Lipodystrophy. Lipodystrophy (hypertrophy of subcutaneous tissue) or lipoatrophy (atrophy of subcutaneous tissue) may result if the same injection sites are used repeatedly, especially with pork and beef insulins. The tissues become hardened and have an orange-peel appearance. The use of refrigerated insulin may trigger the development of tissue atrophy or hypertrophy. These problems rarely occur with the use of human insulins. Lipodystrophy and lipoatrophy alter insulin absorption, delaying its onset or retaining the insulin in the tissue for a period of time instead of allowing it to be absorbed into the body. Lipodystrophy usually resolves if the area is unused for a minimum of 6 months.

Mixing Insulins. When a person with diabetes requires more than one type of insulin, mixing is recommended to avoid administering two injections per dose. Two different concentrations are administered, because a single dose of intermediate-acting or long-acting insulin rarely provides adequate control of blood glucose levels. The procedure for mixing insulins is described in Box 18–9. Following are some general guidelines.

- Commercially mixed insulins are recommended if the insulin ratio is appropriate for the requirements of the client.
- Regular insulin may be mixed with all other types of insulin; it may be injected immediately after mixing or stored for future use.
- NPH insulin and PZI insulin may be mixed only with regular insulin.
- Lente insulin preparations may be mixed with each other; mixing with regular insulin or with PZI and NPH insulin is not recommended.
- Do not mix human and animal insulins.
- Always withdraw regular insulin first to avoid contaminating the regular insulin with intermediate-acting insulin.

Insulin Regimens. The appropriate insulin dosage is individualized by achieving a balance among insulin, diet, and exercise. For most people with diabetes, the timing of insulin action requires two or more injections each day, often a mixture of rapid-acting and intermediate-acting insulins. Timing of the injections depends on blood glucose levels, food consumption, exercise, and types of insulin used. The objective is to avoid daytime hypoglycemia while achieving adequate blood glucose control overnight. Typical insulin regimens are discussed in Table 18–5.

Hypersensitivity Responses. When injected, insulin may cause local and systemic hypersensitivity responses. Manifestations of local reactions are a hardening and reddening of the area that develops over several hours. Local reactions result from a contaminant in the insulin and are more likely to occur when less purified insulin products are used.

Systemic reactions occur rapidly and are characterized by widespread red, intensely pruritic welts. Respiratory difficulty may occur if the respiratory system is involved. Systemic responses are due to an allergy to the insulin itself and are most

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### Mixing Insulins: 10 Units of Regular and 20 Units of NPH

1. Wash hands.
2. Inspect regular insulin for clarity.
3. Gently rotate NPH insulin to mix well.
4. Wipe off the top of both vials with an alcohol pad.
5. Draw 20 U of air into the syringe, and inject air into the NPH vial (Figure A). Withdraw needle.
6. Draw 10 U of air into the syringe, and inject air into the regular vial (Figure B).
7. Invert the vial, and withdraw 10 U of regular insulin (Figure C). Withdraw the needle.
8. Insert the needle into the NPH vial, and carefully withdraw 20 U of NPH insulin (Figure D).
9. Administer the insulin.
10. Wash hands, and properly dispose of the syringe.

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![Figure A](image1.png)

**A** Injecting air into the NPH vial.

![Figure B](image2.png)

**B** Injecting air into the regular insulin vial.

![Figure C](image3.png)

**C** Withdrawing regular insulin.

![Figure D](image4.png)

**D** Withdrawing NPH insulin.