Patient-centred and not disease-focused: a review of guidelines and multimorbidity

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INTRODUCTION Single-disease clinical practice guidelines (CPGs) are not designed to consider patients with multiple chronic conditions, or multimorbidity. Applying multiple CPGs to a single patient may create an overwhelming treatment burden resulting in poor adherence and clinical outcomes. No studies on the cumulative treatment burden from multiple CPGs have been done in Singapore. We described the treatment burden on a hypothetical patient with six chronic conditions when multiple CPGs were applied, and appraised each CPG with respect to the patient-centred care of older adults with multimorbidity.

METHODS A treatment plan was developed for a hypothetical 72-year-old woman with asthma, depression, diabetes mellitus, dyslipidaemia, hypertension and osteoarthritis according to the latest CPG recommendations. Treatment burden was quantified in terms of time spent, cost, and the number of appointments and medications. Each CPG was appraised with respect to the care of older adults, patients with multimorbidity and patient-centred care.

RESULTS Following the CPGs strictly, an average of about two hours was spent daily taking 14 different medications and following 21 non-pharmacological recommendations. Her out-of-pocket payment was SGD 104.42 monthly despite a near 90% subsidy on healthcare bills. Patient-centred care of older adults with multimorbidity was inadequately addressed in all six CPGs.

CONCLUSION When six CPGs were cumulatively followed, the treatment burden was time-consuming, costly and disruptive. Patients' goals and preferences must guide prioritisation of care such that treatment burden remains minimally disruptive to their lives. Developing future CPGs to deliver patient-centred rather than disease-focused care will be crucial to the management of multimorbidity.

Keywords: chronic disease, comorbidity, multimorbidity, practice guidelines, primary care

INTRODUCTION

Multimorbidity is the co-occurrence of two or more chronic conditions in an individual.[1,2] It is associated with increasing age and is most prevalent among older adults.[3] Managing multimorbidity is challenging, as current healthcare systems are predominantly guided by single-disease pathways.[4] For example, most clinical practice guidelines (CPGs) have a single-disease focus.[5] They inadequately address patients with multimorbidity[5] in whom treatment burden, defined as the total healthcare workload experienced by these patients,[6] is cumulative. Consequently, these patients experience a poor quality of life, high healthcare expenditures, polypharmacy, and increased risk for adverse drug events and mortality[7] in a healthcare system with poor coordination and integration.[8] In Singapore, where one in five Singaporeans will be aged 65 years or older by 2030,[9] it is imperative to optimise management of multimorbidity. Following multiple single-disease CPGs may create an overwhelming treatment burden that leads to poor adherence, wasted resources and poor clinical outcomes.[10] While previous studies examining international guidelines have found that treatment burden greatly increases with an increasing number of chronic conditions,[11-13] no similar studies have been conducted in Singapore.

We aimed to identify gaps in current CPGs that run contrary to the goal of patient-centred care, which is for treatment burden to be minimally disruptive to patients' lives. The primary study objective was to describe the treatment burden of a hypothetical patient with six common chronic conditions in the primary care setting when multiple single-disease CPGs are applied. The secondary objective was to appraise the extent to which CPGs address older adults, multimorbidity and patient-centred care.

METHODS

A treatment plan was developed for our hypothetical patient Mdm Wong, a 72-year-old widow with asthma, depression, diabetes mellitus, dyslipidaemia, hypertension and osteoarthritis, all moderate in severity, based on the latest CPG recommendations (Appendix 1). Mdm Wong lives alone and receives a monthly annuity of SGD 650 from her Central Provident Fund account, the mandatory national savings scheme in Singapore,[14] and visits the nearest polyclinic for her multimorbidity. For the purpose of this study, generic medications with the least frequent dosing regimen and combined recommendations applicable to multiple CPGs were chosen whenever possible.

From the 20 chronic conditions that are under the Ministry of Health (MOH) Chronic Disease Management Programme and therefore eligible for subsidies (Appendix 2),[15] six conditions commonly managed in the primary care setting were selected, including a chronic pain condition (osteoarthritis) and a mental health condition (depression), to reflect the full breadth of multimorbidity. MOH CPGs produced within the last ten years

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were selected, as they are most appropriately matched to local practice. As the MOH CPGs for asthma and osteoarthritis had not been updated in the past ten years, international guidelines that are most often used locally (Appendix 2) were selected,[16-21] namely the Global Strategy for Asthma Management and Prevention guidelines from the Global Initiative for Asthma and the Osteoarthritis: Care and Management in Adults guidelines from the National Institute for Health and Care Excellence (NICE). CPGs were evaluated based on criteria selected from similar studies examining the applicability of guideline recommendations to older adults, patients with multimorbidity and patient-centred care.[11,13]

Treatment burden concerning time spent, cost, and the number of appointments and medications was quantified. Estimates of time spent on various health-related activities (HRAs) were obtained from the published literature[22,23] and operational data from the National Healthcare Group Polyclinics (NHGP) (Appendix 3). Both subsidised and unsubsidised costs of treatment in the primary care setting were calculated. The unsubsidised costs included the national goods and services tax (GST) at the prevailing rate of 7% to reflect the true cost to the healthcare system. The out-of-pocket payment by Mdm Wong after MOH subsidy with GST absorbed, and additional coverage from the Pioneer Generation Package (PGP), which entitles patients to an additional 50% off their subsidised healthcare bill,[24] and the Community Health Assist Scheme (CHAS), which enables patients to make claims up to SGD 135 per visit and SGD 54 per year from their Medisave account,[25] were also reported. This was expressed as a percentage of her monthly annuity. Treatment for acute exacerbations of chronic diseases was not considered.

RESULTS

For this study, treatment burden was shown in terms of a total of 21 non-pharmacological recommendations (Box 1 & Table I). These included six referrals, eight laboratory tests and five patient-education interventions, equating to 53 polyclinic appointments annually for Mdm Wong. She would take 14 different types of medications, equivalent to 32.5 pills taken at five different times daily, assuming that 'as needed' salbutamol is taken once daily before exercise, paracetamol thrice daily and kefentech plasters twice daily for pain relief (Table II). In addition, she would spend up to 64.53 hr/mth (2.15 hr/day) on HRAs, including 7.87 hr/mth attending appointments, 8.67 hr/mth monitoring her diseases, 12.00 hr/mth taking medications, 16.00 hr/mth following the recommended diet and 20.00 hr/mth on exercise.

Table III shows the expected treatment costs for Mdm Wong. Without subsidies, a total of SGD 447.72 (SGD 236.64 for medications), 68.9% of her monthly annuity, would be spent monthly. After MOH and PGP subsidies, the monthly payment would decrease to SGD 104.42 monthly (SGD 49.97 for medications), 16.1% of her monthly annuity. This equates to a more than 50% reduction in her monthly payment. Unfortunately, her annual CHAS claim limit (of SGD 540 per year) would be exhausted in five months and she would have

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Box 1. Recommended non-pharmacological patient tasks based on clinical practice guidelines (CPGs). CPGs used for each recommendation are indicated in brackets:

1. Diet (DM, L, HT)
   (a) Medical nutritional therapy for DM
   (b) DASH diet (i.e. Dietary Approaches to Stop Hypertension) for HT
   (c) Low trans-fat, saturated fat, cholesterol, refined grains, simple sugars, salt
   (d) High dietary fibres (whole grain, fruits, vegetables)
2. Weight loss of 5%–10% of total body weight, BMI < 23 kg/m² and waist circumference < 90 cm (male) or < 80 cm (female) (A, DM, L, HT, OA)
3. Exercise (A, DP, DM, L, HT, OA)
   (a) ≥ 150 min/wk
   (b) ≥ 30 min/day
   (c) Moderate intensity aerobic and dynamic exercises for cardiovascular health
   (d) Local muscle strengthening, manipulation and stretching (range-of-motion exercises) for knee OA
   (e) Breathing exercises for asthma
4. Appropriate footwear (DM, OA)
5. Avoid environmental exposures that may exacerbate asthma, e.g. tobacco smoke, pollutants and allergens (A)
6. Written asthma action plan (A)
7. Activity pacing (OA)
8. Home monitoring (A, DM, HT)
   (a) Foot checks daily
   (b) Self-monitoring of capillary blood glucose thrice weekly
   (c) Self-monitoring of home blood pressure once weekly
   (d) Self-monitoring of asthma symptoms and/or peak expiratory flow daily

A: asthma; DP: depression; DM: diabetes mellitus; HT: hypertension; L: dyslipidaemia; OA: osteoarthritis

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to make monthly out-of-pocket payments of SGD 104.42 for the remaining months (Table III). The treatment regimen would cost the healthcare system SGD 5,372.68 annually (SGD 2,839.67 for medications).

Although each individual CPG considers older adults, only four of the CPGs (asthma, depression, dyslipidaemia and hypertension) have dedicated sections with extensive information and evidence (Table IV). Across the six CPGs, recommendations range from modified treatment targets (dyslipidaemia and diabetes mellitus) to specific pharmacological recommendations (hypertension and depression). Most pertain to the increased risk of adverse effects and drug interactions in older adults. Among the recommendations for older adults, only five are based on the highest level of evidence. All except the osteoarthritis CPG mention at least one specific comorbidity (Table IV), and this is most extensive in the hypertension CPG. However, none of the CPGs address multimorbidity or multiple comorbidities. All CPGs include patients' goals and preferences. Three CPGs (dyslipidaemia, hypertension and osteoarthritis) recommend tailoring treatment to the patient, but with no disease-specific elaboration. The other three CPGs (asthma, diabetes mellitus and depression) discuss patient preferences regarding specific treatment options or targets. None of the CPGs address the time needed to treat to benefit (Table IV).

Table I. Recommended non-pharmacological clinician tasks based on clinical practice guidelines.

Recommendation	Frequency	Appointments (per yr)	Cost (SGD per mth)	
			Unsubsidised*	Subsidised†
Referrals			173.79	93.37
1. Dietician referral (DM, L, HT)	Annually	1		
2. Diabetic retinal photography (DM)	Annually	1		
3. Diabetic foot screening (DM)	Annually			
4. Podiatry (DM)	2-weekly	24		
5. Psychotherapy‡ (DP)	6-weekly	8		
6. Physiotherapy (OA)	Monthly	12		
Laboratory tests			14.49	10.04
7. HbA1C (DM)	3-monthly	At clinician review		
8. Electrocardiography§ (DM, L, HT)	Annually	1§ (for all annual tests)		
9. Fasting lipid profile§ (L)	Annually			
10. Fasting blood glucose§ (DM)	Annually			
11. Urine albumin-to-creatinine ratio§ (DM)	Annually			
12. Urea and electrolytes§ (DM, HT)	Annually			
13. Serum creatinine§ (DM, HT)	Annually			
14. Lung function test§ (A)	Annually			
Patient education				
15. Diabetic self-management education with care manager (DM)	Annually	1	2.80	0.57
16. Diabetic footcare and footwear (DM)	With podiatrist during diabetic foot screening			
17. Asthma education (A)	With care manager/pharmacist during medication collection			
18. Psychoeducation (DP)	With psychologist during psychotherapy			
19. Osteoarthritis education (OA)	With physiotherapist during physiotherapy			
Others			20.01	4.93
20. Clinician review (A, DP, DM, L, HT, OA)	3-monthly	4		
21. Influenza vaccination (A)	Annually	1		
Total		53	211.09	108.91

Clinical practice guidelines used for each recommendation are indicated in brackets. *Inclusive of GST. †After Ministry of Health subsidy, with GST absorbed. ‡Comprises cognitive-behavioural therapy and problem-solving therapy. §Typically performed 1 week before clinical review. A: asthma; DP: depression; DM: diabetes mellitus; GST: goods and services tax; HT: hypertension; L: dyslipidaemia; OA: osteoarthritis

DISCUSSION

Similar to Mdm Wong, about one in ten older adults in Singapore has six or more chronic conditions (unpublished data from NHGP). The cumulative treatment plan from six CPGs has created a treatment burden that is time-consuming, costly and disruptive to her daily living. The CPGs also inadequately address the issues of older adults with multimorbidity and patient-centred care. Our results highlight the various shortcomings of single-disease CPGs when managing patients with multimorbidity in Singapore, a finding that is consistent with previous studies from other countries.[11,13,26]

Compared with a 2015 study in which patients with six conditions required up to 18 different medications,[12] Mdm Wong was prescribed 14 medications for her six conditions. This was due to differences in the selection of conditions and disease severity defined.[13] In addition, the cumbersome pharmacological regimen involving a high pill burden and the complexity associated with preparing a large number of medications every day adds to the treatment burden. Therefore, polypharmacy is associated with increased medication errors, adverse drug events, drug interactions and hospital admissions.[27] The 21 non-pharmacological recommendations for six conditions are comparable to those of previous studies,[11,13] with differences due to the varying number of chronic conditions and the disease severity defined.

Russell et al and Yen et al have conducted studies to examine the time spent on HRAs in the American and Australian setting, respectively.[22,28] In Singapore, ready-to-eat food and groceries are readily accessible close to residential areas, which may be different for patients residing in America and Australia. Therefore, in our study, Mdm Wong spends an average of 65 hours a month on HRAs, significantly lower than the 81 hours reported for six conditions by Buffel et al.[12] Furthermore, for polyclinic appointments, the median time estimates for waiting time and time spent receiving healthcare are ten minutes and 15–25 minutes, respectively. These operational values obtained from the NHGP are conservative compared to the mean values of 47 minutes and 72 minutes, respectively, in the American Time Use Survey.[28] Lastly, our patient had the option of bundled appointments. Compared to the average of seven appointments a

Table II. Pharmacological recommendations from clinical practice guidelines for Mdm Wong.

Drugs	Frequency	Pill burden (per day)	Unsubsidised cost* (per mth)	Subsidised cost† (per mth)
Asthma				
Seretide Evohaler (fluticasone/ salmeterol) 50/25 mg 2-puff BD	After breakfast, after dinner	4 (puffs)	38.00	8.30
Ventolin Evohaler (salbutamol) 100 mg 2-puff PRN‡	After breakfast	2 (puffs)		
Depression				
Fluvoxamine 20 mg OM	After breakfast	1	7.79	4.80
Diabetes mellitus				
Metformin 850 mg TDS	After breakfast, after lunch, after dinner	3	103.99	33.56
Glipizide 10 mg BD	Before breakfast, before dinner	4		
Insulin glargine 24 units ON	After dinner	1 (injection)		
Aspirin 100 mg OM	After breakfast	1		
Omeprazole 20 mg BD	Before breakfast, before dinner	2		
Dyslipidaemia				
Atorvastatin 40 mg OD	After breakfast	1	12.88	2.80
Hypertension				
Telmisartan 80 mg OD	After breakfast	1	25.92	16.48
Amlodipine 7.5 mg OD	After breakfast	1.5		
Osteoarthritis				
Glucosamine 500 mg TDS	After breakfast, after lunch, after dinner	3	48.06	34.00
Paracetamol 1,000 mg TDS PRN	After breakfast, after lunch, after dinner	6		
Kefentech plasters 1 BD PRN	After breakfast, after dinner	2 (plasters)		
Total		32.5§	236.64	99.94

*Inclusive of GST. †After Ministry of Health subsidy, with goods and services tax absorbed. ‡Assumes that Mdm Wong uses her Ventolin Evohaler daily before exercise. §Assumes that 1 injection/1 puff/1 plaster is equivalent to 1 pill. BD: twice daily; OD: once daily; OM: every morning; ON: every night; PRN: as needed; TDS: three times daily

Table III. Out-of-pocket treatment costs for Mdm Wong.

Component	Unsubsidised cost* (SGD)		Subsidised cost† (SGD)	
	Per mth‡	Annual	Per mth‡	Annual
Pharmacological	236.64	2,839.67	99.94	1,199.24
Non-pharmacological	211.08	2,533.01	108.91	1,306.90
Total	447.72	5,372.68	208.85	2,506.14
Out-of-pocket payment				
After PGP§	NA	NA	104.42	1,253.07
After CHAS¶	NA	NA	NA	713.07**

*Inclusive of GST. †After Ministry of Health subsidy, with GST absorbed. ‡Monthly costs were derived from annual costs divided across 12 months. §The PGP entitles patients to an additional 50% off their bill for subsidised services. ¶CHAS for the Pioneer Generation enables patients to make claims of up to SGD 135/visit and a maximum of SGD 540/year from their Medisave account. **Value reflected is the annual out-of-pocket payment by Mdm Wong after subsidy of almost 90% for her healthcare bill. CHAS: Community Health Assist Scheme; GST: goods and services tax; NA: not applicable; PGP: Pioneer Generation Package

month from Buffel et al,[12] Mdm Wong only requires an average of four appointments per month. In Singapore, the polyclinics providing public primary healthcare make multiple healthcare services available at a single site, thereby allowing patients to make minimal trips and save time travelling to each appointment. Nevertheless, the allied health services that are available vary between polyclinics, and most polyclinics do not house all services on-site. Hence, while it is theoretically possible to attend multiple appointments in a single sitting (e.g. psychologist, physiotherapist and podiatrist on the same day), our study has not reflected that.

We estimated that the annual out-of-pocket payment by Mdm Wong would be SGD 713.07 despite the heavy subsidies of almost 90% of her healthcare bill. Without subsidies, Mdm Wong would have to spend almost 70% of her annuity each month and SGD 5,372.68 annually on healthcare alone, excluding travel expenses and other indirect costs. The annual economic burden borne by the healthcare system is estimated to be SGD 15,148 per patient with multimorbidity in Singapore, with healthcare costs and social care costs increasing by SGD 2,265 and SGD 3,177, respectively, with each additional chronic condition.[29] Significant increases in healthcare utilisation and costs among patients with

Table IV. Applicability of clinical practice guidelines to older adults with multimorbidity and patient-centred care.

Question	Asthma	Depression	Diabetes mellitus	Dyslipidaemia	Hypertension	Osteoarthritis
Addresses older adults?	Yes Diagnosis of asthma, management of asthma, vaccinations	Yes Side effect of antidepressants, indications for psychiatry referral, management of depression, supportive care	Yes Initiation of oral hypoglycaemic agents, glycaemic targets	Yes Initiation of statins, dosage of statins, LDL treatment targets	Yes Postural BP monitoring, ambulatory BP monitoring, BP treatment targets, choice of antihypertensives	Yes Exercise, use of opioid analgesics, use of oral NSAIDs or COX-2 inhibitors, referral for joint surgery
Addresses patients with multimorbidity?	No	No	No	No	No	No
Addresses quality of evidence for older adults?	Yes Evidence Level B and D for pneumococcal and influenza vaccinations, respectively. 'Limited data on asthma medications in older adults as they are often excluded from major clinical trials'	Yes Grade D, Level 3 for side effects of antidepressants; Grade D, Level 4 for indications for psychiatry referral; Grade A, Level 1 and Grade B, Level 1 for management of depression; Grade B Level 1 for supportive care	Yes Grade D, Level 4 for both initiation of oral hypoglycaemic agents and glycaemic targets	Yes Grade D, Level 4 for initiation and dosage of statins; GPP for LDL treatment targets	Yes Grade A, Level 1 for BP Treatment Targets; Grade B, Level 2 for choice of antihypertensives; Grade D, Level 4 for postural BP monitoring; GPP for ambulatory BP monitoring	Yes 'Strong' recommendations for exercise; use of opioids; use of NSAIDs or COX-2 inhibitors; referral for joint surgery 'Studies often include patients who are not at high risk of drug side effects. Many studies have not included older adults.'
Addresses patients with a specific comorbidity?	Yes Obesity, GERD, anxiety, depression, food allergies and anaphylaxis, rhinitis, sinusitis and nasal polyps	Yes Arrhythmia, cardiac failure, hyponatraemia, personality disorder	Yes Ischaemic heart disease, hypertension, chronic kidney disease, chronic liver disease, acute coronary syndrome, heart failure, albuminuria, vascular disease, dyslipidaemia	Yes Impaired fasting glucose, impaired glucose tolerance, chronic kidney disease, chronic liver disease	Yes Diabetes mellitus, chronic kidney disease, albuminuria, obesity, stroke As a compelling indication: asthma, COPD, gout, bilateral RAS, stable angina, previous AMI, atrial fibrillation, heart block, peripheral arterial disease, aortic aneurysm	No
Discusses time needed to treat to benefit from treatment?	No	No	No	No	No	No
Discusses patients' goals and preferences?	Yes Long-term goals of management, choosing treatment options, stepping down treatment of well-controlled asthma, potential barriers to implementation	Yes Duration of maintenance treatment, decision to use psychotherapy, decision to use electroconvulsive therapy	Yes Medical nutritional therapy (diet and meal planning), choosing treatment options, glycaemic targets, adding lipid-lowering drug	Yes Initiating treatment in older adults	Yes Choice of antihypertensive	Yes Choosing treatment options and plan

AMI: acute myocardial infarction; BP: blood pressure; COPD: chronic obstructive pulmonary disease; GERD: gastro-oesophageal reflux disease; GPP: good practice points; LDL: low-density lipoprotein; NSAIDs: nonsteroidal anti-inflammatory drugs; RAS: renal artery stenosis

multimorbidity have been consistently demonstrated. According to a systematic review by Lehnert et al in 2011, total healthcare expenditures rose almost exponentially with the number of chronic conditions in several studies.[2] Healthcare costs were up to 5.5 times higher in patients with multimorbidity compared to those with none or only one chronic condition, and each additional chronic condition was associated with increased costs of USD 2,382 per year.[1]

Chronic conditions represent a lifetime burden that impact not only health services, but also patients and their caregivers who work to incorporate the increasingly complex treatment regimens into their daily lives.[10] Patients are significantly affected when they have to constantly juggle the demands of managing chronic conditions with other family, social and personal demands.[30] The healthcare workload is balanced against the patient's capacity to manage their own health.[31] When the healthcare workload exceeds the patient's capacity, they become overwhelmed by both the illness and treatment burden. Poor adherence, wasted resources and poor clinical outcomes ensue.[10] A patient-centred approach focuses on achieving patients' targets for life and health while imposing the minimal potential treatment burden on their lives[32] with an empathic and feasible treatment plan.[33] Clinicians must continuously consider whether what is 'asked of' patients is achieving their goals or those of the health system.[34]

In our study, all six CPGs include patients' goals and preferences. While many have advocated for personalised care, there is limited evidence on the best practices to achieve this.[11] One obvious barrier is the lack of information to aid clinical decisions, such as comparable information about the relative risks and benefits of different treatments. Future CPGs would need to incorporate the risks and benefits of prioritisation of care for each patient, while clinicians are trained to apply these principles.[35] One approach to personalise recommendations is to report a 'payoff time', the time over which patients must comply with treatment to achieve the proposed benefit.[36] For example, for a patient with diabetes mellitus and limited life expectancy who has difficulty achieving glycaemic targets on oral hypoglycaemic agents, the payoff time for preventing long-term complications using insulin should be balanced against the risk of hypoglycaemia and burden of regular blood glucose monitoring.[37] This helps to identify patients who may not benefit from recommendations that have immediate risks and delayed benefits.[36] If the payoff time is longer than the patient's life expectancy, a shared decision to remove a prescribed treatment can decrease treatment burden and improve patient-centred care.[37]

In our study, we found that there were a limited number of recommendations for older adults based on the highest level of evidence, and no recommendations for patients with multimorbidity. Currently, there is insufficient published evidence to guide clinicians in managing older adults with multimorbidity or supporting their preferences, as older adults are systematically excluded from clinical trials[38] despite having the highest prevalence of multimorbidity. In future trials, older adults should be included and shared decision-making between patients and clinicians investigated in order to close this gap.[39]

We found that although most CPGs address the increased risk of drug interactions and adverse effects in older adults, none elaborated further on common or high-risk interactions. Furthermore, although the hypertension CPG has an extensive list of comorbidities, most are suggested as 'compelling indications' for specific medications, with no elaboration. While elaborating in CPGs to address all situations is unrealistic, their generalisability can be improved. CPGs should be cross-referenced explicitly to identify and demonstrate how to streamline synergistic recommendations and reconcile contradictory ones.[13] Most importantly, future CPGs should move from a single-disease focus to a patient-centred approach. For example, the United Kingdom (UK) NICE guideline for multimorbidity explicitly recommends establishing the disease and treatment burden alongside patient preferences.[40]

Our study has several strengths. First, we identified local CPGs and used available time and cost data norms whenever possible to contextualise the treatment burden in a local setting. Secondly, we used median time norms to calculate time spent, which is more meaningful for data that is not normally distributed, compared to the use of mean values in previous studies.[12]

The present study also has some limitations. The full range of treatment burdens was not considered. Our hypothetical patient did not present with any disease exacerbations or acute intercurrent illnesses. Furthermore, we excluded recommendations that were not found in the six CPGs we adopted, such as age-appropriate cancer screening or vaccinations as well as the psychosocial aspects of her disease and treatment burden experienced. Therefore, the treatment burden we tabulated would not be realistic if Mdm Wong were to exist in real life.

In conclusion, current single-disease CPGs inadequately address the patient-centred care approach for older adults with multimorbidity. When applied cumulatively, they create an overwhelming treatment burden. Therefore, patients' goals and preferences must guide prioritisation of care such that treatment burden remains minimally disruptive to their lives. Developing future CPGs to deliver patient-centred rather than disease-focused care will be crucial to the management of multimorbidity.

ACKNOWLEDGEMENTS

SUPPLEMENTARY MATERIAL

The appendices are available online at https://doi.org/10.11622/smedj.2019109.

REFERENCES

1. Bähler C, Huber CA, Brüngger B, Reich O. Multimorbidity, health care utilization and costs in an elderly community-dwelling population: a claims data based observational study. BMC Health Serv Res 2015; 15:23.
2. Lehnert T, Heider D, Leicht H, et al. Review: health care utilization and costs of elderly persons with multiple chronic conditions. Med Care Res Rev 2011; 68:387-420.
3. Salisbury C, Johnson L, Purdy S, Valderas JM, Montgomery AA. Epidemiology and impact of multimorbidity in primary care: a retrospective cohort study. Br J Gen Pract 2011; 61:e12-21.
4. Mercer SW, Salisbury C, Fortin M. ABC of Multimorbidity (ABC Series). 1st ed.

UK: John Wiley & Sons Ltd, 2014.

5. Guthrie B, Payne K, Alderson P, McMurdo ME, Mercer SW. Adapting clinical guidelines to take account of multimorbidity. BMJ 2012; 345:e6341.

6. Gallacher K, May CR, Montori VM, Mair FS. Understanding patients' experiences of treatment burden in chronic heart failure using normalization process theory. Ann Fam Med 2011; 9:235-43.

7. Gijsen R, Hoeymans N, Schellevis FG, et al. Causes and consequences of comorbidity: a review. J Clin Epidemiol 2001; 54:661-74.

8. Wolff JL, Starfield B, Anderson G. Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. Arch Intern Med 2002; 162:2269-76.

9. Ministry of Health, Singapore. Ageing in Place in Singapore. Available at: http://www.gs.org.sg/sg50conference/pdf/s4-1.pdf. Accessed August 26, 2019.

10. May C, Montori VM, Mair FS. We need minimally disruptive medicine. BMJ 2009; 339:b2803.

11. Boyd CM, Darer J, Boult C, et al. Clinical practice guidelines and quality of care for older patients with multiple comorbid diseases: implications for pay for performance. JAMA 2005; 294:716-24.

12. Buffel du Vaure C, Ravaud P, Baron G, et al. Potential workload in applying clinical practice guidelines for patients with chronic conditions and multimorbidity: a systematic analysis. BMJ Open 2016; 6:e010119.

13. Hughes LD, McMurdo ME, Guthrie B. Guidelines for people not for diseases: the challenges of applying UK clinical guidelines to people with multimorbidity. Age Ageing 2013; 42:62-9.

14. CPF Advisory Panel, Central Provident Fund, Singapore. Chapter 2: The Retirement Payouts and Sums. Available at: https://services.mom.gov.sg/cpfpanel/media/recommendations/part1/Chapter%202_The%20Retirement%20Payouts%20and%20Sums.pdf. Accessed August 25, 2018.

15. Ministry of Health, Singapore. Chronic Disease Management Programme. Handbook for Healthcare Professionals 2018. Available at: https://www.primarycarepages.sg/Documents/Practice%20Management/CDMP%20Handbook%20for%20Healthcare%20Professionals%202018.pdf. Accessed August 25, 2018.

16. Ministry of Health, Singapore. MOH Clinical Practice Guidelines on Diabetes Mellitus. 2014. Available at: https://www.moh.gov.sg/hpp/doctors/guidelines/GuidelineDetails/cpgmed_diabetes_mellitus. Accessed August 30, 2018.

17. Ministry of Health, Singapore. MOH Clinical Practice Guidelines on Lipids. 2016. Available at: https://www.moh.gov.sg/hpp/doctors/guidelines/GuidelineDetails/cpgmed_lipids. Accessed August 30, 2018.

18. Ministry of Health, Singapore. MOH Clinical Practice Guidelines on Hypertension. 2017. Available at: https://www.moh.gov.sg/hpp/doctors/guidelines/GuidelineDetails/cpgmed_hypertension. Accessed August 30, 2018.

19. 2018 GINA Report, Global Strategy for Asthma Management and Prevention. In: Global Initiative for Asthma [online]. Available at: https://ginasthma.org/gina-reports/. Accessed August 30, 2018.

20. Ministry of Health, Singapore. MOH Clinical Practice Guidelines on Depression. 2012. Available at: https://www.moh.gov.sg/docs/librariesprovider4/guidelines/depression-cpg_r14_final.pdf. Accessed August 30, 2018.

21. National Clinical Guideline Centre (UK). Osteoarthritis: Care and Management in Adults. London: National Institute for Health and Care Excellence (UK); 2014.

22. Yen LE, McRae IS, Jowsey T, Bagheri N. Time spent on health related activity by older Australians with diabetes. J Diabetes Metab Disord 2013; 12:33.

23. Safford MM, Russell L, Suh DC, Roman S, Pogach L. How much time do patients with diabetes spend on self-care? J Am Board Fam Pract 2005; 18:262-70.

24. Ministry of Finance, Singapore. Overview: Pioneer Generation Package. Available at: https://www.pioneers.sg/en-sg/Pages/Overview.aspx. Accessed September 15, 2018.

25. Community Health Assist Scheme, Singapore. CHAS Subsidies. Available at: https://www.chas.sg/content.aspx?id=636. Accessed September 15, 2018.

26. Mutasingwa DR, Ge H, Upshur RE. How applicable are clinical practice guidelines to elderly patients with comorbidities? Can Fam Physician 2011; 57:e253-62.

27. Maher RL, Hanlon J, Hajjar ER. Clinical consequences of polypharmacy in elderly. Expert Opin Drug Saf 2014; 13:57-65.

28. Russell LB, Ibuka Y, Carr D. How much time do patients spend on outpatient visits?: the American time use survey. Patient 2008; 1:211-22.

29. Picco L, Achilla E, Abdin E, et al. Economic burden of multimorbidity among older adults: impact on healthcare and societal costs. BMC Health Serv Res 2016; 16:173.

30. Jeon YH, Jowsey T, Yen L, et al. Achieving a balanced life in the face of chronic illness. Aust J Prim Health 2010; 16:66-74.

31. Shippee ND, Shah ND, May CR, Mair FS, Montori VM. Cumulative complexity: a functional, patient-centered model of patient complexity can improve research and practice. J Clin Epidemiol 2012; 65:1041-51.

32. Leppin AL, Montori VM, Gionfriddo MR. Minimally disruptive medicine: a pragmatically comprehensive model for delivering care to patients with multiple chronic conditions. Healthcare (Basel) 2015; 3:50-63.

33. Boehmer KR, Gionfriddo MR, Rodriguez-Gutierrez R, et al. Patient capacity and constraints in the experience of chronic disease: a qualitative systematic review and thematic synthesis. BMC Fam Pract 2016; 17:127.

34. Trevena L. Minimally disruptive medicine for patients with complex multimorbidity. Aust J Gen Pract 2018; 47:175-9.

35. Garber AM. Evidence-based guidelines as a foundation for performance incentives. Health Aff (Millwood) 2005; 24:174-9.

36. Braithwaite RS, Fiellin D, Justice AC. The payoff time: a flexible framework to help clinicians decide when patients with comorbid disease are not likely to benefit from practice guidelines. Med Care 2009; 47:610-7.

37. Wyatt KD, Stuart LM, Brito JP, et al. Out of context: clinical practice guidelines and patients with multiple chronic conditions: a systematic review. Med Care 2014; 52 Suppl 3:S92-S100.

38. McMurdo ME, Witham MD, Gillespie ND. Including older people in clinical research. BMJ 2005; 331:1036-7.

39. Elwyn G, Edwards A, Britten N. What information do patients need about medicines? "Doing prescribing": how doctors can be more effective. BMJ 2003; 327:864-7.

40. The National Institute for Health and Care Excellence. Multimorbidity: clinical assessment and management. NICE guideline [NG56]. 2016. Available at: https://www.nice.org.uk/guidance/ng56. Accessed September 5, 2018.

APPENDIX 1

Clinical practice guideline recommendations for 72-year-old hypothetical patient.

Disease (Publisher, Yr)	Recommendation

Asthma (Global Initiative for Asthma [GINA], 2018)	**Non-pharmacological**
	• Patient education
	   1. Asthma information
	   2. Inhaler technique/skills
	   3. Adherence
	• Asthma self-management
	   1. Written asthma action plan
	   2. Self-monitoring of symptoms and/or lung infection
	   3. Regular medical review
	• Diet (high in fruits and vegetables)
	• Smoking cessation/avoidance of exposure to tobacco smoke
	• Exercise (with advice on management of exercise-induced bronchoconstriction)
	• Weight loss if obese
	   1. Weight reduction programme plus twice-weekly aerobic and strength exercises
	   2. Quantity of weight loss unspecified
	• Avoidance of exacerbating factors
	   1. Avoid occupational sensitisers for occupational asthma
	   2. Avoid medications that may make asthma worse
	   3. Avoid indoor air pollution
	   4. Avoid outdoor allergens
	   5. Avoid outdoor air pollutants
	• Annual influenza vaccination (but not pneumococcal vaccination)
	• Breathing exercises as an adjunct

	Pharmacological • See GINA's stepwise approach for pharmacological therapy of asthma • Allergen immunotherapy for adult patients with allergic rhinitis and sensitised to house dust mites
	Monitoring • Self-monitoring of symptoms and/or peak expiratory flow • A written asthma action plan • Regular medical review

	Follow-up
	• Within 1–3 mth after starting treatment/step up/step down and every 3–12 mth after that
	• Within 1–2 wk after self-managed exacerbation
	• Within 1 wk (2–7 days) after exacerbation
	• At every visit
	   1. Assess asthma control, i.e. 2 components:
	     ▪ Symptom control (questionnaires, e.g. asthma control test)
	     ▪ Risk factors for poor outcome
	   2. Treatment issues
	     ▪ Response to treatment
	     ▪ Side effects of treatment
	     ▪ Step up or down accordingly
	     ▪ Modifiable risk factors for exacerbation, including smoking cessation if applicable
	     ▪ Inhaler techniques
	     ▪ Adherence
	     ▪ Written asthma action plan
	     ▪ Patient's attitude and goals
	   3. Lung function test at least once every 1–2 yr

Depression (Ministry of Health Singapore, 2012)	**Non-pharmacological** • Psychoeducation

Disease (Publisher, Yr)	Recommendation

	1. Patient education about disease ('depression should be explained as a medical illness that is associated with changes in neurochemicals and brain functioning')
	   2. Lifestyle changes such as exercise and stress reduction
	• Psychotherapy
	   1. Cognitive behavourial therapy for distorted negative thoughts
	   2. Interpersonal therapy for interpersonal difficulties
	   3. Psychodynamic-interpersonal therapy for interpersonal difficulties
	   4. Problem-solving therapy for primary care patients with mild depression
	• Family intervention
	   1. Family involvement where indicated and with patient's agreement
	   2. Marital or couple therapy for significant marital distress
	• Supportive care for older adults and their caregivers

	Pharmacological
	• Antidepressants
	   1. SSRIs (1st line)
	   2. Serotonin-noradrenaline reuptake inhibitors
	   3. Tricyclic antidepressants
	   4. Noradrenergic and specific serotonergic antidepressants
	   5. Noradrenaline-dopamine reuptake inhibitor
	• Depression in older adults
	   1. Mild/moderate: SSRI or psychotherapy
	   2. Severe: SSRI and psychotherapy
	Adjuncts
	• Lithium augmentation
	• Thyroid hormone augmentation (levothyroxine or triiodothyronine)

	Monitoring NA
	Follow-up Frequency of visits not specified and depends on the severity of the depression, suicide risk, the patient's cooperation and the availability of social support

Diabetes mellitus (Ministry of Health Singapore, 2014)	**Non-pharmacological**
	• Diet (medical nutritional therapy in consultation with dietician)
	   1. Balanced diet (50%–60% carbohydrate, 15%–20% protein, < 30% fat)
	   2. Trans fat < 1%, cholesterol < 200 mg/day (same as general population)
	   3. Dietary fibre 20–35 g/day
	   4. Consistently distributed carbohydrate intake through the day
	   5. Low protein if CKD present (reduce to 0.8–1.0 g/kg/day)
	   6. Salt < 2 g/day if hypertension
	• Gradual weight loss of 5%–10% body weight if overweight/obese (0.25–1.0 kg/wk)
	• Smoking cessation
	• Alcohol abstinence of no more than 3 drinks/day (male) or 2 drinks/day (female)
	• Exercise
	   1. At least 150 min/wk
	   2. Moderate-to-vigorous aerobic exercise
	   3. Over ≥ 3 days of the week
	   4. No more than 2 consecutive days
	• Foot care
	   1. Foot care education and footwear advice
	   2. Use of appropriate footwear
	   3. Daily foot checks
	• Diabetes mellitus self-management education
	• Assessment of psychological and social well-being

	Pharmacological • Oral hypoglycaemia agents 1. Metformin as 1st line

Disease (Publisher, Yr)	Recommendation
	2. Sulfonylurea/dipeptidyl peptidase-4 inhibitor/alpha-galactosidase inhibitor are acceptable alternatives as 1st line • Insulin as appropriate • Lipids: statins if appropriate • BP: ACE-I or ARB if appropriate • Low-dose aspirin for primary prevention if appropriate
	Monitoring Self-monitoring of blood glucose (frequency unspecified)
	Follow-up • At every visit, measure HbA1c, BP and BMI and evaluate self-monitoring of blood glucose • Measure HbA1c ever 3–6 mth • Measure fasting lipids and serum creatinine at least annually • Urine albumin excretion, diabetic retinal photography/ophthalmology referral and foot examination (distal pulses) done annually

Dyslipidaemia (Ministry of Health Singapore, 2016)	**Non-pharmacological**
	• Diet
	  1. Rich in wholegrain foods, vegetables, fruits, legumes, nuts, fish, unsaturated oils
	  2. Low in trans fat, saturated fat, cholesterol, refined grains
	  3. Total fat intake 25%–34%, saturated fat < 7%, polyunsaturated fat ~ 10%
	  4. Trans fat < 1% or < 2 g/day, cholesterol < 300 mg/day
	  5. Simple sugars (monosaccharides and disaccharides) < 10% if high triglycerides
	  6. 25–30 g/day dietary fibre (increasing whole grains, fruits and vegetables, and reducing processed grains and sugar)
	  7. Saturated fat should be replaced with mono- and polysaturated fat
	• Weight loss if BMI > 23 kg/m^2
	• Smoking cessation
	• Alcohol abstinence of no more than 3 drinks/day (male) or 2 drinks/day (female)
	• Exercise
	  1. 30–60 min/day (150–300 min/wk)
	  2. Moderate-intensity aerobic exercise
	  3. 5–7 days a week

	Pharmacological
	• Lipid-lowering agents
	  1. Statins
	  2. Ezetimibe
	  3. Resins (bile acid sequestrants)
	  4. Fibrates
	  5. Niacin
	  6. Omega-3 fish oil
	• Choice of lipid-lowering agent based on which lipid profile is deranged

	Monitoring NA
	Follow-up Aspartate transaminase, alanine transaminase and creatine kinase measured at baseline and repeated only if symptomatic

Hypertension (Ministry of Health Singapore, 2017)	**Non-pharmacological**
	• Diet
	  1. Increase vegetables, fruits and low-fat dairy products
	  2. Decrease saturated and total fats
	  3. Low salts (5–6 g/day)
	• Weight loss to BMI < 23 kg/m^2 and waist circumference < 90 cm (male) or < 80 cm (female)
	• Smoking cessation
	• Alcohol abstinence of no more than 2 drinks/day (male) or 1 drink/day (female)

Disease (Publisher, Yr)	Recommendation

	• Exercise
	   1. At least 30 min/day (150 min/wk)
	   2. Moderate-intensity dynamic exercise
	   3. 5–7 days a week
	• Patient education
	   1. Lifestyle modification
	   2. Medication adherence

	Pharmacological
	• Antihypertensive agents
	   ▪ ACE-I
	   ▪ ARB
	   ▪ Diuretics (loop, thiazide, thiazide-like)
	   ▪ Calcium-channel blocker
	   ▪ Beta blockers
	• Consider compelling indications

	Monitoring Home BP monitoring not mentioned except for white-coat hypertension
	Follow-up • At every visit, check patient education on lifestyle modification and medication adherence • BP monitoring every 3–12 mth • BMI, fasting glucose, fasting lipid profile, urea and electrolytes, creatinine, and urine albumin excretion measured at least annually, or more frequently as per individual risk profile • ECG as per individual risk and cardiac profile

Osteoarthritis (National Institute for Health and Care Excellence, 2014)	**Non-pharmacological**
	• Patient education
	• Exercise
	   1. Local muscle strengthening
	   2. General aerobic fitness
	   3. Manipulation and stretching as adjunct
	• Weight loss if overweight or obese
	• Appropriate footwear (with shock-absorbing properties_
	• Activity pacing
	Adjuncts
	• Thermotherapy
	• Transcutaneous electrical nerve stimulation for pain relief
	• Bracing, joint supports or insoles for pain/instability
	• Assistive devices (walking sticks, tap turners) if there are problems with activities of daily living

	Pharmacological
	• Topical analgesia
	   1. Topical NSAIDs
	• Oral analgesia
	   1. Paracetamol
	   2. Oral NSAIDs
	   3. COX-2 inhibitors
	   4. Opioids
	• Proton pump inhibitor co-prescribed with oral NSAIDs/COX-2 inhibitors
	Adjuncts
	• Topical capsaicin
	• Intra-articular corticosteroid injections

	Monitoring NA
	Follow-up • Annual follow-up if troublesome joint pain, more than 1 joint with symptoms, more than 1 comorbidity or taking regular medications for OA

Disease (Publisher, Yr)	Recommendation
	At every visit: 1. Monitor symptoms and ongoing impact on activities of daily living and quality of life 2. Monitor long-term course of the condition 3. Discuss patient's knowledge of the condition, ideas, concerns, expectations, preferences and access to healthcare 4. Effectiveness and tolerability of treatment 5. Support self-management

ACE-I: angiotensin-converting enzyme inhibitor; ARB: angiotensin II receptor blocker; BMI: body mass index; BP: blood pressure; CKD: chronic kidney disease; ECG: electrocardiography; HbA1c: glycated haemoglobin; NSAID: nonsteroidal anti-inflammatory drug; SSRI: serotonin-specific reuptake inhibitors

APPENDIX 2

Chronic conditions selected from the Chronic Disease Management Programme:[15]

Conditions with established disease management programmes (requiring reporting of clinical indicators):
1. Diabetes mellitus and pre-diabetes mellitus*
2. Hypertension*
3. Lipid disorders*
4. Asthma*
5. Chronic obstructive pulmonary disease
6. Chronic kidney disease (nephritis/nephrosis)

Mental illnesses (requiring participation of clinic/doctor in a shared care programme):
7. Schizophrenia
8. Major depression*
9. Bipolar disorder
10. Anxiety

Other chronic conditions:
11. Stroke
12. Dementia
13. Osteoarthritis*
14. Parkinson's disease
15. Benign prostatic hyperplasia
16. Epilepsy
17. Osteoporosis
18. Psoriasis
19. Rheumatoid arthritis
20. Ischaemic heart disease

Chronic conditions selected.

Selected chronic conditions and CPGs

Guideline focus	Title	Organisation	Yr
Asthma	Global Strategy for Asthma Management and Prevention	Global Initiative for Asthma	2018
Depression	Depression	Ministry of Health Singapore	2012
Diabetes mellitus	Diabetes mellitus	Ministry of Health Singapore	2014
Dyslipidaemia	Lipids	Ministry of Health Singapore	2016
Hypertension	Hypertension	Ministry of Health Singapore	2017
Osteoarthritis	Osteoarthritis: Care and Management in Adults	National Institute for Health and Care Excellence	2014

APPENDIX 3

Overall time spent on health-related activities.

Time spent on activity	Median time (min/day)	Time spent (hr/mth)	Time spent (hr/day)
Taking medications*	24.0	12.00	0.40
Following diet†	32.0	16.00	0.53
Home monitoring	17.3	8.67	0.29
Exercise‡	60.0	20.00	0.67
Attending appointments (without buffer)§	–	5.62	0.19
Attending appointments (with buffer)§	–	7.87	0.26
Total without buffer time	–	62.28	2.08
Total with buffer time	–	64.53	2.15

*Composite of three components: time to sort medications, prepare medications and take medications. Median time was derived from 20 min/day spent by patients with > 10 medications(22) and 4 min/episode of insulin administration.(23) †Composite of two components: time to prepare food and shopping for food. Median time was derived from 30 min/day for preparing food and 1 hr/mth (2 min/day) for shopping for food.(22) ‡Composite of two components: time spent engaging in exercise itself and time spent on preparation and wash-up. We assume that our hypothetical patient spends 30 min a day engaging in exercise for 5 days/wk (20 days/mth) as per CPG recommendations. We arbitrarily decided that time spent on preparation and wash-up amounts to 30 min/session. This is because clinicians will likely recommend water-based physical activities instead of land-based activities given our patient's bilateral osteoarthritis of the knees. §Composite of three components: travelling time, waiting time and time for the appointment itself. Values were derived from our calculations using operational time norms from National Healthcare Group Polyclinic

APPENDIX 4

Time spent attending appointments

Activity/care	Time (min/unit activity)		Frequency of activity (times/yr)	Time (hr/mth)	
	Without buffer	With buffer*		Without buffer	With buffer*
Clinician review + HbA1c	95	125	4	0.53	0.69
Travel[†]	30				
Clinical review[‡,§]	25				
HbA1c[‡]	15				
Collect medications (pharmacy)[‡]	15				
Check out	10				
Influenza vaccination	55	85	1	0.08	0.12
Travel[†]	30				
Administer influenza vaccine[‡]	15				
Check out	10				
Dietician referral	65	95	1	0.09	0.13
Travel[†]	30				
Dietician review[‡]	25				
Check out	10				
Diabetic foot screening + diabetic retinal photography	90	120	1	0.13	0.17
Travel[†]	30				
Diabetic foot screening[‡]	25				
Diabetic retinal photography[‡]	25				
Check out	10				
Podiatry session	65	95	24	2.17	3.17
Travel[†]	30				
Podiatrist review[‡]	25				
Diabetic foot education					
Check out	10				
Psychology session	95	125	8	1.06	1.39
Travel[†]	30				
Psychotherapy	55				
Psychoeducation					
Check out	10				
Physiotherapy session	80	110	12	1.33	1.83
Travel[†]	30				
Physiotherapy[‡]	40				
Osteoarthritis education					
Check out	10				
DM self-education management	65	95	1	0.09	0.13
Travel[†]	30				
DSME itself[‡]	25				
Check out	10				
Asthma education[§]	15	45	1	0.02	0.06
Investigations/laboratory tests	95	125	1	0.13	0.17
Travel[†]	30				
Electrocardiography	15				
Fasting lipid profile	15[§]				
Fasting blood glucose					
Urine albumin-creatinine ratio					
Urea and electrolytes					
Serum creatinine					
Lung function test	25				
Check out	10				
Total time spent				5.62	7.87

*For each appointment, we calculated time spent as if more time was required due to unforeseen circumstances, such as missing the bus or exceptionally high patient volume in the polyclinics. This 'buffer time' was arbitrarily decided to be 30 min. †We arbitrarily decided that our hypothetical patient lives 15 min away from the neighbourhood polyclinic. Travelling time of 30 min indicated is for two-way travel from home to polyclinic and back. ‡Time indicated is inclusive of waiting time of 10 min, an approximation of median waiting time data obtained from operational data from NHGP. §Specific activities: (a) time spent on clinical review with the clinician was taken to be 15 min excluding waiting time, an approximation of median consultation time obtained from operational data from NHGP; (b) time spent on performing all haematological investigations was taken to be 5 min, excluding waiting time, as they would be done in the same sitting; and (c) for asthma education, time spent excludes travelling time, as the patient travels to the care manager during diabetic self-management education or the pharmacist during medication collection and it is not considered a separate appointment. DM: diabetes mellitus; DSME: diabetes self-management education; NHGP: National Healthcare Group Polyclinics

Time spent on home monitoring.

Home monitoring activity	Median time (min/unit activity)	Frequency (times/wk)	Time (min/mth)	Time (hr/mth)
Capillary blood glucose*	5	3	60	1.00
Foot check†	10	7	280	4.67
BP monitoring‡	10	1	40	0.67
Asthma symptoms/PEF§	5	7	140	2.33
Total time spent			520	8.67

*Time taken for capillary blood glucose monitoring was obtained from the literature.(22) †Time taken for foot care was obtained from the literature.(23) ‡We assumed that the time taken for BP monitoring is 10 min each, as most protocols recommend 5 min of rest before measurement and taking ≥ 2 readings with a full minute in between. §To our knowledge, there are no studies on time taken for asthma self-monitoring. We assumed that the time taken for disease monitoring of a single chronic condition is approximately 5 min/day, similar to capillary blood glucose monitoring. BP: blood pressure; PEF: peak expiratory flow