

Insulin usage technique and associated factors: a cross-sectional study in Southern Brazil

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Annex 1: insulin administration techniques: official guidelines from the Ministry of Health and the Brazilian Diabetes Society
Storage (for both types of insulin presentation):
Unopened vials or pens that are not in use should be stored in a refrigerator at a temperature between 2°C and 8°C. The vial or pen in use should be stored either outside the refrigerator at room temperature (between 15°C and 30°C) or inside the refrigerator at 2-8°C. Do not freeze insulin. -When opening a vial or pen, write the date of first use. Once opened, it is valid for 4 to 8 weeks, inside or outside the refrigerator, depending on the manufacturer's specifications.
Insulin preparation
Preparing insulin in a vial:
Wash your hands with soap and water, then dry them. Observe the appearance of the insulin before administration. Regular insulin has a crystalline appearance, while NPH insulin is cloudy. If there are any abnormalities, discard it. If using NPH insulin, roll the vial between your palms at least 20 times to homogenize it before extracting it from the vial. Clean the rubber on the vial with 70° alcohol. Draw air into the syringe up to the mark for the insulin dose to be administered. Remove the needle cap and inject this air into the insulin vial. Without removing the needle, turn the vial upside down and draw up the prescribed dose of insulin. Remove any air bubbles. Turn the vial back to its initial position. Remove the needle from the vial and protect it until the moment of application.
Preparing insulin in a pen:
Wash your hands with soap and water, then dry them. Shake at least ten times until the liquid is uniformly white and milky. Screw on the needle and remove its outer and inner protectors. Mark 1 or 2 international units (IU) and press to ensure the needle is not clogged. Add the prescribed number of IU of insulin.
Insulin application
Insulin vial application:
Disinfect the skin with 70% alcohol at the injection site. Rotate the application site sequentially. Pinch the skin. Insert the needle with a single, quick, firm, and light movement at a 90° or 45° angle to the skin, depending on the length of the needle. After applying the insulin, keep the needle in the subcutaneous tissue with the plunger pressed for at least five seconds. The syringe with needle can be reused up to eight times by the same person and should be replaced when it begins to cause discomfort. Dispose of it in a specific sharps container or in an unbreakable container with rigid, puncture-resistant walls, a wide opening, and a lid. Deliver it to the UBS, where it will be disposed of properly.
Insulin pen application:
Disinfect the skin with 70% alcohol at the injection site. Rotate the application site sequentially. Pinch the skin. Insert the needle with a single, quick, firm, and light movement at a 90° or 45° angle to the skin, depending on the length of the needle. After applying the insulin, keep the needle in the subcutaneous tissue with the plunger pressed for at least 10 seconds. Remove the needle gently with a single movement. If bleeding occurs, apply gentle local pressure for a few seconds.



The syringe with needle can be reused up to eight times by the same person and should be replaced when it begins to cause discomfort.

Dispose of it in a specific sharps container or in an unbreakable container with rigid, puncture-resistant walls, a wide opening, and a lid. Deliver it to the UBS, where it will be properly disposed of.

Annex 2: sociodemographic and behavioral profile, characteristics of the disease, and comorbidities among diabetic individuals who got insulin from the Municipal Pharmacy in Canguçu, Brazil (N=118)

Characteristics		N	%
Sociodemographic			
Sex	Male	37	31.4
	Female	81	68.6
Age (years)	<50	17	14.4
	50-59	27	22.9
	60-69	30	25.4
	≥70	44	37.3
Self-reported ethnicity	White	102	87.2
	Brown/Black/Asian/Indigenous	15	12.8
Family income (terciles)	First tercile	39	33.1
	Second tercile	45	38.1
	Third tercile	34	28.8
Education (years completed)	0	28	23.7
	1-3	22	18.6
	4-8	57	48.3
	≥9	11	9.3
Domestic agglomeration	Yes	5	4.2
Behavioral			
Smoker	Yes	14	11.9
	Ex-smoker	36	30.5
Alcohol consumption in the last month	Yes	18	15.3
Physical activity in the last month	Yes	46	39.0
Weekly frequency of physical activity (days)	1-2	12	26.1
	3	11	23.9
	4-6	3	6.5
	7	20	43.5
Disease characteristics			
Age at diagnosis (years)	<20	10	8.5
	20-39	37	31.4
	40-49	29	24.6
	≥50	42	35.6
Duration of disease (years)	<10	24	20.3
	10-19	32	27.1
	20-30	36	30.5
	>30	26	22.0
Type of diabetes mellitus	Type 1	18	15.3
	Type 2	50	42.4
	Don't know	50	42.4
Duration of insulin use (years)	≤4	50	42.4
	5-10	35	29.7
	>10	33	28.0
Type of insulin in use	NPH only	85	72
	NPH and regular	33	28
Applies own insulin	Yes	87	73.7
Places where they usually inject insulin*	Abdomen	108	91.5



	Thighs	12	10.2
	Buttocks	9	7.6
	Posterior arm	7	5.9
	Other	2	1.7
Place where they usually have consultations	Neighborhood UBS**	36	30.5
	Neighborhood UBS + other location	10	8.5
	Other location	72	61.0
Received guidance on insulin administration	Yes	102	86.4
Who provided guidance*	Physician	73	71.6
	Nurse	36	35.3
	Other	6	5.9
Comorbidity (self-reported medical diagnosis)			
Arterial hypertension	Yes	95	80.5
Heart disease	Yes	52	44.4
Kidney disease	Yes	33	28.0
Visual impairment due to DM	Yes	61	51.7
*: the total is greater than 100% because more than one response was accepted; ** UBS: basic health unit; DM: diabetes mellitus; NPH: neutral protamine hagedorn			



Annex 3: medians and interquartile ranges (IQRs) of the overall score and of the insulin storage, preparation, and application scores, according to insulin presentation, among patients who got insulin from the Municipal Pharmacy in Canguçu, Brazil, from March 2023 to March 2024		
Score (N)	Median % (IQR)	Variation in the sample
Overall score in the sample* (N = 114)	66.7 (52.4-71.4)	(0-88.9)
Insulin in vials (N = 44)		
Overall score**	66.7 (52.4-71.4)	33.0-85.7
Storage	75.0 (75.0-75.0)	50.0-75.0
Preparation	60.0 (50.0-70.0)	10.0-100
Application	57.1 (42.9-71.4)	14.3-100
Insulin in pens (N = 70)		
Overall score**	66.7 (55.6-72.2)	0.0-88.9
Storage	75.0 (75.0-75.0)	75-100
Preparation	60.0 (60.0-80.0)	0.0-100
Application	55.6 (44.4-66.6)	0.0-100
*: regardless of the type of insulin used; **: overall score includes storage, preparation, and application of insulin		