clinic on alternate Wednesdays to compile a thorough medication history from selected patients and conduct medication review independently prior to doctors' consultations. During review, the pharmacists also recorded medications not shown in Clinical Management System (CMS), including drugs prescribed by general practitioners (GPs), OTC products, vitamins and herbal supplements.

A MR form (Appendix 1) was then completed by the pharmacists, documenting the identified DRPs and formulating the intervention proposal. The MR forms were collected following doctors' consultations either on the same day or within the next few days.

Pharmacists Intervention

It included:

- Reviewing patient's drug regimen and making recommendations to doctors for adjustment.
- Informing doctors regarding most updated drug list after MR.
- Suggesting need for further investigating patient's condition.
- Providing drug education to patients and caregivers.
- Reinforcing patient's drug compliance.
- Suggesting lifestyle modification such as dietary control.

Identifying DRP's

From the completed MR forms, DRPs were identified and pharmacists' recommendations were collected for analysis, CMS was checked for outcome of intervention.

Data Collection

Demographic data such as age, gender, drug allergy status, number of regular medications obtained from HA clinics (Table 1) and some latest laboratory values, including HbA1c, FPG, and lipids were retrieved from CMS (Appendix 2). Additional information included patients' care provider in terms of medication, drug storage methods, smoking status, drinking habits, vaccination record and latest readings from self-monitoring of blood glucose (SMBG).

Data analysis

Demographic data are tabulated as frequency and percentage using Microsoft Excel 2010. Primary outcomes included the frequency and categories of DRPs, drug classes involved, clinical significance of DRPs and outcome of pharmacists' interventions. The incidence of DRPs was also calculated as the percentage of patients with at least one DRP.

Definition and classification of DRPs

Using the Pharmaceutical Care Network Europe (PCNE) classification system for DRPs V5.01, DRPs were categorised into "adverse reactions", "drug choice problem", "dosing problem", "drug use problem", "interactions" and "others".[7] This is an established system that has been revised several times with tested validity and reproducibility[11, 31] and has been used in many studies.[9, 32 33] When a single drug was associated with more than one possible DRP category, the one that best described the clinical scenario was chosen. Drugs involved in DRPs were categorised according to British National Formulary classification.[34]

The clinical significance of DRPs was assessed to determine their actual or potential consequences on patients' health outcomes. Using a validated scale,[35] four independent reviewers (two pharmacists and two doctors) scored the severity of each DRP from zero (without potential effects on the patient) to 10 (lead to a fatal event). Mean scores below three indicated minor problems (very unlikely to cause adverse effects) while three to seven indicated moderate problems (likely to cause some adverse effects or interfere with therapeutic goals). DRPs scoring above seven were severe and could likely cause death or lasting impairment.

To evaluate prescribers' acceptance levels, the outcome of pharmacists' interventions were categorised into "not known", "solved", "partially solved" or "not solved" according to PCNE classification V5.01.[7]

Results

Patient demographics and characteristics

Within the study period, a total of 652 patients were included based on the selection criteria, from which 526 (80.7% of 652) were interviewed and 522 (99.2% of 526) were analysed (Figure 1).

The age of the 522 patients ranged from 65-91 (mean of 75.2±5.4 years). The number of regular HA medications taken ranged from 5-17 with a mean of 9±2.

Incidence and classification of DRPs

A total of 417 DRPs were identified. Among the 522 patients analysed, 328 patients had at least one DRP with the incidence of 62.8% and the mean number of DRPs per patient as 0.9±0.6. The most prevalent DRP category was related to dosing (n=183, 43.9%), followed by drug choice (n=72, 17.3%) and non-allergic adverse reaction (n=65, 15.6%). Each of these is sub-categorised in Table 2.

Categories of drugs involved in DRPs

The most common class of medication involved were those targeting the endocrine system with 190 DRPs (45.6%) followed by cardiovascular system (CVS) with 159 (38.2 %) DRPs (Table 3).

Clinical significance of DRPs

The average clinical severity scores assigned to DRPs ranged from 0.5-7.0 (Table 4). The majority of DRPs (n=300, 71.9%) were classified as moderate problems while remaining were all minor problems (n=117, 28.1%). No clinically severe DRP was identified.

Outcome of pharmacists' interventions

As Table 5 shows, modifying drug regimens or reinforcing compliance by doctors or referral to pharmacists solved 209 (50.1%) DRPs. Forty-six (11.0%) DRPs were partially resolved by doctors adjusting prescriptions, although not to pharmacists' recommendations. Sixty-two (14.9%) DRPs were not resolved due to patients' reluctance to change prescriptions, absence of the need for resolution or due to some unknown reasons. Twenty-three (5.5%) DRPs had an unknown outcome because they were non-compliance issues that were not acknowledged by doctors.

Discussion

The incidence of patients with DRPs and the average number of DRPs per patient analysed were comparable to a Norwegian study (58.9% and 1.2 respectively)[10] but considerably lower from four overseas studies (incidence of 80.7-90.5% and mean number of DRPs per patient between 1.9±1.2 and 4.6±1.7).[9, 11, 12, 36] Such discrepancies might be attributed to variations in patient selection criteria, data collection methods, pharmacists' clinical experience, study durations and settings.[9, 36, 37]

The majority of DRPs were dosing problems, with "drug dose too low or dosage regime not frequent enough" being the largest sub-category. In contrast to the lower percentage (5.9-21.6%)

in five overseas studies,[9-12, 36] our high prevalence of dosing problems was in-line with a local study on medication incidents among hospital inpatients,[38] mostly arising from self-adjustment of dosage or frequency, confusion about previous dose changes and dosage modification by GPs or doctors overseas. These highlight local pharmacists' pivotal roles in conducting MR, reviewing drug dosages to ensure safety and efficacy, monitoring patients' metabolic control regularly as well as reminding patients and/or their caregivers to maintain an updated medication list and follow the latest drug label instructions.

Drug choice problem was the second most common DRP in the study. Nearly 17.3% of DRPs were issues surrounding drug choice, comparable to the findings of three overseas studies (9.1-30.2%)[11, 12, 36] but deviating from others (18.2-22.5%).[9, 10] The most common sub-category was "no drug prescribed but clear indication", such as the omission of angiotensin-converting enzyme inhibitor/ angiotensin-receptor blocker (ACEI/ARB) in patients with microalbuminuria and patients' reluctance to use insulin. Hence, pharmacists have a role in advising doctors to adhere to the latest treatment guidelines and educate patients about the treatment benefits of each drug class.[39] Other causes of problems surrounding drug choice include drug duplication and changes in drug choices by GPs to prevent side effects, suggesting that some DRPs might have arisen from the lack of a common platform for sharing patient information between the public and private healthcare sectors. Pharmacists could make valuable contributions by establishing patients' drug history through MR and from liaison with the different healthcare sectors.

Adverse reactions were the third most common DRP (15.6%). The major types of "side effects suffered (non-allergic)" were insulin-induced hypoglycaemia, gastrointestinal disturbances and

dizziness caused by anti-diabetic drugs, for which pharmacists recommended changes in drug choice or dosage. Adverse reactions could lead to other DRP categories,[7] such as drug choice and drug use problems. This reflects pharmacists' pivotal role in reviewing prescribed doses, suggesting dosage adjustments to doctors, monitoring for adverse effects and education on prevention of side effects (such as performing SMBG regularly to prevent hypoglycaemia).[39]

Drug use issues were the fourth most common category with comparable prevalence (12.0%) to a Malaysian study[9] but there is considerable variation among other studies (3.8-54.2%).[10-12, 36] Reasons for the sub-category of "drug not taken/administered at all" include financial issues for purchasing self-financed item (SFI) items, unawareness of indications, concern about side effects and confusion about previous regimen changes.[40] In our study, pharmacists mainly intervened using direct patient counselling, recommending reinforcement of patient compliance to doctors or suggesting changes to drug regimens. Pharmacists could also work closely with other DMT members to educate patients about their disease and the most updated regimen, address drug cost concerns or side effects, and encourage patients to update their medication list and use dose administration aids (DAAs) like pill boxes.[41]

The low prevalence of drug interactions (1%) was similar to that (0.6%) in a Danish study,[36] but much higher percentages were found in three other studies (8.0-16.3%),[9-11] possibly ascribed to differences in prescribing practice, references used to define drug interactions,[9] and also because CMS could already detect a range of clinically significant interactions when doctors issued prescriptions. Nonetheless, system checking and prompts are not adequate to replace clinical judgment or recommendations of alternative regimens. "Others" included "insufficient awareness of health and diseases" (such as poor dietary control) and "inappropriate timing of administration",

247 but this category could also encompass therapy failure and inappropriate lifestyle choices, resulting
248 in greater variation of prevalence from overseas studies (6.8-46.6%).[9-11, 36] Pharmacists are ideally-
249 positioned to advise patients on diabetic diet, smoking cessation, regular exercise and SMBG.[21]
250
251 The drugs classes mostly implicated in DRPs were found to be for endocrine system (45.6%)
252 followed by CVS (38.2 %). These findings were not surprising as insulins, oral anti-diabetic drugs,
253 antihypertensives, antihyperlipidaemics, antiplatelets and ACEIs/ARBs are most commonly
254 prescribed for managing diabetes, its comorbidities and complications.[11, 39]
255
256 The majority of DRPs were classified as moderate problems. Among similar overseas studies, only
257 one analysed the clinical significance of DRPs, in which 87% of DRPs had high or medium
258 clinical/practical relevance.[10] These findings could not be readily compared to the present study
259 because of different assessment scales, potential variations in reviewers' clinical experience[35] and
260 unknown relative proportions of cases with medium and high relevance.
261
262 Over half of the DRPs were totally solved as doctors accepted pharmacists' recommendations. The
263 acceptance rate was somewhat similar to that observed in two overseas studies (60.2-62.7%).[12, 13]
264 The physicians acknowledged the provision of service by pharmacists and were more aware of the
265 written recommendations provided by pharmacists. In particular, the value of verbal
266 communication between different HCPs in resolving or preventing DRPs has been recognised in
267 earlier studies,[10, 42-45] suggesting potential improvement in the acceptance rate if pharmacists had
268 more time to hand over DRPs verbally to doctors.
269

The outcome of pharmacists' interventions could also be influenced by doctors' clinical experience and familiarity with the new service. Doctors' acceptance levels could have been underestimated since some of them might have neglected or missed written information from pharmacists. This highlights the importance of promoting pharmacists' roles among doctors and keeping all participating doctors well-informed.

Difficulties and limitations

This pilot study allowed for an opportunity to assess the proportion of patients who may be seen by clinical pharmacists in a busy specialist outpatient clinic at a teaching hospital. Approximately 10% of patients were chosen each week and not all eligible patients could be selected owing to time limitation. The volume of patients actually interviewed was further limited due to time constraint, patients' absence or refusal. Local figures from the QMH Diabetes Clinic indicate that out of all patients attending the clinic, approximately 7-8% are deemed "high risk", based on ongoing work and prioritisation of those taking 5 or more regular medications.

Limited work space was another consideration. A designated area is required for conducting patient interviews and further arrangements could be made with the medical and nursing staff in Diabetes Clinic to access better space.

This study only described the current situation of DRP's without assessing the extent of implementation of intervention and their impact on patient health outcome. As the majority of patients did not bring their drugs and had no medication list available, the MR process was not always effective. Whilst a minority of patients could name their regular drugs, the majority relied on pharmacists' investigation and prompts describing the colour, shape, package or indication of

each drug. Due to potential for misinterpretation, DRP prevalence may be underestimated. One possible solution might be to show patients samples of commonly prescribed medications. Alternatively, selected patients could be telephoned in advance to remind them to bring along their medications, however this measure may not be sustainable. A multifaceted promotional campaign could be introduced to encourage patients to bring their regular medications. This has been shown to be effective in the emergency setting.[46]

Although completed MR forms were presented to doctors after the interviews, some written information might have been missed, resulting in their lack of response to certain DRPs. Pharmacists should ideally hand over every DRP verbally to doctors, however this was not always possible due to time constraints and the great volume of patients. In the long run, it would be desirable for pharmacists to document DRPs and their recommendations in CMS, which would enhance visibility and allow doctors to input their response electronically for organised documentation and easy data retrieval.

Future directions

After this study, pharmacists have continued providing MR and medication review services in QMH Diabetes Clinic. They also have been collecting data about DRPs to plan for a sustainable service. Following a longer study period, patient and staff satisfaction surveys could be introduced and also control groups can be added in study for comparing the effectiveness of pharmacist's intervention. This can further support the extension of hours of service and potentially the setup of similar pharmacy services to other hospitals and diabetic clinics in Hong Kong.

Conclusions

Approximately two-thirds of patients at Diabetes Clinic had at least one DRP. The most frequent categories of DRPs were related to dosing, drug choice and non-allergic adverse reaction. Drugs targeting the endocrine and CVS were most commonly involved. The majority of DRPs were of moderate clinical significance. Pharmacists' interventions for over half the DRPs were accepted or acknowledged by prescribers. Through effective communication and collaboration within the multi-disciplinary healthcare team and pharmacists had a positive impact on identifying, resolving and preventing DRPs. Future plans for sustaining the diabetes service would enable more local research to enhance medication safety and optimise patients' medication regimens in diabetes management.

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Table 1. Demographics and characteristics of study population	
Patient demographics	**n (%)**
Age (Mean Age)	65 – 91 years (75.2±5.4 years)
Gender	
Female	269 (51.5)
Male	253 (48.5)
Drug allergy status	
No known drug allergy	448 (85.8)
Known drug allergy	74 (14.2)
On medications or supplements other than those prescribed by HA clinics	
Yes	119 (22.8)
No	403 (77.2)
Care provider in terms of medications	
Self	364 (69.7)
Family member	80 (15.3)
Domestic helper	26 (5.0)
Self and family	20 (3.8)
Family and domestic helper	5 (1.0)
Self and domestic helper	3 (0.6)
Community nurses	9 (1.7)
Not recorded	15 (2.9)
Method of storing medications	
DAA*	340 (65.1)
Original dispensing bag	125 (24.0)
Others†	22 (4.2)
DAA and original dispensing bag	6 (1.1)
DAA and others	2 (0.4)
Original dispensing bag and others	3 (0.6)
Not recorded	24 (4.6)
Medications brought in with patient	
None	428 (82.0)
Some of the medications	50 (9.6)
All of the medications	14 (2.7)
Not recorded	30 (5.7)
Medication list available on visit	
Yes	39 (7.5)
No	431 (82.6)
Not recorded	52 (9.9)
Smoking status	
Non-smoker	384 (73.6)
Ex-smoker	100 (19.2)
Current smoker	21 (4.0)
Not recorded	17 (3.2)
Drinking habit	

Non-drinker	465 (89.1)
Light drinker	27(5.2)
Moderate drinker	2 (0.4)
Ex-drinker	5 (0.9)
Not recorded	23 (4.4)
Record of latest SMBG readings available	
Yes [‡]	267 (51.1)
No or not recorded	255 (48.9)
Received pneumococcal vaccine within past 5 years	
Yes	77 (14.7)
No	386 (74)
Not recorded or not sure	59 (11.3)
Received influenza vaccine for current year	
Yes	164 (31.4)
No	302 (57.9)
Not recorded	56 (10.7)
Previous hepatitis B vaccine	
Yes	8 (1.5)
No	434 (83.2)
Not recorded or not sure	80 (15.3)
DAA, dose administration aid; HA, Hospital Authority; SMBG, self-monitored blood glucose.	
[*] Examples include pill boxes, monitored dosage systems and patients' dispensing cabinets.	
[†] Examples include film bottles and patients' plastic bags or containers.	
[‡] Patients who did not bring their records but recalled some readings were excluded from "yes".	

Table 2. Frequency and categories of DRPs	
Category of DRPs	**n (%)**
1. Adverse reactions	
Side effect suffered (non-allergic)	65 (15.6)
2. Drug choice problem	
Inappropriate drug	8 (1.9)
Inappropriate drug form	2 (0.5)
Inappropriate duplication of therapeutic group or active ingredient	18 (4.3)
Contraindication for drug	5 (1.2)
No clear indication for drug use	4 (1.0.)
No drug prescribed but clear indication	35 (8.4)
Subtotal	72 (17.3)
3. Dosing problem	
Drug dose too low or dosage regime not frequent enough	97 (23.3)
Drug dose too high or dosage regime too frequent	69 (16.5)
Duration of treatment too long	17 (4.1)
Subtotal	183 (43.9)
4. Drug use problem	
Drug not taken/administered at all	50 (12.0)
5. Interactions	
Potential interaction	3 (0.7)
Manifest interaction	1 (0.2)
Subtotal	4 (1.0)
6. Others	
Insufficient awareness of health and diseases (possibly leading to future problems)	33 (7.9)
Inappropriate timing of administration	2 (0.5)
Therapy failure	1 (0.2)
Patient dissatisfied with therapeutic outcome despite taking drugs correctly	7 (1.7)
Subtotal	43 (10.3)
Total number of DRPs	**417 (100)**
Incidence of patients with DRPs	**328 (62.8)**

Table 3. Frequency and classes of medications involved in DRPs		
Class of medications	**Number of DRPs involved (%)**	**Examples**
Cardiovascular system	159 (38.2)	Aspirin, perindopril, losartan, valsartan, metoprolol tartrate, atenolol, labetalol, simvastatin, atorvastatin, amlodipine, isosorbide mononitrate, frusemide, hydrochlorothiazide, hydralazine, warfarin
Endocrine system		
Insulins	133 (31.9)	Regular insulin, isophane insulin, biphasic isophane insulin, insulin glargine
Anti-diabetic drugs	56 (13.5)	Metformin, gliclazide, sitagliptin
Sex hormones	1 (0.2)	Finasteride
Subtotal	190 (45.6)	
Nutrition and blood	21 (5.0)	Calcium carbonate, potassium chloride, darbepoietin alfa injection
Gastrointestinal system	14 (3.5)	Pantoprazole, rabeprazole, famotidine, digestive enzymes
Obstetrics, gynaecology and urinary tract disorders	6 (1.4)	Prazosin, terazosin, doxazosin
Respiratory system	5 (1.2)	Theophylline, ipratropium, salbutamol, beclomethasone, loratadine
Malignant disease and immunosuppression	3 (0.7)	Azathioprine, prednisolone
Central nervous system	3 (0.7)	Gabapentin, pregabalin, tramadol
Infections	1 (0.2)	Isoniazid and rifampicin
Musculoskeletal and joint diseases	5 (1.2)	Allopurinol, colchicine
Skin	1 (0.2)	Fluocinolone acetonide cream
Others	1 (0.2)	Peritoneal dialysis fluid
Multiple drugs*	8(1.9)	
Total	**417(100)**	
DRP, drug-related problem. * In most of the cases the DRPs were related to poor drug compliance by the patient.		

Table 4. Frequency and categories of clinical severity scores assigned to DRPs

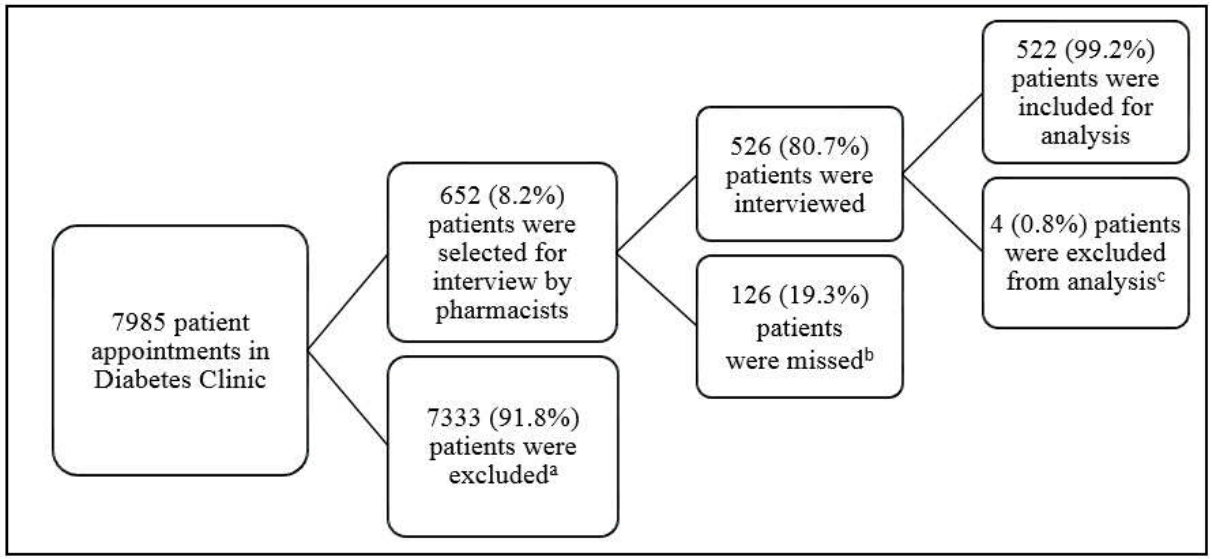
Severity category	Average score	n (%)
Minor	0.5	1 (0.2%)
	1	12 (2.9%)
	1.25	2 (0.5%)
	1.5	10 (2.4%)
	1.75	4 (1.0%)
	2	33 (7.9%)
	2.25	7 (1.7%)
	2.5	30 (7.2%)
	2.75	18 (4.3%)
	Subtotal	**117 (28.1%)**
Moderate	3	45 (10.8%)
	3.25	22 (5.3 %)
	3.5	29 (7.0%)
	3.75	16 (3.8%)
	4	65 (15.6%)
	4.25	8 (1.9%)
	4.5	27 (6.5%)
	4.75	7 (1.7%)
	5	42 (10.1%)
	5.25	5 (1.2%)
	5.5	11 (2.6%)
	5.75	2 (0.5%)
	6	15 (3.6%)
	6.5	1 (0.2%)
	6.75	1 (0.2%)
	7	4 (0.9%)
	Subtotal	**300 (71.9%)**
Total number of DRPs		**417 (100)**

Table 5. Outcome of pharmacists' interventions		
Outcome of pharmacists' interventions	**n (%)**	**Examples**
Outcome of intervention not known	77 (18.5)	• A patient took sitagliptin 50mg instead of 100mg daily claiming that doctor told her half a tablet would be enough. Pharmacist asked the doctor to review but no record was made in CMS and doctor continued prescribing 100mg daily.
Problem totally solved	209 (50.1)	• A patient on perindopril, whose dose was increased in Nephrology clinic during last follow up, presented with hyperkalaemia (serum potassium level: 5.7mmol/L). Pharmacist suspected the cause as the side effect of ACEI. Physician agreed to cease drug until next follow up in Nephrology clinic.
Problem partially solved	46 (11.0)	• A patient was prescribed with the following antidiabetic drugs by GP: metformin 500mg BD, sitagliptin 50mg OD and glimepiride 1mg OD. In view of patient's renal function (serum creatinine increased from 193 umol/L to 213 umol/L), pharmacist suggested stopping metformin and changing sitagliptin to linagliptin. Physician noted "strongly advised to stop metformin" in CMS, but made no comment on changing sitagliptin.
Not solved		
Lack of cooperation of patient	5 (1.2)	• A T2DM patient had good adherence to four oral anti-diabetic drugs (metformin 1500mg BD, gliclazide 160mg BD, sitagliptin 100mg daily and acarbose 50mg TDS). The pharmacist explained that the maximum doses of most drugs had already been reached, but the patient still refused admission, insulin therapy or any additional medications. His latest HbA1c was 12.6% and FPG was 19.6mmol/L. The doctor recorded the problem in CMS, explained health risks and advised patient to attend Emergency Department if he feels unwell.
No need or possibility to solve problem	35 (8.4)	• The pharmacist recorded that a patient would discuss with the doctor in Orthopaedics Clinic regarding calcium carbonate 1000mg daily due to constipation. The doctor in Diabetes Clinic did not record the problem in CMS and kept the current dosage.
For unknown reasons	22 (5.3)	• Frusemide dosage prescribed in Cardiology clinic was increased from 20mg BD to 40mg mane and 20mg nocte by GP due to oedema. The doctor in Diabetes Clinic neither made a record nor changed the prescription.
Subtotal	62 (14.9)	

Others (Acknowledged by doctor, no action taken)	23 (5.5)	• A patient who had coronary artery disease, self-adjusted the dosage of metoprolol tartrate from 25mg BD to 25mg daily. The doctor recorded the problem but did not prescribe the drug (for follow up in Cardiology clinic).
Total	**417 (100)**	

ACEI, Angiotensin-converting-enzyme inhibitor; BD, twice daily; CMS, Clinical Management System; DM, Diabetes Mellitus; FPG, fasting plasma glucose; GP, general practitioner; HbA1c, glycosylated haemoglobin; mane, every morning; nocte, every night; OD, once daily; SFI, self-financed item; T2DM, type 2 diabetes mellitus; TDS, three times daily.

Figure 1. Flow chart of the sample selection process



[a] Excluded if age <65 years, nursing home residents, or patients taking less than 5 medications

[b] Missed due to the absence or refusal of some patients and time limitations.

[c] Key data for one patient was lost, and three patients were found to be nursing home residents and hence excluded.