Prescribed insulin dose versus prepared insulin dose*

Dose de insulina prescrita versus dose de insulina aspirada

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ABSTRACT
Objectives: To compare the dose of prepared insulin to the dosage prescribed among users who self-administer; the differences relate to sociodemographic and clinical variables and identify the difficulties related to the procedure. **Methods:** The study included 169 users of the Family Health Strategy (ESF) of a municipality in the state of Minas Gerais, between August and October 2006. **Results:** Among the users who administered different doses than were prescribed (36.1%), 77% identified difficulty viewing the graduated scale of the syringe and 29.5% had motor difficulties in handling the syringe precisely. Sex (female), age (> 60 years) and education (<8 years) were statistically significant predictors. **Conclusion:** The data show the need for targeted interventions to develop skills for self-application of insulin, considering the limitations /capabilities of each user. The proposals of the ESF can support actions for health care focused on the needs of enrolled clients.
Keywords: Insulin/administration & dosage, Self administration, Diabetes *mellitus*, Family health

RESUMO
Objetivos: Comparar a dose aspirada de insulina na seringa à dosagem prescrita entre os usuários que a autoaplicam; relacionar as divergências às variáveis sociodemográficas e clínicas e identificar as dificuldades referidas no procedimento. **Métodos:** Participaram do estudo 169 usuários acompanhados pela Estratégia Saúde da Família (ESF) de um município do Estado de Minas Gerais, entre agosto e outubro de 2006. **Resultados:** Entre os usuários que aspiraram doses diferentes da prescrita (36,1%), 77% justificaram dificuldade para visualizar a escala graduada da seringa e 29,5%, dificuldades motoras para manusear precisamente a seringa. O sexo (feminino), a idade (>60 anos) e a escolaridade (< 8 anos de estudo) foram as preditoras estatisticamente significantes. **Conclusão:** Os dados mostram a necessidade de intervenções direcionadas ao desenvolvimento de habilidades para a autoaplicação da insulina, considerando as limitações/recursos de cada usuário. As propostas da ESF podem favorecer as ações para atenção à saúde centradas nas necessidades da clientela adscrita.
Descritores: Insulina/administração & dosagem; Autoadministração; Diabetes *mellitus*; Saúde da família

RESUMEN
Objetivos: Comparar la dosis aspirada de insulina en la jeringa en la dosis prescrita entre los usuarios que la autoaplican; relacionar las divergencias a las variables sociodemográficas y clínicas e identificar las dificultades referidas en el procedimiento. **Métodos:** Participaron en el estudio 169 usuarios acompañados por la Estrategia Salud de la Familia (ESF) de un municipio del Estado de Minas Gerais, entre agosto y octubre del 2006. **Resultados:** Entre los usuarios que aspiraron dosis diferentes de la prescrita (36,1%), 77% justificaron dificultad para visualizar la escala graduada de la jeringa y el 29,5%, dificultades motoras para manejar con precisión la jeringa. El sexo (femenino), la edad (>60 años) y la escolaridad (< 8 años de estudio) fueron las predictoras estadísticamente significativas. **Conclusión:** Los datos muestran la necesidad de intervenciones direccionadas al desarrollo de habilidades para la autoaplicación de la insulina, considerando las limitaciones/recursos de cada usuario. Las propuestas de la ESF pueden favorecer las acciones para la atención a la salud centradas en las necesidades de la clientela adscrita.
Descriptores: Insulina/administración & dosificación, Autoadministración, Diabetes *mellitus*, Salud de la familia

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INTRODUCTION

The application of multiple daily doses of insulin in the subcutaneous tissue, to prevent serious and chronic complications of Diabetes *mellitus* (DM) by means of instruments, is an essential condition for metabolic control, both for users with DM type 2 (DM2) and those with type 1 (DM1)[1-2]. In Brazil, disposable syringes are the main instrument to inject insulin, due to their low cost, easiness of acquisition, familiarity healthcare professionals have handling it[3] and for being distributed for free by government institutions[4].

The benefits injecting insulin through disposable syringes in the domicile to treat users with DM are unquestionable, but on the other hand, inadequate and unsafe preparation and administration of insulin have also brought implications that compromise metabolic control, and consequently influence the progress of DM chronic complications[3,5].

Considering concerning situations generated by the use of insulin in the domicile, it is worth highlighting the possibility of measurement errors when drawing the dose into the syringe during preparation. Injecting an amount that is different from the prescribed dose can generate hypoglycemia or hyperglycemia episodes, favoring serious and chronic complications[6].

In this context, healthcare professionals, physicians and nurses have an important role following up on users who inject insulin with syringes in their domicile, fostering their knowledge on the concepts and necessary abilities for an efficient use of the medicine, for there is a smaller possibility for errors during preparation when users are aware of such responsibility[7].

On the other hand, effective self-care requires continuous focus and a solid educational base, because handling subcutaneous injections of insulin takes time, practice and continuous education for self-confidence, skill and technique development[8]. In this context, it is worth highlighting that this takes time and demands professionals to have resources and pedagogical qualification to search for methodological alternatives to generate awareness, teach and enable the targeted group to perform effective self-care and systematic follow up.

Because the Family Health Strategy (Estratégia de Saúde da Família - ESF) chooses a care model focused on promoting self-care, sees users from a systemic perspective, ensures complete follow up actions on individuals with DM[9], and distributes free disposable syringes, according to the Federal Law n°. 11.347 from the 27th of September 2006[4], it was considered important to investigate whether users from the ESF were carrying through the insulin self-injection correctly, according to the prescribed dose.

Considering that, the amount of insulin drawn into the syringe and the prescribed dose were compared to verify whether they were different, relate the results to sociodemographic and clinical variables, and identify difficulties involved in the procedure.

METHODS

The present is a cross-sectional study, with a quantitative approach, carried out in 37 units of the ESF in the urban area of a city in the countryside of Minas Gerais, which is an important economic center and a regional reference with regard to education and health initiatives, between August and October 2006. The study sample was comprised of 781 users with DM that used insulin. The adopted inclusion criteria were: to be 18 years old or older; to be registered in the ESF, and to have been using insulin for more than a year; to be responsible for its injection, and to use disposable syringes.

Considering the inclusion criteria, 231 users were excluded, from this group, 100 were not responsible for the insulin injection, 31 were younger than 18 years old, 84 had been injecting insulin for less than a year, 12 had been registered in the ESF less than a year before, and four used insulin pen injectors. Therefore, the study sample was comprised of 550 users.

Based on a survey of the 550 users distributed in the 37 units of the ESF, a list was elaborated with their names with the purpose of drawing some for simple random sampling, through the application *Statistical Package for the Social Science* (SPSS), version 15.0. For the calculation of the sample size, a 50% prevalence for self-injection, a confidence interval of 95% and a sample loss of 15% were considered. Therefore, the sample consisted of 169 users, after 17 subjects were lost. Interviews took place during domicile visits.

After variables were defined, a data collection instrument was elaborated with close-ended and structured questions, and applied through directed interviews. The instrument included sociodemographic and clinical variables that were related to the value of the prescribed dose and to the direct observation of the technique used to draw in the insulin. The prescribed dose considered was the one reported by the users, for many of them did not have the physician's prescription at home (141/83,4%) and their records generally lacked information.

During the direct observation of the procedure, the researcher remained beside the user when insulin was drawn into the syringe. Users received the recommendation to perform the procedure as they usually did it. Therefore, they were supplied with the syringe they usually used and a flask of insulin and later requested to draw the prescribed dose into the syringe. The procedure was carried out aiming at comparing the prescribed dose and the amount of insulin drawn into the syringe.

Aware of the fact that the researcher observation could interfere in the results, since users would be more careful during the procedure, the researchers did it on purpose, so that only users with real difficulties were identified. Finally, 20 users who used insulin and had not been drawn to participate in the study were interviewed.

Results were presented in tables with absolute and relative frequencies or through measures of central tendency (average and median) and variability (minimum and maximum values, and standard deviation (s.d.), according

to the nature of the studied variables. The associations involving qualitative and quantitative variables were analyzed through the Chi-square, Mann Whitney and Kruskal Wallis tests. In the statistical analyses, a Type I error (p< 0,05) was adopted for all statistical tests.

The study was approved by the Coordination of the ESF of the city where it was carried out and by the Committee of Ethics in Research with Human beings of the Universidade Federal do Triângulo Mineiro, Protocol 527/2005. The interviewed users signed the Informed Consent Term, allowing the data collection and the use of information.

RESULTS

From the 169 users, 120 (71%) were women, 93 (55%) were 60 years old or older, and 146 (86.4%) had less than 8 years of education, with an average of 6 years of education (d.p 3). It is worth highlighting that 38 (22.5%) users had not had formal education at all. As to diagnosis time, the average was 13 years (s.d. 8), the median, 12, with a maximum of 40 and minimum of one year. With regard to the insulin use time, the average was 7 years (s.d. 5), median, six, maximum value of 30 and minimum, one year.

Data in Table 1 show the number of users who drew and incorrect amount of insulin into the syringe, and how different the amounts were.

Table 1 - Users followed up by the ESF, in a city of the countryside of Minas Gerais, according to the comparison of the prescribed dose and amount of insulin draw into the syringe, 2006

Is the amount drawn into the syringe the same as the prescribed dose?		n		%
Yes		108		63.9
No		61		36.1
Units of insulin drawn into the syringe that were superior or	Superior to the prescription		Inferior to the prescription	
inferior to the prescribed dose (IU)	n	%	n	%
1	1	2.9	-	-
2	23	67.7	10	37.0
3	1	2.9	-	-
4	7	20.7	7	26.0
6	-	-	6	22.2
8	-	-	1	3.7
9	-	-	1	3.7
10	-	-	2	7.4
25	1	2.9	-	-
38	1	2.9	-	-
Total	**34**	**100.0**	**27**	**100.0**

Out of the 61 subjects who draw the incorrect amount of insulin into the syringe (36.1%) (Table 1), 47 (77%) reported having difficulty to visualize the dose of insulin in the syringe, and from this group, 18 (29.5%) also mentioned motor difficulty to draw the prescribed dose into the syringe, and 14 (23%) did not mention such difficulties. It is worth saying that data presented in Table 1 were maybe underestimated, for users were aware of the research objectives.

In relation to the subjects who drew a larger dose into the syringe (34/55,7%), 20 (58.8%) presented a 2% to

5% difference, 10 (29.4%), a 6% to 10% difference, 1 (2.9%) a 13% difference, 1 (2.9%), a 50% difference, and 2 (5.8%) presented a 90% to 100% difference. With regard to those who drew an inferior dose into the syringe (27/44,3%), 7 (26%) presented a 3% to 4% difference, 10 (37%), a 6% to 10% difference, 6 (22.2%), a 11% to 20% difference, and 4 (14.8%), a 20% to 30% difference.

Data in Table 2 show through a bivariate analysis that the variables sex, age and education presented significant statistical differences.

Table 2 - Users followed up by the ESF, in a city of the countryside of Minas Gerais, according to the difference between the prescribed dose and amount of insulin draw into the syringe and its association with sociodemographic variables, 2006.

Difference in relation to the prescribed dose	No n (%)	Yes n (%)
Sex (p*=0.007)		
Feminine	69 (57.5%)	51 (42.5%)
Masculine	39 (79.6%)	10 (20.4%)
Age bracket (p*= 0,038)		
< 60 years old	55 (72.4%)	21 (27.6%)
≥60 years old	53 (57%)	40 (43%)
Education (p**= 0.047)		
No education	23 (60.5%)	15 (39.5%)
1-8 years	65 (60.2%)	43 (39.8%)
>9 years	20 (87%)	3 (13%)

From a statistical point of view, no significant differences between the average time of DM diagnosis (p=0,067 - Mann Whitney) and the time of treatment with insulin were found (p= 0,215 - Mann-Whitney) among the users who draw into the syringe the correct or incorrect insulin dose.

The association with the type of DM was not analyzed, due to the inconsistency of such data in the users' records and because 44,8% of the users did not know their type of DM.

DISCUSSION

Users who need insulin therapy must be stimulated to develop self-injection skills, with disposable syringes, through educational processes that should start since the diagnosis. In order to do so, it is necessary to elaborate strategies to promote knowledge and the development of self-care skills, considering the limitations/resources of each user[7].

Because the ESF distributes disposable syringes for free and the insulin treatment is administered at the user's house, ESF professionals' concern about verifying if the prescribed medication is being injected in compliance with the medical prescription is reinforced.

From this perspective, when observing the users' technique drawing insulin into the disposable syringe, it was possible to identify that 36.1% of the users had prepared the injection with an incorrect dose of insulin,

either a larger or smaller dose. The mentioned reasons collaborating with such results were visual and motor difficulties. On the other hand, 23% of the users who presented an incorrect dose reported they did not have any limitations that prevented them from performing the procedure in an adequate and safe manner.

It is believed that *visual* and motor deficits can harm the user ability to visualize the syringe scale and handle the injection device accurately during the procedure, thus interfering with the correct measurement of the prescribed dose. However, there are other factors that can be associated to the incorrect measurement of the prescribed dose, such as the sex, the age and the educational level.

Power relationships between genders and the productive process are articulated and determine interferences in the way self-care is performed by the subjects[10]. Some descriptive studies demonstrate men have a smaller participation in self-care[10-11],which is contrary to the findings of the present study, although the mentioned studies did not refer specifically to self-injection of insulin.

As to the age bracket, a higher frequency of people with 60 years of age or older and DM can be related to the very epidemiological profile of the disease: DM2 is more commonly found among people between 45 and 60 years old, with a significant increase among those with 60 years old or more, and at least 20% of the population who are older than 65 have DM[12].

The mentioned functional limitations that influence self-care, visual and motor difficulties are common with age and the evolution of DM, which justifies the highest frequency of differences between the dose drawn into the syringe and the prescribed dose among people who are older than 60. Among the functional limitations brought by the ageing process, the cognitive function also compromises memory and the time of reaction and perception, and this harms the interaction ability, interfering in the adaptation, adhesion and learning processes[13-14].

Therefore, it is essential for ESF professionals to understand the ageing process, to direct their efforts towards educational actions that consider such limitations[15], for the different phases of life have a great influence over the motivation and the ability of learning and handling DM[16].

A low educational level (less than 8 years of studies) can also be an aggravating factor for the acquisition of knowledge and the development of self-care skills, due to the limitation of access to information, such as: compromising of the abilities of reading, writing, or even speaking and understanding preventive self-care educational actions[11]. Therefore, people with a higher educational level generally adhere more to the treatment and present a better metabolic control[11,17].

In this context, it is believed that some factors can contribute towards drawing an incorrect dose into the syringe, such as: not understanding that syringes can have different volumetric capacities and that each mark can be equivalent to two units (syringes with volumetric capacity

of 100 UI) and *acknowledge* deficit regarding the insulin preparation technique. Therefore, it is important to consider that, when supplying a syringe that is different from the more commonly used, health professionals will have to guide users and caregivers on how to use the injection device and supervise the first injections[18].

Although an association with the average time of DM diagnosis was not found, this variable is considered the main determining factor regarding the emergence of diabetic retinopathy, considering that, from 7 to15 years after the diagnosis, the majority of people will present some alteration to visual accuracy[19], and after 20 years, 99% of the users with DM1 and 60% of those with DM2 will have diabetic retinopathy[20]. Still in this context, the longer the disease has been present for, the lower the development of self-care skills and motivation; users give less importance to the treatment[21].

Similarly to the DM diagnosis time, the average time of treatment with insulin did not present an association, although some studies show that diabetic retinopathy is more common in people with a longer time of treatment with insulin[19-20]. Perhaps this association is more related to the diagnosis time, since DM2 need for exogenous insulin increases with the evolution of the disease[2].

Other factors, beyond functional factors, can also influence the desired results, such as psychological and behavioral factors[22]. Therefore, it is necessary that ESF professionals take early actions regarding the factors that prevent the procedure from being performed according to the recommended way, and establish responsibility and a strong bond with users and their families, so as to stimulate self-care adhesion.

Some resources can assist users with difficulties to see the scales printed in the syringe and handle the instrument, such as: use of appropriate glasses, scale magnifiers, syringes with a smaller volumetric capacity, or the replacement of the syringe for an injector pen. Syringes with a smaller volume capacity encourage users to perform self-injection, since single units make it easier for the insulin to be seen[23].

Considering the above exposed, ESF healthcare professionals should identify facilitating and hindering factors regarding the acquisition of new knowledge and the presence of visual and motor difficulties to draw the prescribed dose into the syringe, before teaching the insulin self-injection technique, for these factors hinder the injection of the correct dose, thus influencing metabolic control. In order to identify the described functional limitations (visual and motor), professionals can be assisted by complementary exams and the continuous supervision of the preparation technique and insulin injection.

In case it is confirmed that the user is not able to carry out such procedure safely, it will be necessary to engage a family member who will be responsible for it. Families, due to the proximity with the users, have better conditions to follow up on the processes of health and illness of their members[24].

Therefore, ensuring that users correctly draw the prescribed dose into the syringe at home must be one of

the goals of ESF professionals. In this context, the researchers believe that the healthcare model is effective, considering the challenge. ESF guidelines allow professionals and users to get closer and interact, facilitating trust, communication, and bonds to be established, in a way that both sides are able to find the best solutions, covering users' and the community needs[25].

CONCLUSION

Users who need insulin therapy must be evaluated in relation to their abilities and stimulated to develop self-injection skills with disposable syringes. However, professionals should first identify if the user presents limitations that can interfere with a safe self-injection at home, so that they can adopt the best methodological strategy to reach the desired objectives.

Data presented in this study show that users who draw incorrect amounts of insulin into the syringe often reported they had difficulties to visualize the dose in the syringe and handle it with confidence. Among the sociodemographic and clinical variables, those associated to incorrect measurements of insulin were: educational level (less than 8 years of studies), sex (feminine) and age (older than 60).

However, it is expected that this study offers subsidies to rethink ESF intervention strategies with regard to safely and effectively using insulin at home, since this healthcare model promotes actions that focus on the real needs of its clients.

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