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PERSPECTIVE

'Patient-Centered Care' for Complex Patients with Type 2 Diabetes Mellitus—Analysis of Two Cases

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Abstract

Purpose: This paper serves to apply and compare aspects of person centered care and recent consensus guidelines to two cases of older adults with poorly controlled diabetes in the context of relatively similar multimorbidity.

Methods: After review of the literature regarding the shift from guidelines promoting tight control in diabetes management to individualized person centered care, as well as newer treatment approaches emerging in diabetes care, the newer guidelines and potential treatment approaches are applied to the cases.

Results: By delving into the clinical, behavioral, social, cultural and economic aspects of the two cases in applying the new guidelines, divergent care goals are reached for the cases.

Conclusions: Primary care practitioners must be vigilant in providing individualized diabetes treatment where multiple chronic illnesses increase the complexity of care. While two older adults with multimorbidity may appear at first to have similar care goals, their unique preferences and support systems, as well as their risks and benefits from tight control, must be carefully weighed in formulating the best approach. Newer pharmaceutical agents hold promise for improving the possibilities for better glycemic control with less self-care burden and risk of hypoglycemia.

Keywords: "person centered care", diabetes, elderly, emerging pharmacotherapy, primary care, multimorbidity

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Introduction

When a primary care practitioner (PCP) sees a patient with diabetes, a wealth of information must be synthesized before reaching an individualized plan of care. This paper follows the process the PCP might follow when seeing two older adults with poorly controlled diabetes in the context of broader clinical complexity and applying principles of person centered care and newer diabetes guidelines. By moving beyond the literature to apply the information to real world practice, the critical thinking involved in individualizing primary care is highlighted.

Mr. A is a 70-year-old African American man with a 20-year history of T2DM. His A1c of 8.7% (72 mmol/mol) is stable from six months ago. He has a history of multiple chronic diseases, including coronary artery disease, and takes more than ten prescription medications. He also has a history of requiring treatment in the emergency room for hypoglycemia five years ago during treatment for throat cancer. He has a high school education and works three nights per week at a megastore. He has missed some medical appointments and readily admits to missing some doses of his medications. When the PCP saw him six months ago, he had recently separated from his wife. Just how much improvement in his diabetes control can the PCP safely and reasonably prescribe for him?

The next patient is Mrs. B. She is also age 70 years, has a 20-year history of T2DM, and also has an A1c of 8.7% (72 mmol/mol). Her medical history is complicated by emphysema and musculoskeletal problems, for which she takes a myriad of prescription medications. However, she is a retired school teacher who has been very observant about her blood glucose levels and compliant in her medications, has a comfortable retirement income, and a very devoted spouse. Can and should the PCP control her glucose more rigorously? What are the critical differences in these cases, if any, that define the different treatment approaches?

These are the common cases seen in primary care since elderly patients comprise approximately half of the population diagnosed with T2DM.[1] Extensive prospective studies, such as the United Kingdom Prospective Diabetes Study (UKPDS), have associated glucose control among persons with T2DM with reduced progression of diabetes complications.[2] This has driven the development of guidelines to encourage all clinicians to work toward A1c goals of 7% or less in their patients. However, the Action to Control Cardiovascular Disease in Diabetes (ACCORD) study revealed an increased cardiovascular mortality rate in intensively treated patients, as well as a minimal benefit to the burden of intensive treatment.[3,4] Some argue that there is a greater risk than benefit to tight control among geriatric patients.[5] The American Diabetes Association (ADA) altered its target glucose goals for the elderly in 2013 to recommend that practitioners individualize therapy.[6] Yet, how to accomplish this goal in a busy primary care office remains elusive for most practitioners.

In 2012, the ADA and the European Association for the Study of Diabetes (EASD) issued a position statement for the management of hyperglycemia advocating a "patient centered approach."[7] In addition to reiterating the importance of diet, exercise, and metformin, the guideline suggests combination therapy with additional oral agents or insulin to reach individualized goals. It also cites a proposal that clinicians should consider seven major aspects of care to help guide the clinician toward or away from stringent care (Table 1).[8] In light of the fact that diabetes prevalence increases with age, when multimorbidity and geriatric syndromes further complicate therapy, the American Geriatrics Society (AGS) and ADA wrote a consensus statement published late in 2012 further advocating a person-centered approach to diabetes care.[4]

Person-Centered Care

The Institute of Medicine (IOM) has identified multiple pillars of patient-centered care, listed in Table 2.[9] The IOM considers care to be patient-centered if it is "respectful of and responsive to individual patient preferences, and ensures that patient values guide all clinical decisions."[9] However, it has been suggested that what patients want for simplicity and quality of

Table 1. Aspects of care to consider in managing T2DM per the EASD/ADA 2012 position statement.

1. Patient attitude and treatment efforts
2. Risks associated with hypoglycemia
3. Disease duration
4. Life expectancy
5. Important co-morbidities
6. Established vascular complications
7. Available social support and resources

Table 2. The Institute of medicine's pillars of patient-centered care.

Access to care
Respect for patient preferences
Health education
Communication about medications
Coordination of care, involvement of the family
Emotional support of the patient and family
Provision of pain management/promotion of physical comfort
Continuity of care across settings

life may not align with treatments that reduce their risk of further disease, leading to misuse of insurance funds.[10] For instance, patients may request avoidance of insulin when it is the best way to control their blood glucose and lessen diabetes complications. In hospice care, the shift away from aggressive medical care and life extension to focusing on patient comfort and quality of life leads to reduced costs and greater patient satisfaction and quality of life. However, at what point this shift occurs in the longer trajectory of chronic diabetes care is less clear. Thus, more research is needed to examine how providers can establish therapeutic plans that best fit patients' values without leading to excess costs or adverse outcomes.

Multimorbidity, Comorbidity, and Risk: Benefit Ratio of Tight Control

While definitions can vary in the literature, multimorbidity is defined as the condition in which a person has two or more chronic illnesses,[11] whereas comorbidity is a medical condition that causes or is caused by another condition.[12] T2DM, by its nature, has several comorbidities. At least 90% of persons with diabetes have T2DM, in which a myriad of genetic and environmental factors converge to produce an insulin-resistant phenotype that progresses to beta cell failure. During its complex pathogenesis, hyperglucagonemia results in excess hepatic glucose production despite increased beta cell insulin secretion. This contributes to "metabolic syndrome," wherein abnormal triglyceride formation and accelerated lipolysis contributes to dyslipidemia, oxidative stress, and atherosclerotic vascular disease.[13] Together, these comorbidities quadruple a person's risk of vascular disease endpoints, including myocardial infarction and stroke.[3] These comorbidities also benefit from similar lifestyle modifications if instituted early in the course of illness, such as a Mediterranean-style diet, aerobic exercise, and weight management.

In comparison, multimorbidity refers more to the situation in which a person has more than one chronic condition, which are not necessarily inter-related. Multimorbidity is a common problem in the elderly that is significantly associated with higher mortality, increased disability, and functional decline, particularly among populations of lower socioeconomic status.[11] Recent studies of multimorbidity have shed light on diabetes care in the context of other diseases. The Medical Expenditure Panel Survey found that almost nine in ten persons with diabetes reported an additional chronic illness, and one in seven reported four or more.[14] The presence of two or more chronic conditions in an adults with diabetes significantly increases the odds that he or she will also have major depression, which negatively effects engagement in self-care.[15] In designing improved models of health care delivery, assessment of a patient's unique constellation of multimorbidity, including aspects of mental health, helps practitioners move away from purely disease-focused care and toward patient-centered care.

There is increasing evidence that cognitive impairment is more prevalent in adults with long-standing T2DM.[16] In fact, dementia is emerging as a late-life complication.[7] The prevalence of dementia among older adults with diabetes is approximately twice that of the general population,[17] with hyperglycemia appearing to be the primary culprit,[18] though recurrent hypoglycemia is also associated with cognitive impairment. Ironically, a person with cognitive decline neither senses nor treats hypoglycemia well, resulting in greater neuroglycopenia and creating a vicious cycle of cognitive decline, hypoglycemia, and hypoglycemia unawareness. Hypoglycemia is especially dangerous for elderly persons, many of whom have a blunting of the adrenergic symptoms (shakiness, hunger, irritability, sweating, and tachycardia), which signal the need for prompt intervention. Without these protective symptoms, neuroglycopenia can manifest with injurious outcomes including delirium, falls, seizures, and arrhythmias.[19]

Diabetes has particularly been associated with loss of executive function among older adults with

cognitive decline;[12] executive dysfunction translates to loss of a critical capacity to plan and carry out complex diabetes care, such as planning meals, taking exercise snacks, or altering medications or carbohydrates to control blood glucose. Once cognitive loss has occurred, there is a decline in a person's ability to self manage both hyper- and hypoglycemia. Hypoglycemia is problematic for all persons with diabetes and can lead to further difficulties with weight control among those with T2DM and obesity, since carbohydrates must be ingested to prevent and treat it.

Simply relaxing glucose goals is not sufficient to protect the elderly from hypoglycemia according to a study by Munshi et al.[20] Among a sample of 40 older adults with a mean age of 75 years, and mean A1c of 9.2%, the majority of subjects had more than one episode of hypoglycemia during 72 hours of blinded continuous glucose monitoring, indicating that elevated glycohemoglobin levels do not necessarily translate to hypoglycemia avoidance. Older persons with diabetes require comprehensive coordinated care to ensure that the management of all their multimorbidities does not increase their risk of hypoglycemia. For instance, the use of beta blockers, a matter of protocol for many heart patients, may increase the risk of hypoglycemic unawareness.

Older adults have a higher prevalence of adverse drug reactions due to polypharmacy, altered pharmacokinetics associated with aging, and decline in renal function.[21] Liver function must also be taken into consideration since fatty liver is common in T2DM. The Beers criteria were created to limit adverse outcomes by educating clinicians about inappropriate prescription of medications in older adults. These criteria were recently updated after extensive review of more recent prescribing patterns and adverse outcomes.[22,23] Among older adults hospitalized for medication overdose, insulin and oral hypoglycemic agents (OHAs) rated second and fourth, respectively, on the list of causative agents.[24] Glitazones, once heralded as the new insulin sensitizers for the millions of people with insulin resistance, have been associated with weight gain, fluid retention, reduced bone density, and increased bladder cancer. Thus, a framework of individualizing a patient's evolving multimorbidity is critical for balancing the risks and benefits of care. Only then can coordinated care result in better patient outcomes.

Framework for Multimorbidities and Stratification of Diabetes Care Goals

Piette and Kerr created a framework dividing multiple chronic conditions into three categories: (a) concordant (illnesses which share similar pathogenesis and management as diabetes such as cardiovascular disease), (b) discordant (where the illness is unrelated, yet whose management may be at odds with diabetes care, such as musculoskeletal disease or mental illness), and (c) dominant illnesses, whose severity overshadows diabetes care (such as end-stage renal failure or metastatic cancer).[25] Dementia often evolves to a dominant illness since the burden of care shifts to family members and avoidance of hypoglycemia is more critical.

The ADA advocates for a proactive team approach in diabetes care engendering informed and activated patients in a chronic care model, yet this approach has not gained the traction needed to change the manner in which patients receive care.[6] To move in this direction, providers need to understand and speak the language of chronic illness management, multimorbidity, and coordinated care in a framework of care that incorporates patients' abilities and values while minimizing risk.

The ADA/AGS consensus breaks diabetes treatment goals into three strata based on the following patient characteristics: for patients with few co-existing chronic illnesses and good physical and cognitive functional status, they suggest a target A1c of under 7.5%, given their longer remaining life expectancy. Patients with multiple chronic conditions, two or more functional deficits in activities of daily living (ADLs), and/or mild cognitive impairment may be targeted to 8% or lower given their treatment burden, increased vulnerability to adverse effects from hypoglycemia, and intermediate life expectancy. Finally, a complex patient with poor health, greater than two deficits in ADLs, and dementia or other dominant illness, would be allowed a target A1c of 8.5% or lower. Allowing the A1c to reach over 9% by any standard is considered poor care, since this corresponds to glucose levels that can lead to hyperglycemic states associated with dehydration and medical instability. Regardless of A1C, all patients need attention to hypoglycemia prevention.

Newer Developments for Management of T2DM

The last quarter century has brought a wide variety of pharmaceutical developments to diabetes care,

after decades of only oral sulfonylurea drugs and injected insulin. Metformin, which proved essential to improved outcomes in the UKPDS, remains the only biguanide in clinical use. The thiazoladinedione class has been limited by problematic side effects related to weight gain and cardiovascular risk. The glinide class offered new hope for patients with sulfa allergy to benefit from an oral insulin-secretatogogue, but were found to be less potent than sulfonylurea agents. The incretin mimetics introduced an entire new class at the turn of the millennium, with the glucagon like peptide-1 (GLP-1) class revealing its power to both lower glucose with less hypoglycemia and promote weight loss. This was followed by the oral dipeptidyl peptidase 4 (DPP4) inhibitors. In 2013, the FDA approved the first sodium-dependent glucose co-transporter-2 inhibitor.

Several new DPP4 inhibitors and GLP-1 agonists are in development. Some will offer combination pills with metformin or pioglitazone. The GLP-1 receptor agonist exenatide is now available in a once per week formulation (Bydureon), which is similar in effect to exenatide 10 mg twice daily (Byetta), and others are in development.[26] Most GLP-1 drugs are not first-line for T2DM but may be used in combination with metformin, a sulfonylurea, or a thiazolidinedione. Little is known regarding the use of these agents in older adults with multimorbidities.

Inhibiting subtype 2 sodium dependent glucose co-transporter proteins in the renal tubules is a new approach for treating hyperglycemia. While the kidneys participate in glucose regulation in many ways, their primary function involves glucose reabsorption from the glomerular filtrate. If the concentration of glucose in the glomerular filtrate exceeds 11 mmol (or approximately 190 mg/dL), the transporters have reached their maximum capacity for reabsorption and glycosuria ensues.[27] The two most studied proteins in this category are SGLT-1 in the distal tubule (as well as in the small intestine) and SGLT-2 in the proximal tubule; SGLT-2 has been found to be the most powerful for pharmacotherapeutic intervention.[13] By inhibiting the action of SGLT-2 in the proximal tubule, glucose can be excreted more easily, aiding the management of hyperglycemia without causing hypoglycemia.

Canagliflozin is the first drug in its class to be approved by the Food and Drug Administration, under the brand name Invokana, and others are in the pipeline. Preliminary studies of these drugs show that they are effective for lowering both fasting and postprandial glucose levels and have helped lower A1c as well as body weight and blood pressure with a low frequency of hypoglycemia. Adverse effects include urinary and genital infections.[13] Given their promotion of glycosuria, SGLT-2 poses a risk of worsening urinary incontinence, a common problem among the elderly. Additionally, given the osmotic diuresis involved in the excretion of glucose, patients may be more prone to dehydration and orthostatic hypotension.

Bromocriptine is a dopamine D2 receptor agonist which the Food and Drug Administration approved for use in Parkinson's disease. Patients using this medication show lower fasting glucose levels, which are thought to be related to central nervous system regulation of morning insulin sensitivity. It therefore is undergoing further investigation as an oral hypoglycemia agent.[28] An expert panel noted that there is insufficient evidence to guide its use in diabetes care.[29]

New insulin analogs are being developed which have a lower tendency to cause hypoglycemia. Insulin Degludec (IDeg) is one such product; With a half-life of 25 hours, which is double that of insulin glargine, IDeg is an ultralong basal insulin.[13] Its mechanism of action involves continuous release of insulin monomers from a subcutaneous depot of soluble hexamers.[30] A systematic review of multiple studies comparing IDeg to insulin glargine reveals overall similar control of hyperglycemia, but subjects taking IDeg experienced significantly less hypoglycemia, particularly nocturnal hypoglycemia.[31] Further, because IDeg can be co-formulated with aspart insulin, patients can receive a single injection and achieve basal bolus coverage, which is not possible with current long acting insulins on the market. It is also produced at a concentration of 200 units per mL, which is helpful for patients with insulin resistance, particularly those using an insulin pen, where a maximum of 80 units can be delivered per shot.[13]

A more rapidly absorbed ultrafast acting insulin is also in development, known as VIAject, and oral insulin spray is also being investigated.[28] Novo Nordisk is working on an oral insulin.[32] All of these products require undergo extensive testing before their safety in regular practice is established, particularly among older adults with multimorbidity, but these new products

have the potential to lessen the self care burden and risk of hypoglycemia compared to current treatment options.

Case Application

Returning to the cases of Mr. A and Mrs. B, how do the new consensus guidelines alter the PCP's approach to the care of these patients? Additionally, do emerging therapies alter the options of pharmacotherapy? Both of these seniors are 70 years old, which is young by the perspective of a geriatric provider, but still considered elderly by social demographics. Reviewing their individual problem lists (Tables 3 and 5), the PCP notes that they both have a 20-year history of diabetes, macrovascular disease, and more than one diabetes complication. They both have multimorbidity as noted by the presence of more than one unrelated chronic condition. They have the same number of prescription medications and are on basal insulin plus oral hypoglycemic agents (Tables 4 and 6). They have similar lab abnormalities including, A1c levels of 8.7%, elevated lipids, and meet the criteria for stage 3 chronic kidney disease (Table 7). They both have mildly elevated blood pressure readings at their appointments, despite treatment for hypertension. They both have a body mass index of 30, meeting the requirements for a diagnosis of obesity. Both patients have the potential to live another decade. They both have had difficulties with hypoglycemia on more intensive diabetes therapy. They both have Medicare insurance. In applying a person-centered approach, how does the PCP arrive at individualized goals of treatment and prescribe tailored hyperglycemic therapy?

Table 3. Mr. A's past medical history.

1. Type 2 diabetes since age 50
2. Hypertension since age 45
3. Hyperlipidemia onset unknown
4. Coronary artery disease status post stent placement age 60
5. Gastroesophogeal reflux disease
6. Diabetic gastroparesis
7. Diabetic polyneuropathy
8. Prostate cancer, status post radiation treatment 8 years ago
9. Squamous cell carcinoma of the throat, status post resection age 65
10. Radiation proctitis, chronic
11. Lumbar disc disease
12. Erectile dysfunction
13. Glaucoma
14. Tinea pedis

Table 4. Mr. A's medications and drug allergies.

1. Econazole cream 1% to feet nightly for one month (1 week remaining)
2. Gabapentin 300 milligrams three times daily
3. Glipizide 10 milligrams XR by mouth twice daily
4. Insulin glargine 40 units at bedtime
5. Hydrochlorothiazide 25 milligrams by mouth daily
6. Latanaprost eye drops 2 gtts both eyes at bedtime
7. Metaclopramide 5 milligrams by mouth three times a day
8. Omeprazole 20 milligrams by mouth daily
9. Ramipril 10 milligrams by mouth daily
10. Simvastatin 40 milligrams by mouth daily at bedtime
11. Tramadol 50 mg by mouth TID
12. Verapamil 240 milligrams by mouth daily
13. Vitamin D 2,000 international units by mouth daily
14. AS NEEDED: Hydrocodone/APAP 5/325 two tablets by mouth as needed for severe pain up to every eight hours

Allergies/contraindications/precautions-

1. Incretin therapies are contraindicated given his gastroparesis
2. Metformin caused gastrointestinal intolerance (diarrhea)

Case #1

Mr. A is a 70-year-old African American man with a 20-year history of diabetes treated with oral agents and basal insulin. His A1c has increased to 8.7%. His scattered glucose readings in the last week ranged from 55–300 mg/dL. His past medical history (Table 3) includes prostate and throat cancer, though he is considered cancer-free by his oncologist at this time. His medications and drug allergies are listed in Table 4.

Table 5. Mrs. B's past medical history.

1. Type 2 diabetes since age 50
2. Hyperlipidemia
3. Hypertension
4. Grade 1 diastolic dysfunction
5. Chronic kidney disease, stage 3, with estimated GFR ranging 40–50 over the past 5 years
6. History of TIA (transient ischemic attack)
7. Hypothyroidism
8. Osteoporosis
9. Chronic Obstructive Pulmonary Disease (COPD)
10. History of breast cancer, status post lumpectomy 3 years ago
11. Charcot foot deformity
12. Mild cognitive impairment versus vascular dementia

Table 6. Mrs. B's medications and drug allergies.

1. Acetominophen 650 mg, two tablets by mouth twice daily
2. Alendronate 70 milligrams by mouth weekly on Sundays 30 minutes before food
3. Anastazole 1 milligram by mouth daily
4. Aspirin 81 milligrams by mouth daily
5. Atorvastatin 20 milligrams by mouth at bedtime
6. Calcium 600 milligrams by mouth bid
7. Fluticasone/salmeterol 50/250 one puff twice daily
8. Furosemide 10 milligrams by mouth daily
9. Glyburide 5 milligrams, two at breakfast and one at supper
10. Insulin glargine 40 units at bedtime
11. Levothyroxine 100 micrograms daily except 1/2 tablet every Tuesday and Saturday
12. Lisinopril 10 milligrams by mouth daily
13. Metoprolol succinate 50 milligrams by mouth daily
14. Vitamin D 2,000 IU by mouth daily with food
15. AS NEEDED: Albuterol 2 puffs every four hours as needed for wheezing (rarely needed)

Allergies/contraindications-
Thiazoledindiones due to precautions about weight gain
Metformin due to precautions about declining kidney function

Issues in diabetes self-care: He is able to sense and treat hypoglycemia. Because of working during the night shift, he wants to avoid bolus insulin, which is more likely to give him hypoglycemia. His son once took him to the emergency room for agitated delirium due to severe hypoglycemia when he was on bolus insulin injections with tube feedings during his throat cancer care. He now tends to eat several small snack-like meals rather than regular meals to avoid hyperglycemia, but notices that this is not always effective. For exercise, unless he is experiencing an acute flare of back pain, he is able to walk three miles in a park near his home or ride a recumbent bike at the gym.To prevent exercise induced hypoglycemia, he snacks on protein bars before hand.

Table 7. Mr. A and Mrs. B's Key abnormal laboratory reports from CBC, CMP, B12, folate, TSH, FTA, vitamins B12 and D, Westergren sedimentation rate, and urinalysis.

Test	Result Mr. A	Result Mrs. B	Reference range
A1c	8.7%	8.7%	4.0%–6.4%
Serum potassium	5.1	4.5	3.5–5.0 mmol/L
serum creatinine	1.4	1.2	0.6–1.03 mg/dL
Estimated GFR	50*	45*	>90 mL/min (30–60 consistent with stage 3 CKD)
Serum LDL cholesterol	108	110	Optimal <70 mg/dL
Triglycerides	178	210	<150 mg/dL
Urine microalbumin: creatine	60	235	<30

Note: *Adjusted for age, gender and race.

For social characteristics and values, Mr. A has a high school education and technical training in various blue collar jobs. He values independence and physical vigor. He has given up smoking tobacco and occasionally smokes marijuana with a friend. He avoids colas and coffee. He enjoys a beer once per week. He lives a life independently of his wife though they are not divorced, and he is close to a son he sees daily. He is looking forward to semi-retirement where he can have some extended vacations through job sharing before completely retiring. Despite multiple chronic illnesses, he feels well overall and wants to avoid exacerbations of his back pain in order to travel, including visiting grandchildren and attending a fishing trip with friends.

His physical exam and lab values are noted in Box 1 and Table 7 respectively.

Box 1. Mr. A's physical exam

Vital signs: Blood pressure 144/84 mmHg, pulse 56 beats per minute, respirations 18 per minute, temperature 98 °F (36.7 °C), and oxygen saturation 96% on room air. He has an elevated body mass index at 30.5. His affect is pleasant, speech is fluent, and content appropriate and positive. His Montreal Cognitive Assessment (MoCA) is 29/30 with one error in short-term recall. His remaining neurologic exam is non-focal. The HEENT exam is remarkable for neck scarring from throat surgery and soft bilateral carotid bruits. Recent carotid ultrasound confirmed 40%–60% stenosis bilaterally. The lungs are clear and heart rate is regular without murmurs. The point of maximum impulse is diffuse. His last echocardiogram showed a reduced ejection fraction at 45% and no inducible ischemia with fixed wall motion defect from prior myocardial infarction. His abdomen is benign. His feet have trace edema bilaterally and reduced vibratory sensation below the knees as well as two areas of reduced light touch sensation on monofilament testing. The skin is intact and clean with minor callus formation at both heels with resolution of previous tinea pedis.

Table 8. ADA/EASD glycemic stringency criteria and IOM person centered care principles[7,9] applied to cases.

Criteria	Applied to Mr. A	Outcome-Mr. A	Applied to Mrs. B	Outcome-Mrs. B
Patient attitude and treatment efforts	Mr. A expresses renewed interest in self care of DM	In favor of tighter control	Waning attitude and efforts from depression and cognitive decline	In favor of looser control
Risks associated with hypoglycemia	Has had when acutely ill but currently able to self manage lows	In favor of tighter control	Demonstrated hypoglycemia unawareness causing spousal stress	In favor of looser control
Disease duration	20 yrs	No real effect/unable to benefit from early CV risk reduction of diagnosis earlier in pathogenesis.	20 years	No real effect/unable to benefit from early CV risk reduction of diagnosis earlier in pathogenesis.
Life expectancy	10+ years	"	10+ years	"
Important concordant co-morbidities and established vascular complications	HTN, Hyperlipidemia heart disease and CKD	Needs better control of CV risk factors, eg add enteric coated aspirin, refer for low salt, low fat menu	HTN, Hyperlipidemia, TIAs, possible vascular dementia, and CKD	Needs better control of CV risk factors, strict avoidance of hypoglycemia—discontinue glyburide and resume low dose metformin
Discordant chronic conditions which complicates care	Back pain, polyneuropathy, GERD, radiation proctitis	Avoid NSAIDs, physical therapy for home exercise precription, regular exercise routine, diabetic shoes	COPD, DJD knees, charcot foot, depression, cognitive decline	Avoid NSAIDS and beta blockers, provide exercise and care routines, diabetic shoes
Available social support and resources	Despite marital separation, notes adequate social support at present	Referred back to diabetes self management education (DMSE) and given option of marital counseling	Psychosocial stress overwhelming with patient's waning cognitive competency and husband's illness	Placement in day program for patient in memory loss and social work evaluations and interventions for family support
Access to care	Medicare and no drug plan or counseling coverage	Limits access to non generic drugs, counselors	Medicare and full drug plan; limited mental health services	Consider cost with community service referrals
Respect for patient preferences	PCP discusses pros and cons of various approaches	PCP allows Mr. A to prioritize- he agrees with tighter BP control, referrals, and resuming SMBG with quick follow up	PCP discusses pros and cons of various approaches	PCP allows Mr. and Mrs. B to choose-Couple agrees to referral to social work, and drug changes in care plan
Health education	Wants DSME, written education	Refer for DSME and dietitian	Does not want DSME	Written handouts for Mr. and Mrs. B
Communication about medications	PCP discusses all meds with pt and refers to pharmacist for further info	Gets printed list and access to pharmacist	PCP discusses all meds with pt and husband and refers to pharmacist	Gets printed list and access to pharmacist for further info
Coordination of care, involvement of the family	PCP coordinates care with pharmacist, nurse educator dietitian, and podiatrist	PCP suggests family members attend follow up visit with Mr. A	PCP coordinates care with pharmacist, social worker, and podiatrist	

Emotional support of the patient and family	PCP uses open ended questions to elicit info about emotional status	Offers referral to marital counselor if desired, suggests family attend revisit	PCP uses open ended questions to elicit info about emotional status	Offers Mr. and Mrs. B referral to social worker for evaluation of caregiver burden, and community resources to reduce stress
Provision of pain management	Assess need for, and understanding of gabapentin, tramadol and hydrocodone	Renews meds as appropriate; incorporates swimming and recumbent bike work to avoid pain flares that offset glycemic control	Continue acetaminophen for pain management-should not exceed three grams daily given CKD	No change needed/NSAIDs added to list of drug "allergies" since they are contraindicated in persons with CKD, in addition to limitation of acetaminophen dose.
Continuity of care across settings	PCP aware that Mr. A has gotten some meds and care at veterans hospital; gets release of info to coordinate care	PCP offers close follow up and nurse contact between visits; PCP reviews outside reports when they come	PCP aware that Mrs. B saw an outside neurologist so gets release of information for outside reports	PCP offers close follow up and nurse contact between visits; PCP reviews outside reports when they come and sends annotated reports to patient to share with other providers (especially when in Florida).

Case #2

Mrs. B is a 70-year-old Caucasian female with no complaints. She has had T2DM since age 50, treated for the last five years with basal insulin and glyburide. Her recent glucose readings show ranges of 95–170 fasting and greater variability between 48 and 330 mg/dL throughout the day. The low glucose reading, the first she has had in years, occurred last week after church. Her husband noted at that time that she appeared weak and shaky and he tested her glucose before giving her some juice, which revived her. Her husband relates that Mrs. B's memory has been gradually worsening. This past winter when they were in Florida, he took her to undergo an evaluation by a neurologist, whose report indicated a diagnosis of mild cognitive impairment versus vascular dementia in the context of mild depression. He is frustrated that she is not only unable to drive and manage the household as she was previously, but that she may not be safe when left alone. Her past medical history and medications are noted in Tables 5 and 6.

Her diabetes self-care has included no previous difficulties with hypoglycemia, other than occasional symptomatic events that she self-managed. She does not smoke or drink alcohol. She has primarily followed a diabetic menu, though more recently she enjoys going out to eat more than any other diversional activity, craves sweets, and has gained some weight. She feels discouraged by the idea of following a diabetic menu. She is not able to exercise since it exacerbates her shortness of breath. Lately, she has not tested her blood glucose reliably and makes errors in taking her medications without her husband's supervision.

Personal values: She enjoys attending church each week and going out to eat. She enjoys their trip to Florida for two months every winter. Her husband is undergoing treatment for prostate cancer, and is more fatigued; Mrs. B does not want to be a burden to him.

Her physical exam and laboratory reports show multiple chronic abnormalities; the most significant new finding is her impaired cognitive screen (Box 2 and Table 7).

Box 2. Mrs. B's physical exam

Vital signs: Blood pressure 142/84 mmHg, pulse 56 beats per minute, respirations 18 breaths per minute, Temp 98 °F, (36.7 °C), and oxygen saturation 95%

on room air. She has an elevated body mass index at 32. Her affect is blunted, though she smiles when addressed, is well-groomed, and has good eye contact. Her speech is fluent. Montreal Cognitive Assessment (MoCA) score is 24/30 with impairment in executive function, orientation to date, and short-term memory. Her remaining neurologic exam is non-focal. The HEENT exam is unremarkable and her neck has no masses or carotid bruits. The lungs are clear, though with decreased respiratory excursion on full inspiration at the bases, and her heart rate is regular without murmurs. The point of maximum impulse is diffuse. Her breasts have no new masses with healed lumpectomy scar noted and palpable scar tissue. Her abdomen is obese and benign. Her feet have trace edema bilaterally and the right foot has a bunion deformity as well as a flattened arch with bony prominence medially at the mid plantar region consistent with Charcot foot. Both feet have reduced pulses, reduced vibratory sense below the ankles, and absent light touch sensation to testing with a 10 gram monofilament. The skin is intact and clean.

Categorization of multimorbidity in Mr. A and Mrs. B

Both Mr. A and Mrs. B have diseases concordant with diabetes, or common co-morbidities, including overweight, hypertension, and dyslipidemia. Both also have chronic kidney disease from longstanding hypertension and microalbuminuria from persistent hyperglycemia. Both have significant comorbid macrovascular disease and neuropathic complications of diabetes. The most critical concordant illnesses are the coronary artery disease for Mr. A, which makes it critical to avoid hypoglycemia given that the condition, as well as the counterregulatory hormones, can create greater myocardial stress. For Mrs. B, the most critical condition arguing against avoidance of hypoglycemia is her cognitive decline, since she has demonstrated inability to promptly sense and self-treat low blood glucose.

Both have discordant illnesses, including arthritis, cancers, hypothyroidism, and lung disease. It is incumbent upon the PCP to help each patient-family unit to understand the significance of the interaction of their diabetes with their other conditions. For instance, if Mr. A experiences a flare of his musculoskeletal back pain, he doses himself with narcotics, eats convenience foods, and does not exercise or check his blood sugar as often, at which time he notices higher average glucose levels. Similarly, if Mrs. B experiences an acute exacerbation of her chronic obstructive pulmonary disease and takes a burst of steroids, her glucose increases to very high levels and she may become dehydrated and delirious in the context of her vulnerable cognitive status.

In terms of psychosocial support, while it may appear to the PCP that Mrs. B has more support than Mr. A since Mr. A is separated from his wife, further history reveals that Mrs. A's husband cannot take on complex care of her given his own illness, while Mr. A actually continues to receive attention from his wife, son, and extended family, which is very supportive and helpful.

Using the ADA/EASD framework for establishing glycemic stringency (Table 1) and the IOMs criteria for person-centered care (Table 2), the PCP is able to identify individualized priorities from which to tailor interventions (see Table 8).

Within the framework for gauging treatment intensity provided in the AGS/ADA consensus, the PCP arrives at the treatment targets noted in Table 9.

Mr. A can be categorized as "healthy." Despite his multimorbidity, his cancer is in remission, he has been through extensive rehabilitation for his back, and he has stable chronic illness, including coronary artery disease, with intact physical and cognitive function. Therefore, his A1c goal is "under 7.5% if this is achievable without severe hypoglycemia or undue treatment burden."[4] A goal of under 7.5% is not as stringent as the goal of under 7% for healthy younger adults set by the ADA.[33] Mr. A has expressed his value of being more involved in his care and doing what he can to minimize the progression of his diabetes complications for his remaining life. While both patients have a history of severe hypoglycemia (defined as requiring help from others to treat it), Mr. A's history of severe hypoglycemia occurred during acute illness with his cancer treatment when he was having too many acute symptoms of illness to be an active member in his care. Equally important, he is also now able to sense and promptly self-manage hypoglycemia.

Mrs. B, in contrast, fits into the category of "very complex/poor health" given her cognitive deficit and increasing dependency on her husband for multiple

Table 9. Framework for gauging treatment targets according to the AGS/ADA consensus report on diabetes in older adults.[4]

Patient characteristics/health status	A1c goal	Fasting or preprandial glucose	Bedtime glucose	Blood pressure (mm/Hg)
Healthy (stable and manageable chronic illnesses, intact functional and cognitive status)	Mr. A is here Under 7.5% (<58 mmol/mol)	90–130 mg/dL (5.0–7.2 mmol/l)	90–150 mg/dL (5.0–8.3 mmol/l)	<140/80
Intermediate complexity (multimorbidity where illnesses may decompensate quickly, two or more instrumental ADL impairments, or mild to moderate cognitive impairment)	Under 8% (<64 mmol/mol)	90–150 mg/dL (5.0–8.3 mmol/l)	100–180 mg/dL (5.6–10.0 mmol/l)	<140/80
Very complex, poor health (Long term care or end stage chronic disease, advanced cognitive impairment or dependence in 2 or more ADLs	Mrs. B is here Under 8.5% (<69 mmol/mol)	100–180 mg/dL (5.6–10.0 mmol/l)	110–220 mg/dL (6.2–12.2 mmol/l)	<150/90

Adapted from M. Sue Kirkman et al (2012), diabetes in older adults: a consensus report.[4]

aspects of her care, particularly reminders to test her glucose and take her medications. Without the careful attendance of others, she is at risk for recurrent severe hypoglycemia. Therefore, the A1c goal of under 8.5% means that she has almost reached her goal. However, her treatment requires alteration to lessen her wide fluctuations in glucose levels.

Treatment Approaches in Person-Centered Care

For Mr. A, person-centered care would address that Mr. A has decided that he wants to pay more attention to his health and take on a more active role in his diabetes care. With his schedule variability in swinging shifts, he needs a plan with greater flexibility in timing of meals and medications, yet with maximum control of blood glucose. He is first interested in more education and tailoring of non-pharmaceutical lifestyle interventions, including diet and prescribed physical therapy, to minimize glucose excursion at meals, improved fitness, and back pain control. Mobilizing the other diabetes team members would be very helpful for him at this time.

As for oral pharmacotherapy, it would be best to avoid the use of a sulfonylurea given the need to lessen risk of cardiac events and hypoglycemia. He would prefer not to have to use a pre-prandial glinide since before meal dosing is too challenging of a variable. He cannot tolerate metformin and is not a candidate for incretin therapy given his difficulties with gastroparesis. Similarly, alpha glucosidase inhibitors are likely to cause gastrointestinal distress. Pioglitazone is also not ideal given his interest in avoiding weight gain and fluid retention. Canagliflozin or other drugs in the SGLT-2 class may offer the potential to lower his glucose levels with a lowered risk of hypoglycemia than the sulfonylurea, while also lowering weight and blood pressure. However, it is important to determine how the new drug performs in patients with a history of heart disease and cancer, and specifically determine the precautions in patients with renal insufficiency before prescribing.

In the future, after further testing, Mr. A may benefit from the new ultra-long-acting insulin degludec rather than insulin glargine. Degludec offers the advantage of greater flexibly in dosing times between working the night shift and enjoying his days off. If he eats one

main meal per day and desires greater post-prandial coverage, the co-formulation of degludec with aspart insulin offers the advantage of greater coverage in a single injection with his largest meal, something not currently possible with glargine. Again, safety testing must be conducted before the PCP can prescribe this medication.

In the meantime, closer follow-up with the PCP creates the following clinical impressions and care plan with the input of Mr. A:

Suggested documentation of clinical impression: Mr. A presents for primary care visit with interest and ability to control cardiovascular risk factors and blood glucose with a glycemic goal of under 7.5%. To accomplish this, he will require diabetes education, a diabetic menu plan which is low in salt and fat for his hypertension and hyperlipidemia, custom-fit shoes, an exercise routine which avoids flares of acute pain, and close follow-up of lipids, blood pressure, and glucose. He is separated from his wife but may bring her to classes and is considering a referral to marriage counseling.

Plan for Mr A

A. Referrals:

1. Diabetes self-management education (DSME) classes
2. Podiatry
3. Physical therapy for a home exercise prescription to avoid flares of back pain
4. Registered dietitian for a personalized low-salt and low-fat diet and consistency in carbohydrates across several small meals with swinging to night shift schedule

B. Interventions:

1. Add enteric coated aspirin 81 mg by mouth every day with food to minimize risk of clot formation while minimizing gastric upset
2. Consider sitagliptin 50 mg or other DPP4 of lowest cost instead of sulfonylurea to minimize risk of hypoglycemia
3. Optimize insulin dose once patterns of glucose are established after new diet and exercise routine are practiced for 8–12 weeks
4. Recheck fasting lipid panel after following heart healthy menu; if needed optimize statin to achieve LDL of under 70
5. Mr. A to assess blood pressures at home daily; if average is not less than 140/80 mmHg with consistent exercise and low salt menu and consistent use of ramipril and HCTZ, then alter therapy with consideration of microalbuminuria, CKD 3, and mild hyperkalemia

For Mrs. B, although she is now close to the target A1c goal of less than 8.5%, she has had a severe episode of hypoglycemia, so her program requires modification. First, the PCP should discontinue glyburide, which has potent prolonged hypoglycemic effects, especially when given with basal insulin. Metformin may be reinstituted at a low dose such as 500 or 850 mg extended release every evening, since no serious adverse effects are seen at this doses in persons with stage 3 CKD.[35] While the glinide class or an alpha glucosidase inhibitor is a possible alternative, her husband would have to administer these before meals, which may increase his caregiver burden. A DPP4 inhibitor, renally dosed, is a good alternative treatment for her post-prandial glucose management. These agents are less powerful than sulfonylurea agents, but may offer adequate potency for her current needs to limit post prandial glucose levels. Her husband may be able to assist her to administer a once daily or once weekly injection of a GLP-1 agent to offer greater post-prandial effect without hypoglycemia. For her other co-morbidities, she should also have her beta blocker discontinued since it can mask hypoglycemia, contribute to depression, and is contraindicated in persons with chronic obstructive pulmonary disorder and peripheral vascular-occlusive disease. Her angiotensin-converting enzyme inhibitor should be escalated gradually to control blood pressure and her potassium and renal function closely watched.

For Mrs. B, person-centered care means that the caregiver burden imposed on her husband is taken into consideration and all possible community services are used to lessen his burden. It has been shown that elder abuse can be avoided by limiting burden on caregivers.[36] Thus, a social worker could connect Mrs. B's husband with agencies which offer dementia-related care so that he can have some respite from supervising her health. Advance directives should be placed on file as well for Mrs. B, with discussion as to when they are ready to be activated depending on her level of mental capacity. It should

be made clear that with her failing cognition, aggressive medical care in the face of a vascular event may not offer her an improved quality of life. All health professionals should work together to improve interprofessional communication and coordinate care with clear description of individualized and relaxed glucose targets in the context of a palliative care approach.

Mrs. B's clinical impression and plan follow.

Impression:

Mrs. B presents for primary care follow-up with a new diagnosis of mild cognitive impairment and possible vascular dementia. Given her impairments in self-care since her diagnosis (reliance on husband for help with glucose monitoring, medications, and hypoglycemia management), it is more prudent to consider dementia as the diagnosis. Her husband as primary caregiver is coping with fatigue and cancer. Her glycemic target therefore is relaxed to less than 8.5%. While her current A1c of 8.7% is close to target, she needs her glucose fluctuations altered to lessen hyper- and hypoglycemia.

Plan

Referrals:

1. Visiting nurse referral to monitor blood pressure and glucose with medication changes, educate husband in heart-healthy menu planning
2. Social work for family assessment and counseling; referral to appropriate day program in or out of the home for respite care for husband and attention to her needs
3. Social worker can also work with PCP at next visit to discuss need for advanced directive and help family get paperwork completed
4. Podiatry for custom-fit shoes given her Charcot foot deformity

Interventions:

1. Taper metoprolol to 25 mg by mouth daily for one week then stop
2. Increase lisinopril to 20 milligrams by mouth daily
3. Check blood pressure daily at home
4. Discontinue glyburide
5. Follow fasting, mid-day and bedtime readings at home with help of husband and visiting nurse
6. Resume metformin XR 500 mg bid since eGFR still above 30.
7. Revisit in 6–10 weeks to review home blood pressure and glucose readings, recheck A1c and basic chemistry panel and fasting lipid profile
8. Consider discontinuation of alendronate if therapy has already been in place for five years given the added complexity it creates for the medication program.

For both subjects, newer technology is becoming available so that patients and their caregivers can contact medical personnel through patient portals, mobile device applications, and electronic mail to stay in contact regarding day-to-day variability in glucose levels and treatment changes.[37,38] Additionally, a newer diagnostic assay 1,5-anhydroglucitol (1,5-AG), currently under the trade name GlycoMark, may be used to assess glycemic excursions. While the hemoglobin A1c assay determines recent glycemic averages, 1,5-AG reflects maximal mean glucose for better assessment of post-prandial glucose excursions in the previous two weeks.[39] Used with an A1c, the 1,5-AG may be less cumbersome than use of a continuous glucose monitor for identifying patients with wide variability in glucose levels, though it is not as effective for identifying patterns of hypoglycemia.[39]

In summary, while it may have first appeared to many PCP's that both of these elderly patients with multimorbidity should have a relaxed approach to their diabetes care, particularly Mr. A with his history of severe hypoglycemia and reduced social support, a closer look at these cases reveals a different outcome. Mrs. B requires more relaxed glucose goals in the face of declining cognition and a stressed caregiver, while Mr. A is a good candidate for updated diabetes self-management education and a flexible yet more intensive therapeutic plan.

In conclusion, this case analysis serves to demonstrate the importance of the PCP carefully discussing each patient's unique needs, values, and overall management of multimorbidities before stratifying their diabetes treatment goals. The new ADA/AGS consensus is helpful in this endeavor. While new pharmacotherapies offer promise for improving overall glucoses levels with a lower risk of hypoglycemia, broader use of geriatric team members can improve health outcomes. To implement the IOM's recommendations for person-centered care, the health system must be designed with the PCP better able to

coordinate care with a wider variety of team members, including podiatrists, pharmacists, advanced practice nurses, social workers, mental health specialists, and community agencies. For every hospitalization that is prevented, health care costs, currently climbing to unsustainable levels, can be kept to a minimum while quality of life is optimized.

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Wrote the first draft of the manuscript: JMH. Agree with manuscript results and conclusions: JMH. Developed the structure and arguments for the paper: JMH. Made critical revisions and approved final version: JMH. All authors reviewed and approved of the final manuscript.

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