Case Study: A Patient With Type 2 Diabetes Working With an Advanced Practice Pharmacist to Address Interacting Comorbidities

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Advanced practice pharmacists in the field of diabetes work collaboratively with patients' medical providers, often in primary care settings or in close proximity to the providers' practices. They help to integrate the pharmaceutical, medical, education/counseling, and direct patient care activities necessary to meet patients' individual self-management and diabetes care needs.

Patient education and self-management behavioral change are underpinnings of pharmaceutical care, and not only as they directly relate to the use of medications. Pharmacists, especially those who are certified diabetes educators (CDEs), frequently provide diabetes patients with education not only on medications, but also on the overall disease state, nutrition, physical activity, decision-making skills, psychosocial adaptation, complication prevention, goal setting, barrier resolution, and cost issues.

In addition to these substantial education responsibilities, advanced practice pharmacists who are Board Certified–Advanced Diabetes Managers (BC-ADMs) play an expanded role that encompasses disease state management. This includes performing clinical assessments and limited physical examinations; recognizing the need for additional care; making referrals as needed; ordering and interpreting specific laboratory tests; integrating their pharmacy patient care plans into patients' total medical care plans; and entering notes on patient charts or carrying out other forms of written communication with patients' medical care providers. Depending on state regulations and physician-based protocols, some advanced practice pharmacists can prescribe and adjust medications independently or after consultation with prescribing clinicians.

The clinical activities of BC-ADM pharmacists are not carried out independent of referring, collaborative practitioners. Rather, they are complementary to and serve to enhance the diagnostic, complex physical assessment, and management skills of medical providers.

The following case study illustrates the pharmacotherapeutic challenges of diabetes with other comorbidities, which can lead to potential drug-drug and drug-disease interactions. Although it does not offer detailed solutions to such problems, this case does describe the process of patient care and problem resolution as approached by advanced practice pharmacists.

Case Presentation

B.L. is a 58-year-old white woman who has been referred to the pharmacist clinician for pharmacotherapy assessment and diabetes management. Her multiple medical conditions include type 2 diabetes diagnosed in 1995, hypertension, hyperlipidemia, asthma, coronary artery disease, persistent peripheral edema, and longstanding musculoskeletal pain secondary to a motor vehicle accident. Her medical history includes atrial fibrillation with cardioversion, anemia, knee replacement, and multiple emergency room (ER) admissions for asthma.

B.L.'s diabetes is currently being treated with a premixed preparation of 75% insulin lispro protamine suspension with 25% insulin lispro preparation (Humalog 75/25), 33 units before breakfast and 23 units before supper.

She says she occasionally "takes a little more" insulin when she notes high blood glucose readings, but she has not been instructed on the use of an insulin adjustment algorithm.

Her other routine medications include the fluticasone metered dose inhaler (Flovent MDI), two puffs twice a day; salmeterol MDI (Serevent MDI), two puffs twice a day; naproxen (Naprosyn), 375 mg twice a day; enteric-coated aspirin, 325 mg daily; rosiglitazone (Avandia), 4 mg daily; furosemide (Lasix), 80 mg every morning; diltiazem (Cardizem CD), 180 mg daily (per cardiologist consult); lanoxin (Digoxin), 0.25 mg daily (per cardiologist consult); potassium chloride, 20 mEq daily; and fluvastatin (Lescol), 20 mg at bedtime. Medications she has been prescribed to take "as needed" include sublingual nitroglycerin for chest pain (has not been needed in the past month); furosemide, additional 40 mg later in the day if needed for swelling (on most days the additional dose is needed); and albuterol MDI (Proventil, Ventolin), two to four puffs every 4–6 hours for shortness of breath. She denies use of nicotine, alcohol, or recreational drugs; has no known drug allergies; and is up to date on her immunizations.

B.L.'s chief complaint now is increasing exacerbations of asthma and the need for prednisone tapers. She reports that during her last round of prednisone therapy, her blood glucose readings increased to the range of 300–400 mg/dl despite large decreases in her carbohydrate intake. She reports that she increases the frequency of her fluticasone MDI, salmeterol MDI, and albuterol MDI to four to five times/day when she has a flare-up. However, her husband has been out of work for more than a year, and their only source of income is her Social Security check. Therefore, she has been unable to purchase the fluticasone or salmeterol and so has only been taking prednisone and albuterol for recent acute asthma exacerbations.

B.L. reports eating three meals a day with a snack between supper and bedtime. Her largest meal is supper. She states that she counts her carbohydrate servings at each meal and is "watching what she eats." She has not been able to exercise routinely for several weeks because of bad weather and her asthma.

The memory printout from her blood glucose meter for the past 30 days shows a total of 53 tests with a mean blood glucose of 241 mg/dl (SD 74). With a premeal glucose target set at 70–140 mg/dl, there were no readings below target, 8% within target, and 91% above target. By comparison, her results from the same month 1 year ago averaged 112 mg/dl, with a high of 146 mg/dl and a low of 78 mg/dl.

Physical Exam

B.L. is well-appearing but obese and is in no acute distress. A limited physical exam reveals:

- Weight: 302 lb; height 5'1"
- Blood pressure: 130/78 mmHg using a large adult cuff
- Pulse 88 bpm; respirations 22 per minute
- Lungs: clear to auscultation bilaterally without wheezing, rales, or rhonchi
- Lower extremities +1 pitting edema bilaterally; pulses good

B.L. reports that on the days her feet swell the most, she is active and in an upright position throughout the day. Swelling worsens throughout the day, but by the next morning they are "skinny again." She states that she makes the decision to take an extra furosemide tablet if her swelling is excessive and painful around lunch time; taking the diuretic later in the day prevents her from sleeping because of nocturnal urination.

Lab Results

For the sake of brevity, only abnormal or relevant labs within the past year are listed below.

- Hemoglobin A_{1c} (A1C) measured 6 months ago: 7.0% (normal range: <5.9%; target: <7%)
- Creatinine: 0.7 mg/dl (normal range: 0.7–1.4 mg/dl)
- Blood urea nitrogen: 16 mg/dl (normal range: 7–21 mg/dl)
- Sodium: 140 mEq/l (normal range: 135–145 mEq/l)
- Potassium: 3.4 mg/dl (normal range: 3.5–5.3 mg/dl)
- Calcium: 8.2 mg/dl (normal range: 8.3–10.2 mg/dl)
- Lipid panel
  - Total cholesterol: 211 mg/dl (normal range <200 mg/dl)
  - HDL cholesterol: 52 mg/dl (normal range: 35–86 mg/dl; target: >55 mg/dl, female)
  - LDL cholesterol (calculated): 128 mg/dl (normal range: <130 mg/dl; target: <100 mg/dl) Initial LDL was 164 mg/dl.
  - Triglycerides: 154 mg/dl (normal range: <150 mg/dl; target: <150 mg/dl)
- Liver function panel: within normal limits
- Urinary albumin: <30 μg/mg (normal range: <30 μg/mg)

Assessment

- Poorly controlled, severe, persistent asthma
- Diabetes; control recently worsened by asthma exacerbations and treatment
- Dyslipidemia, elevated LDL cholesterol despite statin therapy
- Persistent lower-extremity edema despite diuretic therapy
- Hypokalemia, most likely drug-induced
- Hypertension JNC-VI Risk Group C, blood pressure within target and stable
- Coronary artery disease, stable
- Obesity, stable
- Chronic pain secondary to previous injury, stable
- Status post–atrial fibrillation with cardioversion
- Status post–knee replacement
- Financial constraints affecting medication behaviors
- Insufficient patient education regarding purposes and role of specific medications
- Wellness, preventive, and routine monitoring issues: calcium/vitamin D supplement, magnesium supplement, depression screening, osteoporosis screening, dosage for daily aspirin

Discussion

Strand et al.[1] proposed a systematic method for evaluation of and intervention for a patient's pharmacotherapy, using a process called the Pharmacist's Work-Up of Drug Therapy (PWDT). The PWDT has been modified by subsequent authors,[2–4] but the process remains grounded in the following five questions:

1. What are reasonable outcomes for this patient?
2. Based on current guidelines and literature, pharmacology, and pathophysiology, what therapeutic endpoints would be needed to achieve these outcomes?
3. Are there potential medication-related problems that prevent these endpoints from being achieved?
4. What patient self-care behaviors and medication changes are needed to address the medication-related

problems? What patient education interventions are needed to enhance achievement of these changes?
5. What monitoring parameters are needed to verify achievement of goals and detect side effects and toxicity, and how often should these parameters be monitored?

Outcomes and Endpoints

Clinical outcomes are distinctly different from therapeutic or interventional endpoints. The former refers to the impact of treatment on patients' overall medical status and quality of life and should emphasize patient-oriented evidence that matters (POEMs) rather than disease-oriented evidence (DOEs).

Therapeutic endpoints include the *anticipated* and *desired* clinical effects from drug therapy that are expected, ultimately, to achieve the desired outcome(s). As such, therapeutic endpoints are used as surrogate markers for achievement of outcomes. Commonly, more than one endpoint will be needed to achieve an outcome. For example, near-normal glycemic control and normalization of blood pressure (endpoints) would be necessary to significantly reduce the risk of end-stage renal disease (outcome).

Therapeutic endpoints should be specific, measurable, and achievable within a short period of time. Achievement of clinical outcomes usually cannot be determined except by long-term observation or retrospective analysis.

Outcomes and endpoints for any given patient should be determined collaboratively between patient and provider before selecting or initiating pharmacotherapy or nonpharmacological interventions. Taking the time to identify these components up front (and periodically revise them later on) helps ensure that subsequent medications or strategies are appropriately directed. It further ensures a common vision and commitment for ongoing patient care and self-management among the care team (including the patient), thus maximizing the potential for optimal disease control and patient satisfaction.

The outcomes and endpoints for a patient such as B.L. are numerous and obviously would not be addressed or attained in a single session. Therefore, after desired outcomes and endpoints are determined, they should be prioritized according to medical urgency and patient preference. Implementation and goal setting related to these priorities can then be undertaken, thus establishing a treatment plan for the eventual attainment of the full list.

During ongoing and follow-up visits, this care plan should be reviewed and modified as indicated by changes in patient status, preferences, and medical findings. Examples of desired outcomes and endpoints for B.L. are given in Tables 1 and 2. For the sake of brevity, these tables are not intended to be inclusive.

Medication-Related Problems and Proposed Interventions

With agreement between patient and clinician concerning desired outcomes and endpoints, the next logical step is to evaluate whether the current treatment plan is likely to achieve those goals, or, if treatment is to be initiated, which therapies or interventions should be selected.

According to Strand et al.,[1] a medication-related problem is any aspect of a patient's drug therapy that is interfering with a desired, positive patient (therapeutic) outcome or endpoint. The PWDT proposes a systematic and comprehensive method to identify, resolve, or prevent medication-related problems based on the following major categories:
1. No indication for a current drug
2. Indication for a drug (or device or intervention) but none prescribed

Table 1. Examples of B.L.'s Desired Outcomes

1. *Mortality outcomes*
   a. Avoid respiratory, cardiovascular, thromboembolic, or diabetes-related premature death.
      - Life expectancy, American females: 79.4 years[5]
2. *Morbidity outcomes*
   a. Disease-related: Reduce morbidity resulting from uncontrolled blood glucose, blood pressure, dyslipidemia, and cardiovascular disease.
      - Retard the progression of disease.
      - Prevent, recognize, and treat early any complications of chronic conditions, such as neuropathy (autonomic or peripheral), eye disease (e.g., retinal vascular narrowing, hemorrhages, exudates, papilledema), cardiac disease (e.g., left ventricular hypertrophy, congestive heart failure, myocardial infarction), nephropathy (e.g., proteinuria, nephrosclerosis), and lower-leg amputation.
      - Prevent chronic symptoms of asthma (e.g., coughing or breathlessness at night, in the early morning, or after exertion).
      - Retain recognition of hypoglycemia symptoms.
      - Maintain near-normal lung function.
      - Maintain normal activity levels (including exercise and other physical activity).
      - Prevent recurrent exacerbations of chronic conditions and minimize the need for hospitalization or ER visits.
      - Prevent recurrence of atrial fibrillation.
   b. Drug-related: Prevent, minimize, or manage drug-related morbidity.
      - Monitor for side effects or toxicity.
      - Monitor for drug-drug, drug-disease, and drug-food interactions.
3. *Behavioral outcomes*
   a. Obtain annual eye exams.
   b. Develop a consistent support system.
   c. Adhere to a medication regimen.
   d. Get routine and timely medical examinations and laboratory tests.
   e. Avoid stimulants or over-the-counter products that may affect blood glucose, blood pressure, asthma, or circulation, such as alcohol, caffeine, nicotine, and decongestants.
4. *Pharmacoeconomic outcomes*
   a. Keep drug and treatment costs within patient resources.
   b. Make cost-effective and efficient use of health care resources.
5. *Quality-of-life outcomes*
   a. Match, or only minimally change, patient lifestyle and activities with disease treatment.
   b. Aim for no missed days or interference with work, school, or daily activities because of disease symptoms.
   c. Work to ensure patient satisfaction with the pharmaceutical care and health care team.

Table 2. Examples of B.L.'s Therapeutic Endpoints

- LDL cholesterol: <100 mg/dl
- HDL cholesterol: >55 mg/dl
- Triglycerides: <150 mg/dl
- A1C: <7.0%
- Self-monitoring of blood glucose: testing at least twice daily with a mean <140 mg/dl (SD <40) and no more than 25–30% of results >180 mg/dl
- Retention of recognition of hypoglycemic symptoms
- No more than one to two episodes of mild hypoglycemia per 1–2 weeks; no episodes of severe hypoglycemia requiring emergency assistance
- Blood pressure: <130/80 mmHg, with minimal or no signs or symptoms of orthostatic hypotension
- Biochemical measures, such as potassium, calcium, magnesium, uric acid, serum creatinine, and blood urea nitrogen: within normal levels
- Improvement in or no worsening of peripheral edema
- Daytime asthma symptoms less than twice a week, nighttime symptoms no more than twice a month, and symptoms responsive to inhaled β2-agonist within 15 minutes
- Sublingual nitroglycerin use limited to identifiable causes such as exertion or for prophylaxis (e.g., pre-exercise dose)
- No emergency or urgent medical visits and no ER admissions
- Attain/maintain control of ventricular rate to <100 bpm
- Urinary albumin excretion: <30 μg albumin/mg creatinine
- Serum digoxin: 1.5–2.0 ng/ml

3. Wrong drug regimen (or device or intervention) prescribed/more efficacious choice possible
4. Too much of the correct drug
5 Too little of the correct drug
6. Adverse drug reaction/drug allergy
7. Drug-drug, drug-disease, drug-food interactions
8. Patient not receiving a prescribed drug
9. Routine monitoring (labs, screenings, exams) missing
10. Other problems, such as potential for overlap of adverse effects

Once problems are identified, resolutions must be developed, prioritized, and implemented. Patient or caregiver input is especially helpful at this stage because the individual can describe subjective as well as objective data, expectations or concerns that may be affecting drug therapy, and deficits in drug knowledge, understanding, or administration.

Resolutions may result from numerous strategies, including dose alteration, addition or discontinuation of medication, adjunct medications, regimen adjustment, complementary therapies, instruction on medication administration or devices, disease or medication education, development of "cues" as compliance reminders (e.g., pill boxes), and identification of ways to avoid, detect, or manage side effects or toxicities. Needless to say, the involvement of patients and family or caregivers is critical for successful implementation of most resolution strategies and for optimal disease management.

Because of the extent of B.L.'s medication-related problems and potential interventions (Tables 3 and 4), it was agreed to tackle first her asthma exacerbations and high blood glucose levels. To this end, B.L. was counseled about the role of maintenance asthma medications versus rescue drugs. The root of her confusion between these agents was easy to understand—because the prednisone and fluticasone were both called steroids, it seemed likely that the tablets were a cheaper and easier way to take the medicine. Likewise, since albuterol and salmeterol were both called bronchodilators, it seemed that the albuterol was the cheaper way to take the medicine.

Having grasped the concept of asthma prevention, she was willing to convert to a product combining fluticasone and salmeterol (Advair Diskus) for maintenance/prevention and to reserve the albuterol for quick relief of acute symptoms. Free samples of the new product were dispensed, and B.L. was enrolled in the manufacturer's indigent drug program for subsequent supplies.

She was further instructed on the use of a peak flow meter and advised to monitor her readings and symptoms. At the next visit, these data will be used to determine her maximal expiratory effort ("personal best") and to construct an asthma action plan.

B.L.'s insulin was changed to a basal-based regimen utilizing bedtime glargine (Lantus) insulin and premeal lispro (Humalog) insulin. Education was provided on this dosing concept. She and the pharmacist discussed how this regimen can give greater flexibility in dosing, especially for responding to changes in diet, exercise, and disease exacerbations or medications. She was also given an initial supplementary adjustment algorithm (sliding scale) to correct for any temporary elevation of blood glucose. She agreed to test four times daily and to record her blood glucose results, carbohydrate intake, and insulin doses. At the next visit, these data will be used to modify the adjustment algorithm and to construct a prospective algorithm for matching premeal bolus insulin to the anticipated carbohydrate intake (insulin-to-carbohydrate ratio).

The final interventions for this visit were to increase the dose of potassium chloride and change the fluvastatin to atorvastatin (Lipitor) to further reduce B.L.'s LDL cholesterol. Medication education for atorvastatin was provided, and patient questions were answered.

Other medication-related problems and interventions identified for B.L. are listed and briefly discussed in Tables 3 and 4. For the sake of brevity, these lists are not inclusive nor are all pharmacotherapy issues discussed.

Monitoring for Effectiveness, Side Effects, and Toxicity

The last step in the PWDT process is to develop a plan to evaluate the patient's progress in attaining desired outcomes, therapeutic endpoints, and behavior changes; to assess effectiveness of pharmacotherapy; and to identify side effects, drug interactions, or toxicity issues that need to be addressed.

The monitoring/follow-up component is the most tedious aspect of the PWDT. For each medication or intervention, key parameters must be identified as markers for effectiveness, for side effects, for drug interactions, and for toxicity. In addition, the time frame and process for assessing those parameters must be determined. Finally, the desired range for the parameter must be listed or a "decision point" must be identified to signal that additional action will be required.

It should be noted that only a limited number of parameters are selected for a given patient. For example, it is not necessary to list and monitor for every possible side effect with equal intensity and frequency. Selection of the monitoring parameters is based on the positive effects (efficacy) that are most important to the care of that patient, as well as the adverse effects

Table 3. Examples of B.L.'s Medication-Related Problems

1. *No indication for a current drug*
   None
2. *Indication for a drug (or device or intervention) but none prescribed*
   a. Peak flow meter
   b. Calcium/vitamin D supplementation
      • Chronic or frequent systemic or inhaled corticosteroid therapy has been associated with decreased bone mineral density (especially in postmenopausal women not taking estrogens); furosemide can cause hypocalcemia.
   c. Magnesium supplementation
      • Evidence for the routine use of magnesium in diabetes is lacking. However, hypomagnesemia is a risk factor for recurrence of atrial fibrillation and is associated with hypertension, insulin resistance, glucose intolerance, dyslipidemia, increased platelet aggregation, and cardiovascular disease.[6] Addition of a magnesium supplement is warranted in light of the recent exacerbations of asthma, elevated blood glucose, and increased doses of drugs that deplete body magnesium. An added benefit is that this may counter some of the constipation that may occur with the calcium supplement.
   d. Angiotensin-converting enzyme (ACE) inhibitor
      • For most patients >55 years of age with diabetes and hypertension, an ACE inhibitor is indicated. For B.L., however, the use of diltiazem (a nondihydropyridine calcium-channel blocker) addresses several needs with just one agent: angina therapy, hypertension therapy, prevention of recurrence of atrial fibrillation, and prevention of progression of nephropathy. If additional antihypertensive, renal, or cardiac effects are indicated, an ACE inhibitor should be added to the drug regimen.
   e. Evaluation for possible drug-induced or postmenopausal osteoporosis
3. *Wrong drug regimen prescribed/more efficacious drug (or nonpharmacological intervention) possible*
   a. Fluvastatin is inadequate to achieve a 39% reduction in LDL cholesterol. Even at maximal doses (80 mg daily), this agent would be expected to reduce LDL by about 36%.[7]
   b. Routine twice-daily doses of premixed insulin do not allow for rapid and efficient correction of glycemic excursions.
   c. Patient has no asthma action plan to guide self-monitoring and self-management of acute or impending exacerbations.
   d. Fluticasone and salmeterol can be given in a combined product (Advair).
   e. Nonpharmacological options for lower-extremity edema may improve diuretic response, such as elevation of extremities during the day to reduce swelling and minimize use of diuretic; use of support stockings; limit salt intake if appropriate.
   f. The use of >120 mg furosemide/day may signal the emergence of diuretic resistance and suggest the need for sequential nephron blockade.[8] However, before adding an agent such as spironolactone (Aldactone) or metolazone (Zaroxolyn), other causes should be ruled out or minimized, such as excessive dietary fluid and sodium intake and the use of sodium-retentive or anti-natriuretic drugs such as prednisone and nonsteroidal anti-inflammatory drugs (NSAIDs).
   g. Patient is using prednisone and albuterol as sole maintenance and rescue medications for asthma (because of financial constraints).
4. *Too much of the correct drug*
   a. Patient is using excessive doses of salmeterol and fluticasone as treatment for asthma exacerbations (at times when she can afford them).
5. *Too little of the correct drug*
   a. Potassium chloride supplement
6. *Adverse drug reaction/drug allergy*
   None
7. *Drug-drug, drug-disease, drug-food interactions*[7]
   a. Systemic corticosteroid therapy, inhaled corticosteroid therapy, loop diuretics in postmenopausal woman: increased risk for development of osteoporosis
   b. Furosemide, prednisone in diabetes, w/insulin, rosiglitazone: may increase blood glucose (dose-related response), thus diminishing the pharmacodynamic activity of antidiabetes agents
   c. Albuterol, salmeterol in diabetes, w/insulin, rosiglitazone: sympathomimetics may increase blood glucose via stimulation of β2-receptors, leading to increased glycogenolysis and diminished pharmacodynamic activity of antidiabetes agents
   d. Albuterol, naproxen, prednisone, fluticasone in hypertension: may increase blood pressure (dose-related response)
   e. Naproxen, prednisone, aspirin w/furosemide: may decrease the diuretic, naturetic effects of furosemide
   f. Naproxen in hypertension: may increase blood pressure by inhibition of vasodilatory prostaglandins
   g. Naproxen in diabetes: may increase risk of nephropathy by inhibition of vasodilatory prostaglandins in renal arteries. Chronic or excessive use of NSAIDs should be avoided in diabetes.
   h. Furosemide, fluticasone, elevated blood glucose levels: additive hypomagnesemic effects
   i. Furosemide, prednisone, fluticasone, salmeterol, albuterol: additive hypokalemic effects
   j. Furosemide, prednisone, fluticasone, salmeterol, albuterol w/digoxin: additive hypokalemic effects may lead to increased potential for digoxin toxicity.
   k. Diltiazem w/digoxin: may elevate digoxin levels. As long as the dose of diltiazem is consistent, dose of digoxin can be titrated to compensate. Risk of AV block
   l. Rosiglitazone, insulin: edema. Combined use of insulin with rosiglitazone may increase the risk of heart failure or edema. However, discussion with the patient and examination of the record shows that the edema predated the initiation of rosiglitazone, and the edema has not significantly worsened.
   m. Digoxin with fluvastatin: some HMG CoA reductase inhibitors, including fluvastatin, may increase serum digoxin levels.
   n. Prednisone, aspirin, naproxen, and potassium chloride in patient with history of anemia: additive potential for adverse gastrointestinal effects, such as gastritis and gastric mucosa injury, and recurrence of anemia
   o. Aspirin with diltiazem: diltiazem may enhance the antiplatelet effects of aspirin, leading to prolonged bleeding time.
8. *Patient not receiving a prescribed drug*
   a. Salmeterol and fluticasone: not purchased because of financial constraints
9. *Routine monitoring (labs, screenings, exams) missing*
   a. Annual dilated eye exam is due.
   b. Annual microalbuminuria test is due.
   c. Consider screening for depression.

(side effects, toxicity, or drug interactions) that are most important to avoid for the safety of that patient or to which that patient is most prone.

Because the monitoring component is usually extensive, examples listed for B.L. in Table 5 have been limited to three of the medication or regimen changes that were made at the first pharmacist visit: switching from fluvastatin to atorvastatin; switching from two shots of premixed 75/25

Table 4. Examples of B.L.'s Interventions (Prioritized and to be Implemented Accordingly)

1. *Asthma*
   a. Change fluticasone and salmeterol prescriptions to a single combination product.
   b. Limit use of albuterol inhaler (short-acting β-agonist) to rescue only.
   c. Consider addition of leukotriene inhibitor if symptoms are not controlled by consistent use of inhaled corticosteroid (medium to high dose) and inhaled long-acting β-agonist.
   d. Begin use of peak flow meter every morning upon arising.
   e. Develop and implement an asthma action plan.
   f. Remove or reduce exposure to environmental triggers.
2. *Diabetes*
   a. Change insulin to a basal-based regimen using bedtime glargine and premeal lispro to allow initiation and optimal use of insulin adjustment algorithms.
      • Compensatory algorithm (insulin supplement, or "sliding scale"): adjustments to compensate for unexpected, transient elevations of blood glucose such as from asthma exacerbation or prednisone therapy
      • Prospective algorithm: adjustments to match premeal rapid-acting insulin with anticipated carbohydrate ingestion at meals
3. *Dyslipidemia*
   a. Change fluvastatin to atorvastatin.
4. *Persistent lower-extremity edema*
   a. Elevate extremities for 20–30 minutes, two to three times during the day.
   b. Wear support stockings on days when B.L. is anticipating being on her feet most of the day.
   c. Limit salt intake.
   d. Minimize use of nonsteroidal antiinflamatory drugs (NSAIDs) (see below).
5. *Hypokalemia*
   a. Increase potassium chloride supplement temporarily; reassess potassium level in 7–10 days. Titrate potassium dosage with decreasing use of albuterol, furosemide, and prednisone to attain and maintain potassium level of 3.5–5.0 mEq/l.
6. *Hypertension*
   a. No changes at this time. Monitor and consider addition or change to ACE inhibitor if additional antihypertensive effects are needed, microalbuminuria occurs, cardiac or other adverse effects occur from diltiazem, or cardiac status warrants.
7. *Coronary artery disease*
   a. No changes at this time.
8. *Obesity*
   a. Refer B.L. for nutrition counseling and weight loss.
9. *Chronic pain*
   a. Change ongoing pain medications to acetaminophen ES, 500–650 mg three times a day. Minimize use of NSAIDs by limiting it to "breakthrough" pain only, using lower doses, such as naproxen, 250 mg, or ibuprofen, 200 mg, as needed.
10. *Financial constraints*
    a. Apply for manufacturers' indigent drug programs for combination asthma product and other expensive medications. If B.L. qualifies for one or more of these programs, her family may be better able to afford blood glucose strips and other health care costs.
11. *Wellness, preventive, and routine monitoring issues*
    a. Initiate calcium/vitamin D supplementation.
    b. Initiate magnesium supplementation.
    c. Screen for depression.
    d. Reduce daily aspirin from 325 to 81 mg.
    e. Refer for annual eye exam.
    f. Refer for bone density scan.
    g. Refer for nutritional counseling for assessment of and intervention for cholesterol, sodium, calcium, vitamin D, and carbohydrate intake.
12. *Patient education*
    a. Asthma
       • Medication education related to purposes and dosing schedule for maintenance versus quick-relief (rescue) medications
       • Use of peak flow meter and peak flow diary. Establishing patient's "personal best" and individualized peak flow zones. Actions to take if meter readings are in the "red zone," "yellow zone," or "green zone" (asthma action plan)
       • Early warning signs of asthma exacerbation; identification and avoidance of asthma triggers; environmental modifications
       • Use of combination dry powder inhalation product
    b. Diabetes
       • Use of insulin adjustment algorithms. Relationship of blood glucose to other medications and disease states
       • Verification of accuracy of glucose self-monitoring technique and insulin administration
       • Verification of patient's ability to identify and quantify carbohydrate content in meals
    c. Lower-extremity edema
       • Use of support stockings (sizing, how/when to apply correctly)
    d. Nutrition
       • Carbohydrate, sodium, cholesterol, calcium, vitamin D
    e. Medication education
       • For all new medications

lispro to bedtime glargine with premeal lispro; and substituting the combination inhaler product for her fluticasone and salmeterol MDI prescriptions. Because atorvastatin and fluvastatin differ chemically, the monitoring parameters for this change are similar to those for initiation of a new medication. Monitoring for the new insulin regimen (basal insulin with premeal bolus) focuses primarily on glycemic control patterns and hypoglycemic episodes. Because B.L. has previously used the two ingredients of her new inhaler product (fluticasone and salmeterol) without adverse effect, monitoring of her new asthma therapy is focused on effectiveness, tolerance of inhalation of its dry powder formula, and use of the administration device.

Summary

Diabetes patients with multiple comorbidities have concerns about all of their problems, not just the diabetes; therefore, BC-ADM pharmacists must comprehensively explore all the ramifications of comorbidities as well as patients' feelings, expectations, and concerns for total health. B.L. is a good example of this; even though her

Table 5. Examples of B.L.'s Monitoring Plans

Fluticasone/salmeterol combination inhaler

Monitoring: *Effectiveness*

Parameter	Frequency	Desired Range
Wheezing, shortness of breath	Ongoing by patient; notify provider if bothersome, intolerable, increased frequency, or nonresponsive to quick-acting bronchodilator; assess at every visit.	None or minimal
Breath sounds	Baseline and at every visit	Minimal or no change from baseline; ideally, normalization
Pulmonary function tests	Baseline and annually or if suspect	Minimal or no change from baseline; ideally, normalization

Monitoring: *Toxicity/Adverse Reactions*

Parameter	Frequency	Desired Range
Headaches (12–13%)	Ongoing by patient; notify provider if bothersome or intolerable.	None or minimal
Pharyngitis; signs/symptoms of upper respiratory infection, sinusitis; oral candidiasis	Ongoing by patient; notify provider if noted.	None or minimal
Conjunctivitis, eye redness, keratitis, or eye pain	Ongoing by patient; notify provider if noted.	None
Nasal congestion	Ongoing by patient; notify provider if bothersome or intolerable.	None or minimal
Throat irritation; hoarseness	Ongoing by patient; notify provider if bothersome or intolerable.	None or minimal
Blood pressure	Baseline and at every visit. If patient can be taught to perform home blood pressure monitoring, encourage daily, then weekly, then monthly monitoring when stable.	Minimal or no change from baseline
Pulse	Baseline and at every visit. If possible, teach patient to perform with each home blood pressure check.	Minimal or no change from baseline
Excessive nervousness, hyperactivity, insomnia, malaise or dizziness (signs/symptoms of central nervous system stimulation)	Ongoing by patient; notify provider if bothersome or intolerable.	None or minimal

Glargine and lispro

Monitoring: *Effectiveness*

Parameter	Frequency	Desired Range
Blood glucose	Baseline and daily by patient, two to four or more tests per day depending on clinical status	Premeal and bedtime blood glucose 70–140 mg/dl
A1C	Baseline and every 6 months; every 3 months if unstable or if blood glucose target not met	<7%
Hypoglycemic symptoms	Ongoing by patient; assess at every visit.	No more than one to three mild episodes/week; fewer or none if elderly or hypoglycemia unawareness
Hyperglycemic symptoms	Ongoing by patient; assess at every visit.	None or minimal

Monitoring: *Toxicity/Adverse Reactions*

Parameter	Frequency	Desired Range
Moderate or severe hypoglycemia, requiring assistance	Ongoing by patient; assess at every visit.	None or minimal. If severe or frequent, decrease dose of appropriate insulin
Injection site reactions: itching, swelling, redness, lipodystrophy	Ongoing by patient; assess at every visit. Notify provider as soon as possible if bothersome or intolerable.	None or minimal
Serum potassium	Baseline and every 6–12 months or if suspect	3.5 < K < 5.0 mEq/l
Weight gain, with no other apparent cause	Baseline and at every visit	Minimal or no change from baseline

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Table 5. Examples of B.L.'s Monitoring Plans *cont'd*

Atorvastatin

Monitoring: *Effectiveness*

Parameter	Frequency	Desired Range
Fasting lipid profile	Baseline, and in 6 weeks, 3–4 months, and then yearly or if suspect	In diabetes: HDL, male >45 mg/dl, female >55 mg/dl; LDL <100 mg/dl; triglycerides <150 mg/dl

Monitoring: *Toxicity/Adverse Reactions*

Parameter	Frequency	Desired Range
Creatine phosphokinase	Baseline and every 6–12 months or if suspect	Minimal or no change from baseline. Discontinue if >10× upper base limit of normal.
Liver function tests	Baseline, at 12 weeks after initiation or elevation in dose, and periodically (e.g., every 6 months)	Minimal or no change from baseline. Consider discontinuing if >2.5–3× upper limit of normal.
Muscle aches or muscle weakness, especially with fever or malaise	Ongoing by patient; notify provider immediately.	None or minimal
Gastrointestinal: constipation, flatulence, dyspepsia, and abdominal pain	Ongoing by patient; notify provider if bothersome or intolerable.	None or minimal
Headache	Ongoing by patient; notify provider if bothersome or intolerable.	None or minimal
Digoxin level	At initiation of atorvastatin and in 6–8 weeks or if signs/symptoms of digoxin toxicity	Minimal or no change from baseline

referral was for "diabetes management," her greatest concern at this visit was her asthma exacerbations.

As can be seen in this case, each coexisting disease or coprescribed drug has a domino effect, affecting other diseases or drugs and ultimately affecting quality of life. With input from B.L., the pharmacist clinician was able to develop a PWDT that addresses her diabetes as well as her other health care needs.

B.L. was able to leave the health center with a few achievable self-care goals and medication changes that address her acute concerns and with the knowledge and confidence that, at each subsequent visit, additional progress will be made toward her personalized health status goals.

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Suggested Readings

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For information concerning POEMs and DOEs: a multitude of literature on this topic is available through Internet sources. Search for "patient oriented evidence that matters" using a medical topic browser.

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