

Diabetes-related knowledge among medical and nursing house staff

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Summary

Questions under study: To assess the diabetes-related knowledge of medical and nursing house staff with particular focus on inpatient diabetes management and insulin therapy.

Methods: In a cross-sectional design, diabetes-related knowledge among physicians, graduate nurses, medical students and student nurses of the departments of internal medicine, surgery and gynaecology was assessed using a 42-item multiple-choice questionnaire.

Results: Of 466 subjects approached 232 completed the questionnaire. Knowledge was highest for physicians in internal medicine (total score $62 \pm 11\%$, mean \pm SD, max. 100%). Physicians in surgery and gynaecology had lower scores ($48 \pm 14\%$ and $47 \pm 12\%$, $p < 0.001$ and $p < 0.05$ respectively, compared with internal medicine), which were comparable to those of medical students ($49 \pm 9\%$). Knowledge of attending physicians and residents did not differ within the three specialities. Nurses in internal medicine and surgery had the same level of knowledge (total score $41 \pm 11\%$

each), which was comparable to that of student nurses ($40 \pm 9\%$). Nurses in gynaecology had lower total scores ($30 \pm 10\%$, $p < 0.001$ compared with nurses in medicine and surgery respectively). The comfort level in dealing with diabetes correlated with the knowledge score for physicians, but not for nurses.

Conclusions: Knowledge of diabetes is mediocre among medical and nursing house staff. For physicians, the knowledge level depends on the speciality (internal medicine better than surgery and gynaecology) and correlates with the comfort level in dealing with diabetes, but is not higher in attending physicians than in residents. Nurses have a high comfort level, which, however, does not correlate with knowledge, which is similar in medicine, surgery and student nurses, but low in gynaecology.

Key words: knowledge; diabetes; insulin; questionnaire

Introduction

Traditionally, inpatient management of diabetes mellitus has been marked by a certain tolerance for hyperglycaemia, except for extreme magnitudes, and by reluctance to use insulin intensively, in the belief that it is better to “do no harm” [1, 2]. In recent years, a large body of evidence has revealed various detrimental effects of elevated blood glucose concentrations during hospitalisation, and a growing number of prospective interventional studies in medical and surgical patients support the recommendations of near-normoglycaemic blood glucose control (around 8 mmol/L) of inpatients, although several studies suggest that targeting strict normoglycaemia (less than 6.1 mmol/L) may be associated with unacceptably high rates of hypoglycaemia [3–6].

Irrespective of the exact optimal blood glucose levels for inpatients, wide fluctuations in blood glucose levels due to inappropriate diabetes therapies commonly hamper safe approximation

to these relatively narrow target ranges [2, 7]. Indeed, the occurrence of hypoglycaemic events may primarily derive from incorrect implementation of treatment protocols rather than from the treatment protocols themselves. While single centre studies focusing on implementation of safe insulin protocols have demonstrated good safety profiles even when targeting normoglycaemic levels [8, 9], multicentre studies focusing on achievement of normoglycaemia using default insulin protocols without particular reeducation projects have led to remarkably high rates of hypoglycaemic events [4].

Insulin is not only one of the most commonly prescribed medications in hospital, but also one of the potentially most harmful if used inappropriately. In addition, with the introduction of several new insulin preparations, insulin therapy has become increasingly complex over the past few years. In teaching hospitals, residents commonly

bear primary responsibility for implementing diabetes therapy, and staff nurses are in the key position to administer insulin and recognise dangerous orders and impending hyper- and hypoglycaemia. However, both groups have been reported to be inadequately trained in diabetes management and particularly insulin treatment [10–20]. An isolated use of correctional or so-called sliding scale insulin as the single therapy for control of inpatient hyperglycaemia has been repeatedly condemned in recent decades [21, 22]. Notwithstanding, the non-physiological sliding scales have remained the most popular regimen for the treatment of elevated glucose values during a stay

in hospital, being passed down through the ranks as an easy to remember quick fix to a problem, whereas the recommendation to use physiological insulin therapy consisting of basal, prandial and correctional insulin is still skated over [1, 2, 21, 22].

The aim of this study was to assess our medical and nursing house staff's knowledge of inpatient diabetes management with particular focus on insulin therapy. It was hypothesised that physicians' and nurses' knowledge may be deficient in several areas, especially with regard to use of appropriate insulin therapies.

Observation material and methods

In a cross-sectional study, diabetes-related knowledge among physicians, nurses, medical students and student nurses was anonymously assessed in the departments of internal medicine, surgery and gynaecology of the Kantonsspital Graubünden in Chur, Switzerland, using a 42-item multiple-choice questionnaire (Appendix). The hospital serves as regional hospital as well as tertiary care centre for the Grisons, with almost 200 000 population and a large number of tourists. Each year some 16 000 inpatients are treated. Two diabetes nurse practitioners are involved in the treatment of diabetic inpatients.

The questionnaire had been newly generated on the basis of validated questionnaires published by Derr et al. [11] and Rubin et al. [13], translated into German and adapted to local drug specifications where appropriate. The questionnaires and an accompanying letter guaranteeing data protection and anonymity were distributed by e-mail to all physicians and medical students, and directly to all nurses and student nurses of the above-mentioned departments in early April 2008 with a set deadline for anonymous return by internal mail until the end of May 2008.

Scoring of the inpatient diabetes questionnaire

The knowledge level was assessed as follows. Each of the 42 items equally counted 1 point if answered correctly. Items 20 and 42 counted 1 point if all subquestions were answered correctly and ½ point if all but one subquestions were answered correctly. Unanswered items were counted as incorrect. A total score, a subtotal score including items 1–20, which were considered to address basic knowledge,

and scores of different subscales addressing insulin therapy (items 1–12, 14–16, 20, 28–31 and 38–42), hypoglycaemia (items 17–19 and 37), ketoacidosis (items 13 and 32–36), oral hypoglycaemic agents (items 25–27) and targets of diabetes management (items 16 and 21–24) were obtained by adding the respective points and were expressed as percentages of the relevant maximum score to scale between a minimum of 0% (worst) and a maximum of 100% (best).

Based on the study of Derr et al. [11], the participants were also asked how secure they felt in the management of diabetic patients (comfort level: 1 [very insecure] – 6 [very secure]).

Statistical analysis

Reliability and internal consistency of the questionnaire were evaluated by Cronbach's Alpha and item-total correlation. One-way analysis of variance (ANOVA) with Tukey-Kramer multiple comparisons test was performed to compare scores of different study groups. Nonparametric Spearman rank correlation was used to explore correlations between comfort levels and achieved scores. A p-value of <0.05 was considered significant.

Cronbach's Alpha analysis was performed using SPSS computer program version 12 (SPSS Inc., Chicago, Illinois, USA). One-way analysis of variance with Tukey-Kramer multiple comparison test and nonparametric Spearman rank correlation were computed using GraphPad Prism version 5 (GraphPad Software, La Jolla, California, USA).

Results

Return rate (table 1), reliability and internal consistency

A total of 466 questionnaires were distributed and 232 (50%) were received for evaluation. Return rates did not significantly differ between the study groups.

Cronbach's Alpha analysis showed satisfactory reliability and internal consistency of the Inpatient Diabetes Questionnaire (alpha 0.75, item-total correlation 0.01–0.43).

Total score (fig. 1)

When all study groups were taken together, fewer than half of the questions were answered correctly (total score $43 \pm 14\%$ mean \pm SD, max. 100%, $n = 232$). Attending physicians' and residents' knowledge did not significantly differ within the three specialities. Attending physicians and residents of a given speciality were therefore summarised as physicians of the respective speciality for all further analyses.

Table 1

Return rates of the questionnaire.

	Return rates
Medical house staff	71/152 (46%)
Physicians internal medicine	27/56 (48%)
Physicians surgery	27/60 (45%)
Physicians gynaecology	8/18 (44%)
Medical students	9/18 (50%)
Nursing house staff	161/314 (51%)
Nurses internal medicine	52/114 (45%)
Nurses surgery	65/116 (56%)
Nurses gynaecology	32/60 (53%)
Student nurses	12/24 (50%)
Total	232/466 (50%)

Knowledge was highest for physicians working in internal medicine (total score $62 \pm 11\%$, mean \pm SD, $n = 27$). Physicians in surgery ($n = 27$) and gynaecology ($n = 8$) had similar lower total scores ($48 \pm 14\%$ and $47 \pm 12\%$; $p < 0.001$ and $p < 0.05$ compared with physicians in medicine respectively) which were comparable to the medical students' knowledge ($49 \pm 9\%$, $n = 9$).

Nurses in internal medicine ($n = 52$) and surgery ($n = 65$) had the same level of knowledge (total score $41 \pm 11\%$ each), which was comparable to student nurses' knowledge ($40 \pm 9\%$, $n = 12$). Nurses in gynaecology ($n = 32$) had lower total scores ($30 \pm 10\%$, $p < 0.001$ compared with nurses in medicine and surgery respectively).

Subtotal score (fig. 1)

When all the study groups were taken together, somewhat more than half the questions of the subtotal score addressing basic knowledge were answered correctly ($54 \pm 14\%$ mean \pm SD).

Basic knowledge was highest for physicians working in internal medicine (subtotal score $71 \pm 12\%$). Physicians in surgery and gynaecology had lower, similar total scores ($56 \pm 15\%$ and $51 \pm 16\%$; $p < 0.01$ compared with physicians in medicine respectively), which were comparable to the basic knowledge of medical students ($53 \pm 10\%$).

Nurses in internal medicine and surgery had similar levels of basic knowledge (subtotal score $56 \pm 13\%$ and $51 \pm 12\%$ respectively), which was comparable to the basic knowledge of student nurses ($49 \pm 12\%$). Nurses in gynaecology had

lower subtotal scores ($41 \pm 14\%$, $p < 0.001$ compared with nurses in medicine and surgery respectively).

Subscales (fig. 2)

In the subscale addressing insulin therapy, the mean \pm SD score of all study groups was $46 \pm 16\%$. Knowledge of insulin therapy was highest for physicians in internal medicine ($68 \pm 13\%$) and lowest for nurses in gynaecology ($31 \pm 12\%$). Lowest percentages ($\leq 30\%$) of correct answers were found for items 9 and 11 addressing mixed insulin formulations containing newer insulin analogues, and for items 38–41 addressing periinterventional management of insulin therapy. Item 20, which specifically addressed the appropriate use of insulin sliding scales, was answered correctly in 34%.

The highest scores were achieved in the subscale addressing hypoglycaemia ($59 \pm 25\%$ for all study groups). However, 44% did not answer correctly item 17, addressing the blood glucose levels below which hypoglycaemia should be treated and only 38% answered correctly item 37 addressing management of severe hypoglycaemia with loss of consciousness. The results of this subscale did not differ between the study groups.

The lowest scores were achieved in the subscales ketoacidosis and oral hypoglycaemic agents ($32 \pm 22\%$ and $32 \pm 32\%$ respectively, for all study groups taken together). In the subscale ketoacidosis in particular, physicians achieved higher scores than nurses ($47 \pm 22\%$ vs $27 \pm 19\%$). Noteworthy was that medical students had the highest scores in this subscale ($49 \pm 9\%$), although not significantly different from physicians.

In the subscale targets, the mean \pm SD score of all study groups was $43 \pm 22\%$. Physicians in internal medicine had higher scores than nurses in medicine, surgery and gynaecology ($30 \pm 10\%$ vs $39 \pm 21\%$, $41 \pm 20\%$ and $36 \pm 23\%$, respectively, $p < 0.05$ for each comparison). Other comparisons between the different study groups did not yield significant differences.

Comfort levels (fig. 3)

Nurses in internal medicine and surgery had the highest comfort level (4.2 ± 1.0), physicians in gynaecology and medical students the lowest (2.3 ± 0.9 and 2.4 ± 1.2). Among physicians and medi-

Figure 1

Total and subtotal scores of different study groups (mean \pm SD) with relevant statistics (ANOVA with Tukey-Kramer multiple comparisons test) in medical house staff and nursing house staff respectively.

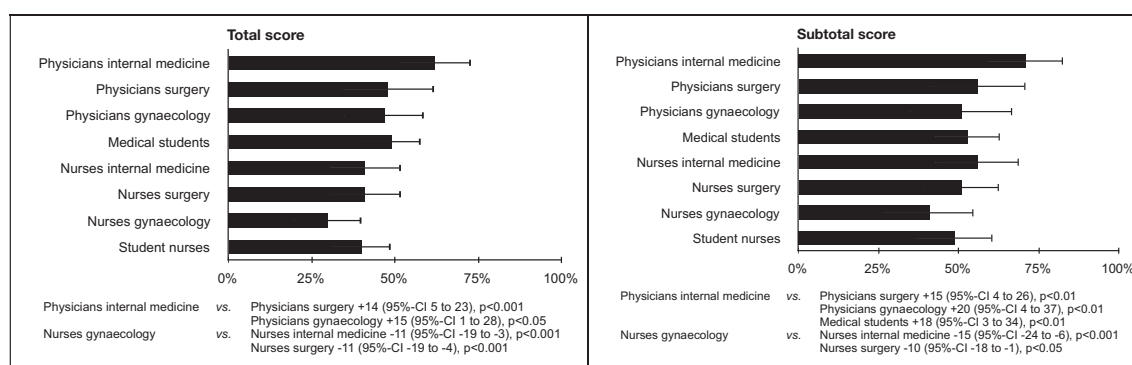


Figure 2

Scores of subscales of different study groups (mean ± SD) with relevant statistics (ANOVA with Tukey-Kramer multiple comparisons test) in medical house staff and nursing house staff respectively.

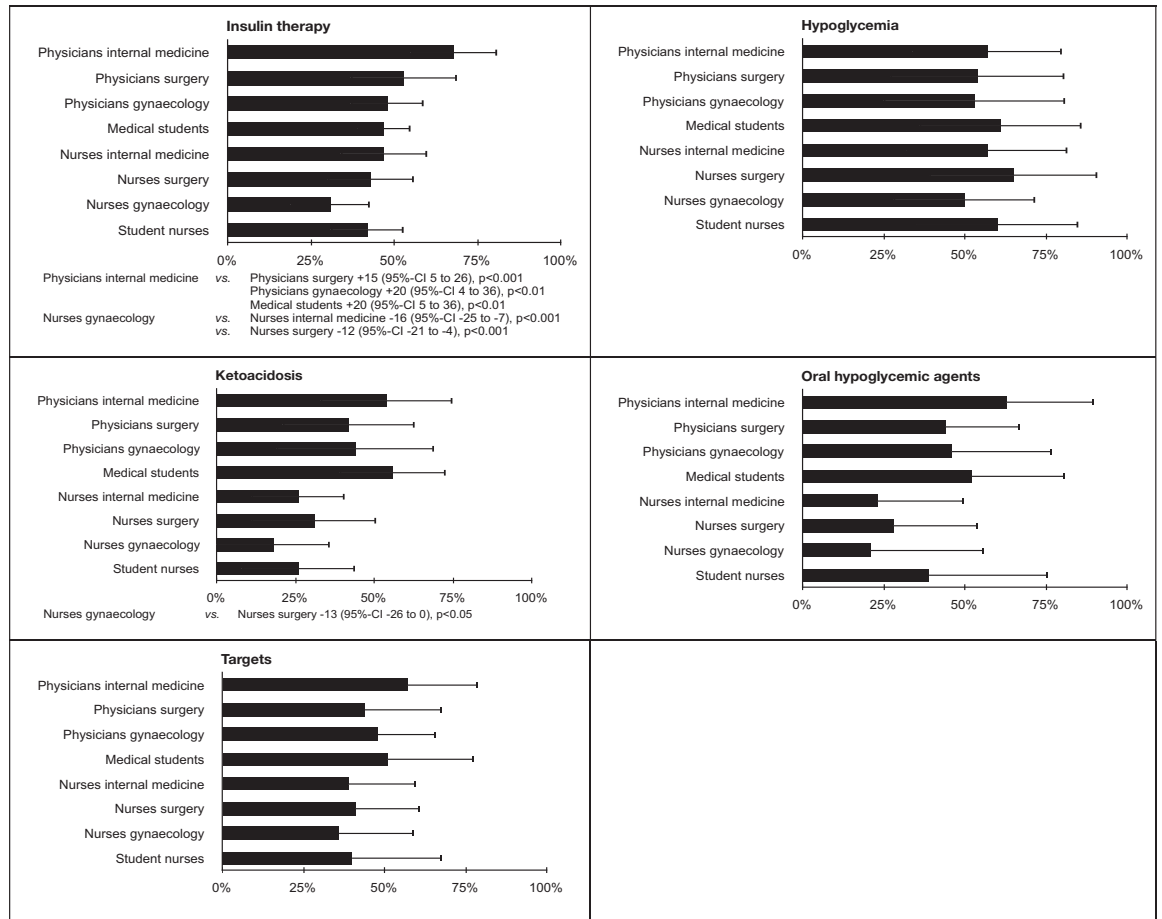
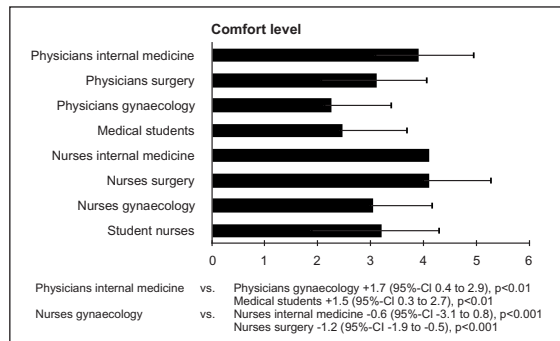


Figure 3

Comfort levels of different study groups (mean ± SD) with relevant statistics (ANOVA with Tukey-Kramer multiple comparisons test) in medical house staff and nursing house staff respectively.



cal students the comfort level correlated reasonably well with the total score ($r = 0.48$, 95%-CI 0.29 to 0.64, $p < 0.001$) and the subtotal score ($r = 0.55$, 95%-CI 0.36 to 0.70, $p < 0.001$), whereas in nurses and student nurses the correlation was only weak ($r = 0.18$, 95%-CI 0.02 to 0.33, $p = 0.027$, and $r = 0.13$, 95%-CI -0.03 to 0.28, $p = ns$ respectively).

Discussion

Hyperglycaemia is one of the most common medical problems in hospitals, affecting one out of three patients [3]. Every third of these patients is not previously known to have diabetes mellitus, i.e. has either hospital-related hyperglycaemia or preexisting unrecognised diabetes [3]. Poor glycaemic control during hospital stay contributes to increased morbidity and mortality; however, there is little or no formal didactic training in inpatient management of patients with diabetes [1-3]. Identification of areas of deficient knowledge among medical and nursing house staff represents a pivotal step towards implementation of targeted

educational programmes and ultimate improvement of care standards for hospitalised patients with diabetes [1-3].

With an overall 43% of correctly answered questions our medical and nursing house staffs' knowledge of inpatient diabetes care was mediocre. Previous studies investigating diabetes-related knowledge among medical and nursing staff using different, albeit partly similar questionnaires found comparable results with about one half to two thirds of the questions answered correctly [10-20]. The slightly lower results in our study population might be explained by the use of a

questionnaire addressing advanced in addition to basic diabetes-related knowledge and of a rather physician-oriented questionnaire for both physicians and nurses. In particular, questions addressing management of ketoacidosis and the use of oral hypoglycaemic agents did not seem to address common knowledge of our nursing staff. Nevertheless, reliability and internal consistency of the questionnaire used were satisfactory.

We are not aware of another study investigating all medical educational levels from students via residents to attending physicians at the same time. Interestingly, except for a small increase in diabetes-related knowledge from medical students to residents in internal medicine, no differences in inpatient diabetes-related knowledge were detectable. Residents and attending physicians in surgery and gynaecology did not achieve better scores than medical students, and in all specialities there was no further improvement from residents to attending physicians. Similarly, no progression was found from student nurses to graduate nurses; graduate nurses in gynaecology even scored lower. This indicates that for physicians and nurses a certain level of knowledge is reached during education which is not enhanced during the postgraduate period except slightly for physicians engaged in internal medicine, where diabetes is a major clinical issue. Our study indicates that this lack of further progression may be due to insufficient continuing education of attending physicians, the teachers of the other study groups.

Improved inpatient diabetes control is considered to result in substantial cost savings [3, 23–25], and structured reeducation projects are of proven efficacy in ameliorating inpatient diabetes control [28]. However, as long as reimbursement for treating rather than preventing complications of diabetes pays off, many hospitals may be somewhat reluctant to make improvements in diabetes management a top priority [26]. In particular, investments for improvements in medical education suffer from obstacles of this kind [27]. A systemically organised inpatient diabetes service headed by a diabetologist providing regular training and support for residents and nurses has been recommended by professional societies and experts, but is frequently lacking [1, 3, 6, 10]. In hospitals without a diabetologist this training and support depends on the qualifications of the remaining attending physicians. Considering the inadequate performance of attending physicians not specifically trained in diabetes management in the cur-

rent study, hospitals without a diabetologist may need to focus primarily on (re-)education of their attending staff. Employment of a diabetologist has been implemented recently at our hospital (after completion of this study). A follow-up reexamination of the issues investigated in this study will allow us to analyse the impact of a specialist on knowledge of diabetes mellitus in our hospital.

It is interesting to note that nurses in internal medicine and surgery had the highest comfort level, i.e. they felt more secure than physicians despite a similar or even lower knowledge level. This could indicate that some of the questions were not really relevant to the daily practice of nurses in the hospital. However, the poor correlation between comfort level and knowledge level persisted with use of the subtotal instead of the total score, suggesting that nurses tend to overestimate their knowledge in diabetes care, as others have also observed [14]. This intriguing finding could have a major negative impact on patient safety.

Some limitations of the study warrant mention. 50% of the questionnaires despatched were not returned. Assuming that the average interest in diabetes might be lower in those who did not complete the questionnaire, the “real” scores might even be lower. In addition, the questionnaire was completed unsupervised, again potentially falsely elevating the score. We acknowledge the fact that our study was done at a single centre, limiting generalisability to other settings. Also, the numbers of participating physicians in gynaecology, medical students and student nurses were low.

In conclusion, our study indicates that knowledge of inpatient diabetes care is mediocre among medical and nursing house staff. For physicians, knowledge depends on the speciality (internal medicine better than surgery and gynaecology) and correlates with the comfort level in dealing with diabetes, but is not greater in attending physicians than in residents. Nurses have a high comfort level, which, however, does not correlate with knowledge, which is similar in medicine, surgery and student nurses but low in gynaecology.

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