



City Health Information

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The New York City Department of Health and Mental Hygiene

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DIABETES PREVENTION AND MANAGEMENT

CLINICAL CARE PRIORITIES: THE ABC'S OF DIABETES

Measure	Frequency of Monitoring	Goal
A1C	Every 3–6 months	< 7%
Blood Pressure	Every visit	< 130/80
Cholesterol (LDL)	Annually	< 100 mg/dL
Smoking status	Every visit	Prevention and cessation

WHAT PROVIDERS CAN DO

- Promote physical activity, healthy food choices, and weight loss in persons at risk for developing diabetes.
- Screen for diabetes and pre-diabetes in adults with hypertension, hyperlipidemia, and those ≥ 45 years of age who are overweight.
- Prevent diabetes-associated complications by monitoring and controlling the **ABC'S** of diabetes (hemoglobin **A1C**, **B**lood pressure, **C**holesterol, **S**moking status).

Diabetes is epidemic throughout the United States. In New York City (NYC), the prevalence has doubled in the past 8 years. Approximately 1 in 5 New Yorkers 65 years of age and older has diabetes!

Diabetes is a leading cause of hospitalization and death. Persons with diabetes have a 2–6 times greater risk of death from cardiovascular events than persons without diabetes. Nationally, the annual cost of caring for persons with diabetes is estimated to be \$132 billion; 1 in 10 health care dollars.²

Overweight and obesity greatly increase the risk of diabetes. Eighty percent of adults in NYC with diabetes are overweight. In the United States, epidemics of both obesity and type 2 diabetes are emerging in both children and adolescents.³ The national prevalence of obesity among children and adolescents is over 15%, and among certain ethnic populations is as high as 30%.^{4,5} Type 2 diabetes now accounts for 8–45% of new cases of childhood diabetes.⁶ There is also an increase in adult New Yorkers under the age of 40 who have diabetes, particularly Hispanics. In this age group, the prevalence in Hispanics is 3%, twice that of blacks and 4 times that of non-Hispanic whites and Asians.

On average, diabetes is present 4–7 years before being diagnosed.⁷ At the time of diagnosis, approximately half of all persons with the disease are already experiencing

complications. It is estimated that 1 in 3 Americans with diabetes is undiagnosed.⁷

Gestational diabetes (GDM) complicates approximately 7% of all pregnancies and is seen in 14% of pregnancies among certain ethnic groups (eg, Hispanic, African-American, and Native-American).⁸ Approximately half of all women with GDM progress to diabetes, usually type 2, within 10 years.⁸ Offspring of women with GDM are at increased risk for obesity, glucose intolerance, and diabetes in late adolescence and young adulthood (**Table 1**).

There are significant neighborhood and racial/ethnic disparities in diabetes prevalence. East Harlem has the highest prevalence in NYC (15%), 7.5 times that of the Upper East Side (2%). Other neighborhoods with high prevalence (10–15%) include Bushwick, Bedford-Stuyvesant, Washington Heights, and the South Bronx. Hispanic (12%) and black (11%) adult New Yorkers are more likely to have diabetes than non-Hispanic whites or Asians (< 7%).¹

PREVENTING DIABETES

Recently, persons at high risk for developing diabetes have been described as having pre-diabetes. Pre-diabetes is defined as either impaired fasting glucose or impaired glucose tolerance (**Box 1**). Without lifestyle modification, most individuals with pre-diabetes will develop diabetes within 10 years.⁹ Persons with pre-diabetes are also at a

50% greater risk of developing heart attack or stroke than are persons without pre-diabetes.¹⁰ There is strong evidence that overweight persons (**Table 2**) with pre-diabetes can reduce their risk of developing diabetes by up to 60% with modest increases in physical activity and reduction in weight.^{9,11} Lifestyle modification is more effective at preventing or delaying diabetes than drug therapy with metformin.⁹ For every 7 persons with pre-diabetes who engage in 30 minutes of physical activity 4 days each week and reduce their weight by 5%, 1 case of diabetes is prevented.

PREVENTING DIABETES-ASSOCIATED COMPLICATIONS

Stopping smoking and controlling the **ABC'S** of diabetes (hemoglobin A1C, Blood pressure, Cholesterol, Smoking status) (**Boxes 2, 3**) can significantly improve the quality of life and rates of illness and death in persons with diabetes. Intensive glycemic control (**Table 3**) in persons with type 1 diabetes reduces retinopathy, nephropathy, and neuropathy by 54–76%.¹² Persons with type 2 diabetes who adhere to intensive blood pressure control significantly reduce their risk of microvascular complications, visual loss, stroke, heart failure, and diabetes-related death.¹³ Intervention aimed at intensive control of blood glucose (A1C) (**Table 4**), blood pressure, and cholesterol reduces by approximately 50% the risk of cardiovascular and microvascular events in patients with type 2 diabetes and microalbuminuria (a strong predictor of cardiovascular risk).¹⁴ Optimally treating 5 people who have type 2 diabetes and microalbuminuria will prevent 1 cardiovascular event. Studies suggest that aspirin therapy and angiotensin-converting enzyme (ACE) inhibition also reduce cardiovascular risk.^{15,16} Moderate drinking (not more than 1–2 drinks a day) is associated with lower CVD risk.

Caring for patients with diabetes (**Box 3**) involves a team approach, including physicians, nurses, diabetes educators, pharmacists, nutritionists, podiatrists, mental health professionals, exercise specialists, and the patient. Meal planning, physical activity, blood glucose monitoring, and patient education are the cornerstones of diabetes management for all patients. When drug therapy is used (**Box 4**), it should always be in combination with meal planning and physical activity. Over time, most patients will require insulin and/or combination therapy with 2 or more drugs with different mechanisms of action. If glycemic control is not maintained, more aggressive therapy, including starting insulin, should be initiated early in the progression of the disease (**Figure 1**). The practice of medicine is a blend of science and art, and guidelines are not a substitute for good clinical judgment.

Clinicians can address the diabetes epidemic by identifying and effectively counseling high-risk patients (Box 2) and by treating diabetes and its complications aggressively.

TABLE 1. GESTATIONAL DIABETES: SCREENING AND DIAGNOSIS

Screening for Gestational Diabetes (GDM): Risk assessment should begin at the first prenatal visit.

High risk: Women with a personal history of GDM or an obstetric outcome indicative of GDM, a strong family history of diabetes, marked obesity, or glycosuria should be screened as soon as feasible. If they are found not to have GDM, they should be re-screened at 24–28 weeks of gestation.

Average risk: Women > 25 years of age not considered to be at high-risk should be screened at 24–28 weeks of gestation.

Low risk: Women who have ALL of the following characteristics do not need to be screened: < 25 years of age; normal weight before pregnancy; member of an ethnic group with low prevalence of GDM; no known history of diabetes in first-degree relatives; no history of abnormal glucose tolerance; and no history of poor obstetric outcome.

Diagnosis of GDM is made with a 1-step or 2-step approach.

1-step approach: Perform a diagnostic oral glucose tolerance test (OGTT) without prior glucose screening. This may be cost-effective in high-risk patients or populations.

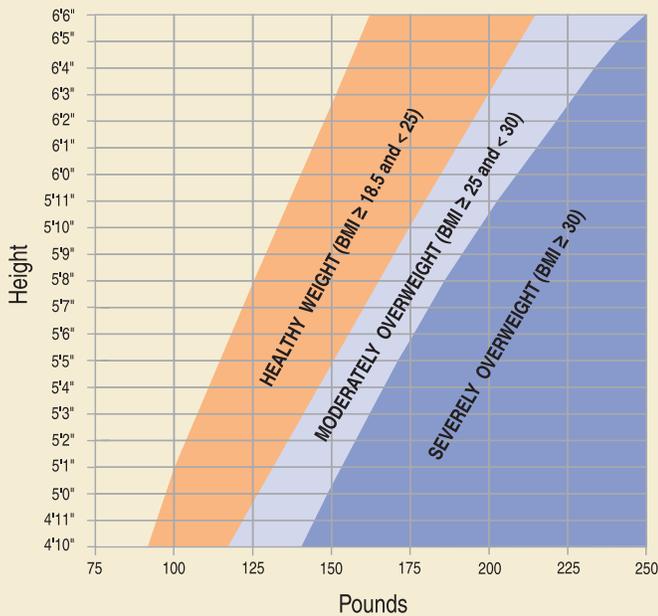
2-step approach: Perform an initial screening with the 1-hour 50-g oral glucose load using a glucose challenge test (GCT). Perform a diagnostic OGTT on women exceeding a glucose threshold of 140 mg/dL (80% sensitivity) or 130 mg/dL (90% sensitivity) for the GCT at 1 hour.

Diagnosis of GDM with a 100-g OGTT

Fasting	≥ 95 mg/dL
1-h	≥ 180 mg/dL
2-h	≥ 155 mg/dL
3-h	≥ 140 mg/dL

Two or more of the above 100-g OGTT values must be met for a positive diagnosis of GDM. The test should be done in the morning after an 8–14 hour fast.

TABLE 2. HEALTHY WEIGHT GUIDELINES*



To calculate BMI visit <http://nhlbisupport.com/bmi>

*Not applicable to pregnant women.

Adapted with permission from Willett WC. *Eat, Drink, and Be Healthy. The Harvard Medical School Guide to Healthy Eating.* New York, NY: Simon and Schuster; 2002.

TABLE 3. GLYCEMIC CONTROL FOR NON-PREGNANT ADULTS WITH DIABETES

A1C	< 7.0%
Preprandial plasma glucose	90–130 mg/dL
Peak postprandial plasma glucose	< 180 mg/dL

Key concepts for setting optimal glycemic goals:

- Goals are tailored to meet a patient’s individual needs. Certain populations, such as children, pregnant women, and the elderly, warrant special consideration.
- Patients with severe or frequent hypoglycemia may warrant less intensive glycemic control.
- Intensive glycemic goals may reduce microvascular complications but at the cost of increased risk of hypoglycemia.
- If preprandial glucose goals have been met, but A1C goals have not, consider altering postprandial glucose goals.

TABLE 4. CORRELATION BETWEEN A1C AND MEAN PLASMA GLUCOSE LEVELS

A1C (%)	Mean Plasma Glucose (mg/dL)
6.0	135
7.0	170
8.0	205
9.0	240
10.0	275
11.0	310
12.0	345

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Table 3 and 4 adapted with permission from the American Diabetes Association. Standards of medical care for patients with diabetes mellitus. *Diabetes Care.* 2003;26:33–50.

NATIONAL DIABETES STUDIES CURRENTLY RECRUITING PARTICIPANTS IN NEW YORK CITY

Diabetes Prevention Studies

DREAM

Diabetes Reduction Approaches with Ramipril and Rosiglitazone Medications

The aim of this study is to determine if the drugs ramipril and/or rosiglitazone can prevent type 2 diabetes in persons at high risk with impaired glucose tolerance.

(212) 305-6357

www.dream-ctn.org

TRIGR

Trial to Reduce Insulin-Dependent Diabetes in the Genetically at Risk

The aim of this trial is to determine if a diet free of complex proteins within the first 6 months of life will reduce the risk of type 1 diabetes in persons at high-risk genetically for diabetes.

(212) 851-5425

www.TRIGR.org

Diabetes Management Studies

ACCORD

Action to Control Cardiovascular Risk in Diabetes

The aim of this study is to determine the best approach to lowering the risk of heart disease and stroke by controlling blood sugar, blood pressure, and cholesterol in adults with type 2 diabetes.

(212) 305-6357

www.accord-ne.org

BARI 2D

Bypass Angioplasty Revascularization Investigation in Type 2 Diabetes

The aim of this study is to determine if immediate coronary revascularization vs. delayed or no revascularization improves the 5-year survival in patients with type 2 diabetes, coronary stenoses, and stable angina who are simultaneously given optimal medical care.

Local (212) 241-8901 National (412) 624-4300

www.BARI2D.org

LOOK AHEAD

Action for Health in Diabetes

The aim of this study is to assess the long-term effects of weight loss, especially on heart attack and stroke incidence, in both men and women who are overweight and have type 2 diabetes.

(212) 523-8037

www.lookaheadstudy.org

RESOURCES

National

American Association of Diabetes Educators (800) Team-Up-4
(800) 832-6874
www.aadenet.org

American Diabetes Association (800) DIABETES
(800)-3-422-3837
www.diabetes.org

American Dietetic Association (800) 366-1655
www.eatright.org

Centers for Disease Control and Prevention
Division of Diabetes Translation (877) 232-3422
www.cdc.gov/diabetes

National Diabetes Education Program (800) 438-5383
www.ndep.nih.gov

National Institute of Diabetes and Digestive and Kidney Diseases
National Diabetes Information Clearinghouse. (800) 860-8747
www.niddk.nih.gov

Juvenile Diabetes Research
Foundation International (800) JDF-CURE
(800) 533-2873
www.jdf.org

State

New York State Diabetes Prevention
and Control Program (518) 474-1222
www.cdc.gov/diabetes/states

Local

New York City Department of Health and Mental Hygiene
Diabetes Prevention and Control Program (212) 676-2165
www.nyc.gov/health

Greater New York City Area American
Diabetes Association (888) DIABETES
(888)-3-422-3837
www.diabetes.org



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BOX 1. DIAGNOSING DIABETES

	Pre-Diabetes	Diabetes
Fasting Plasma Glucose	100–125 mg/dL (Impaired fasting glucose)	≥ 126 mg/dL
75-g Oral Glucose Tolerance Test (OGTT), 2 hour	140–199 mg/dL (Impaired glucose tolerance)	≥ 200 mg/dL
Random Plasma Glucose	No Criterion	≥ 200 mg/dL and symptoms of diabetes (eg, polyuria, polydipsia, unexplained weight loss)

Adapted with permission from the American Diabetes Association. Standards of medical care for patients with diabetes mellitus. *Diabetes Care*. 2003;26:33–50.

BOX 2. SCREENING FOR DIABETES AND PRE-DIABETES IN ADULTS

TARGET POPULATIONS:

- Screen adults with hypertension or hyperlipidemia. If test results are normal, repeat periodically.
- Screen adults 45 years of age and older if they are overweight (BMI ≥ 25 kg/m²). If test results are normal, repeat in 3 years.
- Use clinical judgment to determine if adults with other risk factors should be screened.

RECOMMENDED SCREENING TEST (TABLE 1):

Fasting plasma glucose (preferred initial screening test) or Oral Glucose Tolerance Test (OGTT). A1C should not be used as a screening test.

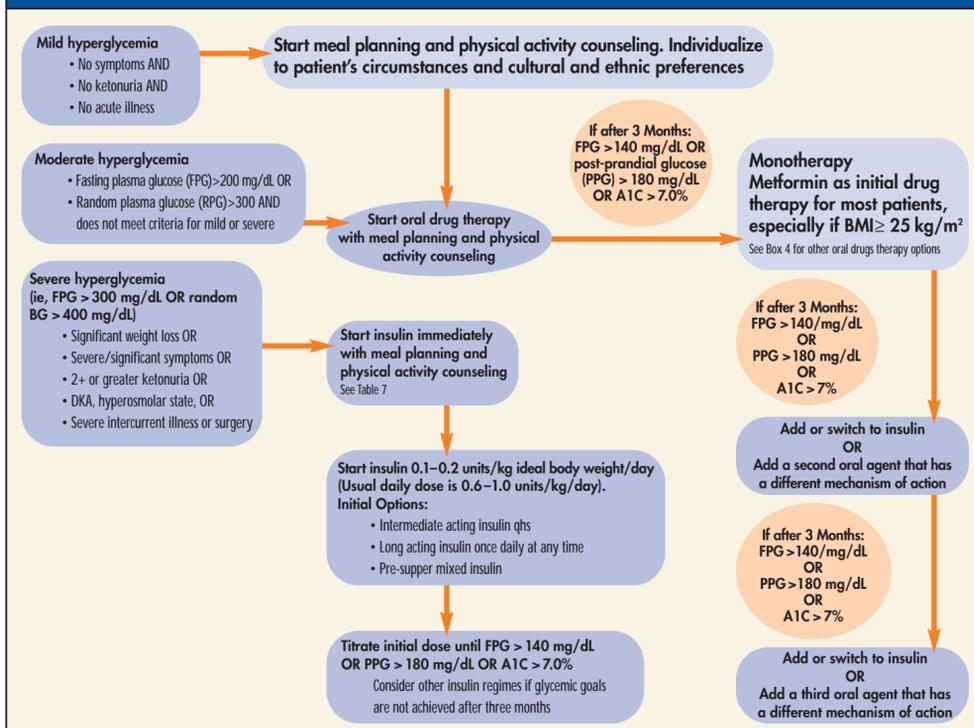
BOX 3. NYC DOHMH ADULT DIABETES CLINICAL PRACTICE RECOMMENDATIONS

CLINICAL CARE PRIORITIES		
Measure	Frequency of Monitoring	Goal
A1C	Every 3–6 months	< 7.0%
Blood pressure	Every visit	< 130/80
Cholesterol (LDL)	Annually	< 100 mg/dL
Smoking status	Every visit	Prevention and cessation
STANDARDS OF CARE		
History and Physical	Frequency	Goal
Blood pressure	Every visit	< 130/80
Weight and BMI (Table 2)	Every visit	Individualize
Dilated retinal exam	Annually	Retinopathy prevention
Comprehensive foot exam	Annually or every visit for high-risk patients	Lower extremity amputation prevention
Laboratory Analysis	Frequency	Goal
A1C	Every 3–6 months	< 7.0%
Fasting lipid profile	Annually	
LDL		< 100 mg/dL
HDL		> 40 mg/dL in men; > 50 mg/dL in women
Triglycerides		< 150 mg/dL
Total		< 200 mg/dL
Urine albumin-to-creatinine ratio (spot sample)	Annually, to screen for microalbuminuria	< 30 µg/mg
ECG	Baseline, as clinically indicated	
Vaccination		
	Recommendation	
Influenza	Annually	
Pneumococcal	Once, but revaccinate if patients are currently ≥ 65 years of age and were vaccinated when < 65 years of age and if 5 years have elapsed	
Counseling and Risk Reduction		
	Recommendation	
Smoking status	Assess tobacco use in all patients at every visit and advise patients NOT to smoke. Provide smoking cessation treatment (www.nyc.gov/html/doh/pdf/di/di21-6.pdf)	
Aspirin therapy	75–325 mg/day in all patients with macrovascular disease and all patients ≥ 40 years of age with 1 or more cardiovascular risk factor(s)	
ACE inhibition/Angiotensin receptor blockade (ARB)	Treatment for HTN or microalbuminuria. Consider using in patients who are > 55 years of age and do not have HTN or microalbuminuria but do have 1 or more other cardiovascular risk factor(s)	
Dental care	Refer for annual dental care	
Sexual functioning	Ask both female and male patients if they are experiencing sexual dysfunction and discuss therapy options	
Depression	Screen using the Prime-MD 2-question Depression Screen below: ¹⁷ <i>During the past month, have you often been bothered by feeling down, depressed, or hopeless?</i> <i>During the past month, have you often been bothered by little interest or pleasure in doing things?</i>	
Preconception counseling and pregnancy care	Optimize glucose control both before and during pregnancy. Consider referring patients to a high-risk perinatal program	
Self-Management		
	Goals (to be set jointly by the clinician and the patient)	
Physical activity	30 minutes of moderate to vigorous physical activity at least 4 days a week	
Nutrition*	Advise a diet low in saturated and trans fats and high in fiber (http://care.diabetesjournals.org/cgi/content/full/26/suppl_1/s51)	
Weight management	For overweight patients (BMI ≥ 25 kg/m ²), advise a 10% weight reduction at a rate of 1–2 lbs per week	
Self blood glucose monitoring	Teach technique; agree on how frequently it should be used and the actions to take if blood sugar is too high or too low	
Self foot exam	Teach technique and evaluate how the patient performs exam	

Adapted with permission from the American Diabetes Association. Standards of medical care for patients with diabetes mellitus. *Diabetes Care*. 2003;26:33–50.

*For more comprehensive nutrition recommendations, visit http://care.diabetesjournals.org/cgi/content/full/26/suppl_1/s51

FIGURE 1. DIABETES TREATMENT ALGORITHM



BOX 4. DIABETES DRUGS

INITIAL ORAL DRUG THERAPY OPTION	ORAL AGENTS	USUAL DAILY DOSE	COST/MONTH
MEFORMIN: Consider in most patients, especially those with BMI ≥ 25 kg/m ² Primary mechanism of action: Decrease hepatic glucose output A1C (%) reduction: 1.5–2.0% Advantages: • Little or no weight gain; possible weight loss • Little or no hypoglycemia • Improved lipid profile • Decreased cardiovascular events by 1/3 in overweight patients • Long-term outcomes have been studied. ¹³ Contraindications: • Creatinine ≥ 1.5 in women or ≥ 1.4 in men • Congestive heart failure • IV Contrast administration • ≥ 80 years of age unless creatinine clearance is normal • Dehydration • Alcohol excess/binge drinking • Pregnancy Adverse effects: Dose-related GI symptoms in ~30% of patients; start at 500 mg or 850 mg qd and increase slowly to minimize GI symptoms; very rare lactic acidosis	BIQUANIDIS Metformin <i>Glucophage*</i> Metformin extended-release <i>Glucophage XR*</i>	1,500–2,550 mg divided 1,500–2,000 mg once	\$51.30 \$69.30 \$37.49 \$61.20

OTHER ORAL DRUG THERAPY OPTIONS

SULFONYLUREAS: Consider in patients with contraindications for metformin or as additional therapy Primary mechanism of action: Increase insulin secretion A1C (%) reduction: 1.5%–2% Advantages: Can be used in patients with mild liver or renal disease; long-term outcomes have been studied. ¹³ Contraindications: • Severe liver or renal disease • Hypoglycemia unawareness • May not be effective in marked hyperglycemia due to glucotoxicity • Pregnancy Adverse effects: Hypoglycemia, especially in the elderly; weight gain	SULFONYLUREAS SECOND GENERATION Glimepiride <i>Amaryl*</i> Glipizide <i>Glucotrol*</i> Glipizide-sustained-release <i>Glucotrol XL*</i> Glyburide <i>DiaBeta*</i> <i>Micronase*</i> Glyburide micronized tablets <i>Glyrase PresEbb*</i>	1–4 mg once 10–20 mg once or divided 5–20 mg once 5–20 mg once or divided 3–12 mg once or divided	\$10.80 \$10.20 \$23.10 \$12.90 \$12.60 \$22.20 \$27.30 \$12.60 \$24.60
MEGLINIDES: May be useful in some patients with post-prandial hyperglycemia: Primary mechanism of action: Increase insulin secretion A1C (%) reduction: ~ 0.5% Advantages: Short-acting; less hypoglycemia than sulfonylureas Contraindications: • Use cautiously in patients with renal insufficiency and impaired liver function • Pregnancy Adverse effects: Hypoglycemia, especially in the elderly; weight gain Long-term outcomes have not been well studied.	NON-SULFONYLUREA SECRETAGOGUES (MEGLINIDES) Nategline <i>Starlix*</i> Regagline <i>Prandin*</i>	60–120 mg t.i.d. before meals 1–4 mg t.i.d. before meals	\$84.60 \$77.40
THIAZOLIDINEDIONES: May be useful in some overweight or obese patients with insulin resistance Primary mechanism of action: Increases insulin sensitivity in skeletal, hepatic, and adipose tissue A1C (%) reduction: ~0.5–1% Advantages: Improved insulin sensitivity; less hypoglycemia than with sulfonylureas. Contraindications: • Class III or IV congestive heart failure • L ≥ 2.5 x upper limit of normal • Pregnancy Adverse effects: Edema, weight gain Long-term outcomes have not been well studied.	THIAZOLIDINEDIONES Pioglitazone <i>Actos*</i> Rosiglitazone <i>Avandia*</i>	15–45 mg once 4–8 mg once or divided	\$88.20 \$75.90
ALPHA-GLUCOSIDASE INHIBITORS: May be useful in some patients with post-prandial hyperglycemia. Primary mechanism of action: Delay gastrointestinal absorption of carbohydrates A1C (%) reduction: ~0.5–1% Advantages: Reduces post-prandial blood glucose related to excessive carbohydrate intake Contraindications: Bowel or intestinal disease Adverse effects: GI symptoms are very common. Start at 25 mg dose and increase slowly over several weeks to minimize. Long-term outcomes have not been well studied.	ALPHA-GLUCOSIDASE INHIBITORS Acarbose <i>Precose*</i> Miglitol <i>Glyset*</i>	50–100 mg t.i.d. with meals 50–100 mg t.i.d. with meals	\$53.10 \$57.60
COMBINATION THERAPY See individual combination drugs for contraindications, advantages, and adverse effects.	COMBINATIONS Glyburide/metformin <i>Glucovance*</i> Glipizide/metformin <i>Meta GLIP*</i> Rosiglitazone/metformin <i>Avandamet*</i>	5 mg/500 mg b.i.d. 5 mg/500 mg b.i.d. 4 mg/500 mg b.i.d.	\$52.20 \$64.20 \$146.40

INSULIN

	ONSET	PEAK	DURATION	COST/10ml VIAL
SHORT-ACTING				
Regular	30–60 min	1.5–2 hrs	5–12 hrs	\$26.20
Rapid-acting				
Lispro - <i>Humalog*</i>	10–30 min	30–60 min	3–5 hrs	\$46.20
Aspart - <i>Novolog*</i>	10–30 min	30–60 min	3–5 hrs	\$48.70
INTERMEDIATE-ACTING				
NPH/Lente	1–2 hrs	4–8 hrs	10–20 hrs	\$25.50/\$24.75
LONG-ACTING				
Glargine - <i>Lantus*</i>	1–2 hrs	no peak	24 hrs	\$43.70
Ultralente	2–4 hrs	8–20 hrs	16–24 hrs	\$25.10
MIXED INSULINS	CONTENT			COST/10ml VIAL
Humulin and Novolin 70 / 30*	70% NPH/30% Regular			\$64.80/\$63.90
Humalog Mix 75 / 25*	75% Lispro protamine suspension/25% Lispro			\$136.50
NovoLog Mix 70 / 30*	70% Aspart protamine suspension/30% Aspart			\$131.40
Humulin 50 / 50*	50% NPH/50% Regular			\$69.30

Adapted with permission from Medical Letter. Treatment guidelines from the Medical Letter: drugs for diabetes. *Medical Letter*. 2002;1–6.

*Use of brand names is for informational purposes only and does not imply endorsement by the New York City Department of Health and Mental Hygiene.