Two-step POCT training model

ORIGINAL ARTICLE

An interactive two-step training and management model of point-of-care glucose testing in northern Finland

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ABSTRACT

Objectives. To assess an interactive 2-step training and management model for nurses in glucose point-of-care testing (POCT).

Study design. The training of the nursing staff by the point-of-care coordinator of the laboratory started with interactive sessions with contact persons who subsequently trained their nursing colleagues at the Oulu University Hospital in northern Finland. The 2-step training model was applied in blood glucose testing as a pilot study.

Methods. Functional quality was assessed through interviews with clinical contact persons and a questionnaire was given to the trained nurses. Technical quality was assessed through control measurements by laboratory and nursing staff.

Results. Training succeeded because of basic resources (trainers’ knowledge and skills, organized contents of training and place), interpersonal communication and high-quality interactions. Nurses were especially satisfied with the prerequisite training of the contact persons (mean score 1.58, Likert scale from -2 to +2, strongly disagree – strongly agree). Day-to-day repeatabilities of less than 3% were achieved in control measurements by both nursing and laboratory staff.

Conclusions. The interactive 2-step training and management model could be implemented in the clinical units using a reasonable amount of laboratory resources. The goal of good functional and technical quality in point-of-care testing in the clinical units was achieved. Despite successful implementation, POCT needs continuous support from the laboratory.

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Keywords: glucose test, point-of-care testing, training, management, nurse
INTRODUCTION

Point-of-care testing (POCT) is defined as laboratory measurement performed outside the traditional laboratory environment, usually at the bedside and by non-laboratory personnel. The main reason for increased use of POCT is the need to shorten turnaround times from testing to diagnosis or treatment decision, with the aim of shortened hospital stays and minimized complications (1,2). In untrained hands, POCT could be a source of medical errors. Analytically, glucose tests at POC may achieve a similar quality to those performed by laboratory personnel (3,4). Unfortunately, clinical units have not been able to prepare themselves with the proper training needed to meet this quality in their increased use of POCT (5). Patients have the right to expect reliable results without compromised safety or unnecessary costs, independent of the site of testing.

Many hospitals continue to adapt POCT into their clinical routines. Relatively large nursing staff carry out the testing, leading to frequent non-conformities or even procedural errors in measurements (6). This may be due to a lack of teaching or a lack of motivation to learning the bioscience behind POCT (7–9). It is widely recognized that the hospital laboratory has the key responsibility for the quality of POCT, including advice concerning appropriate planning, purchase and establishment of measurements and quality control procedures (10).

The managing model for the delivery of POCT from the laboratory to the clinical units of our hospital was the backbone of our pilot study, as recommended by Wood and Burnett (11). Management included designation of a person as the POC coordinator with substantial allocation of time for training clinical unit staff in how to apply POCT (11). Interactive training (IT) was used as an active learning process that promoted a deeper understanding (12). Our procedure combined direct observation with repeated opportunities for supervised practise and feedback (13). The aim of our study was to assess an interactive 2-step training and management model for nurses in the use of glucose POCT.

MATERIALS AND METHODS

Management model

We developed a comprehensive model for managing high-quality POCT in 2 clinical departments of Oulu University Hospital (OUH), with special attention being given to interactive training of non-laboratory personnel (nurses) by a 2-step training strategy that could be applied to a wide area of responsibility. This model was based on the international standard for POCT and the Finnish national guidelines for POCT (14–16). To our knowledge no one else has published a similar model. The 6 key elements of the model were as follows:

1. Establishment of leadership and designation of individuals into the shared POCT management group from the laboratory and clinical units.

In 2006, the POCT management group was created with representatives of the pilot units of the Department of Internal Medicine at OUH: a senior clinical consultant in endocrinology and diabetes care (T.E.), and participants from 1 hospital ward and 1 intensive care unit (ICU). These individuals worked with the laboratory personnel at OUH: a POC coordinator (L.L.), a clinical biochemist (T.M.), and a laboratory physician (T.K.). The management was shared by all participants.
2. **Purchase of POC instruments.**

Glucose monitoring devices of a single type (Ascensia® Contour™) were purchased for the clinical units based on analytical applicability to various patient populations and a multi-user environment. Evaluation of few of the devices was performed according to laboratory protocol. The precision was less than 5% (17) and the accuracy goal for glucose monitoring devices set in ISO 15197 was achieved (18). The reagent strips and control solutions were provided by the laboratory to ensure identity of batches.

3. **Standardization of measurements and quality control procedures.**

The clinical biochemist and POC coordinator drew up the details for the measurement and quality control procedures. They also designed a familiarization program that included instructions for (1) use of the device, (2) sample collection and analysis, (3) evaluation and reporting of patient results, (4) quality assurance, (5) handling of reagent strips and control material, (6) troubleshooting, (7) laboratory information systems, and (8) equipment maintenance. Standard operating procedures were implemented. Their legibility was tested by a nurse from a clinical department (19). The familiarization program served as an outline for the training strategy.

4. **Interactive 2-step training of the nursing staff.**

To optimize the educational workload of the laboratory, a 2-step strategy was evidently needed. There, the POC coordinator of the laboratory trained contact persons from the selected clinical units, after which they had to train the other nurses in their own units in POCT. The first step was to inform the nursing staff of the new procedures to encourage a positive attitude towards the new approaches in their POC glucose testing.

Our training was based on an interactive model, aimed at increasing learner engagement by influencing the amount, quality and momentary effectiveness of tutor-learner interactions that relate to learner (nurse) engagement (13). The head nurse of both clinical units designated a responsible contact person to act as liaison between the laboratory and her unit for POCT. The contact person from each of the participating units was privately instructed by the laboratory POC coordinator, providing each of them the possibility to address freely any ambiguous issues related to POC glucose testing. The POC coordinator spent 60–90 minutes on training each contact person. Time for training was booked in advance, and the place for training was peaceful and suited for the purpose. The contact persons were trained in factors contributing to test results, sources of errors, uncertainty of measurements and the consequences of false results. In addition to general topics, the POC coordinator emphasized details that appeared important for each clinical unit. For example, at ICU, it was essential to pay attention to skin puncture specimens from patients with poor peripheral circulation. Our training model required active participation by the POC coordinator, contact persons and nurses. An interactive training method was used to encourage contact persons to challenge their previous POCT practices. The POC coordinator supported nurses by visiting them and by being available by e-mail or phone at least once a week. The units received feedback on the results of quality control, success and problems with POCT. In IT, the tutor and learner openly discussed their expectations and needs. They were comfortable contacting each other as necessary.

After the contact person felt confident with using the POC measurements, she went on to familiarize other nurses in her unit with the
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procedures. Once competence in the procedure was obtained, a certificate was signed by both the contact person and the trained nurse. A total of 49 nurses signed cards as their “driving licenses” for glucose testing between April and September 2007.

In addition to the training provided by the contact person, a total of 35 nurses were instructed in small groups by the POC coordinator on sample collection and on the rationale of control measurements behind successful POCT. Practise and interactive discussions facilitated a deeper understanding of the value of POCT. Nurses had an opportunity to influence the goals and contents of their training. They were allowed to practise their skills and discuss any issues related to POC glucose testing during these lessons. Written instructions were available in the units at the training sessions. For a deeper understanding of quality procedures, the nurses recorded quality control and patient results by themselves under the supervision of tutors. This kind of experimental learning is well-suited to adult learning (20).

5. Computerized data collection.
The internal quality control data from POCT was collected manually with local computer software via a local area network. The clinical biochemist and POC coordinator reviewed the control results and addressed targeted feedback to the departments. Another computer interface was developed to record patients’ POC glucose results manually on location. These were later reviewed together with the patients’ other laboratory results within the laboratory information system, marking the POCT results with brackets. After familiarization by the contact person, the nurses were permitted to add glucose test results into electronic patient records, being careful to avoid transcription errors.

6. Financing POC tests and supervision.
The costs of training were kept within the laboratory budget. In our model, billing for the costs of POCT was linked with the storage of patients’ POC results in the laboratory information system. A discount price was used as compared with the price of glucose testing ordered from the laboratory. The purpose was to compensate the use of nursing staff in the measurements, but to include the costs of purchasing instruments and reagent strips, maintaining quality systems, data transfer and storage, and continuous training.

Assessment
Total quality of POCT consists of several factors. The impact of the applied model on the quality of POCT was measured both functionally and technically. Thus, it was possible to assess 2 factors: qualitative features of interactive training and technical outcome of training (glucose measurements). Functional quality of training was evaluated with a questionnaire to the trained nurses in May 2008. The questionnaire consisted of 25 Likert-scale questions (-2 to +2; strongly disagree – strongly agree) and 2 open-ended questions. A neutral response in this scale was 0 (neither agree nor disagree). Open-ended questions allowed the nurses to respond in their own words in a narrative style, while the Likert scale made it possible to discriminate different points of view (21). For statistical analysis, 4 sum variables were also created, assessing the internal consistencies with Cronbach’s a coefficient (21). To ensure validity of the questionnaire, a panel of experts (laboratory medicine, clinical laboratory technology, point-of-care testing and training) was used in defining the contents. The questionnaire was anonymous.

By the end of 2008, the 2 contact persons were interviewed by E.L., who had not met them before, to check the POC coordinator’s role in the training
process. Objectivity is very important during all steps in quality research, in particular in data collection (22). The themes of the interviews focused on content and circumstances of training, implementation of POC and changes in action. The 2 interviews were recorded (duration 25 and 38 minutes) and transcribed. The data were analysed by qualitative content analysis. Analysis of the contents of the narrative data brought up prominent themes and patterns among themes (21). In qualitative studies, a guiding principle of sampling is data saturation – that is, sampling to the point where no new information is obtained and redundancy is achieved (21,23). In our case, we interviewed only 2 contact persons whose responses were assessed. Thus, we had to identify redundant key elements within the interviews and the questionnaire. Data were broken down into smaller units that were coded and named according to the contents they presented, and the coded material was grouped based on shared concepts.

The technical outcome of the training was assessed by measurements of commercial glucose solutions (Ascensia® Microfill™ Control, normal) during 2 periods by personnel in the OUH laboratory and by nurses in the ICU and the clinical ward.

RESULTS

The results of the interactive training and management model are divided into functional and technical qualities.

Functional quality of training by the POC coordinator
The qualitative content analysis of the contact persons' interviews revealed 4 themes in training: basic requirements for training, interpersonal communication, quality interaction and the advantages of change.

The facilities (e.g., place) were convenient for training, and the written procedures and familiarization program were appropriate. The training was considered competent and clear, and the POC coordinator was motivated throughout the training. One criticism was that the training schedules were too hasty. The following comments attest to the POC coordinators quality of training:

She is personally interested in the topic. (Contact nurse 1)
Extremely clear instructions were provided. (Contact nurse 2)

Communication took place in many ways, for example, active visiting, phone calls and e-mail. The POC coordinator contacted the nurses when necessary. I The following comments highlight the POC's interpersonal communication skills:

... she did in fact answer [my questions] really well. (Contact nurse 1)
She was prepared to even visit the ward, and indeed did so fairly often. (Contact nurse 2)

The POC coordinator acted like a coach for the team of non-laboratory personnel. Her guidance was sufficient and communicative, and she used a cooperative approach along with a dialogue-type interaction. The contact nurses felt that they could freely ask questions and that the POC coordinator was approachable. The following statements speak to the quality of her personal interactions:

She made me feel welcome. (Contact nurse 1)
I've asked lots of things, and I've always been given an answer. (Contact nurse 2)

Changes in action have resulted in many advantages in the wards. Patients' glucose results
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Table 1. Satisfaction of clinical nurses with point-of-care test training by their contact nurses. Frequencies of responses to each statement (variable) are shown (Likert scale –2 to +2; from strongly disagree to strongly agree, 0=neither disagree nor agree; n=28), with means and consistencies (Cronbach’s α coefficient) of the 4 sum variables.

| Variables                                      | Disagreement (strongly disagree) | Neither (0) | Agreement (strongly agree) | Missing Mean Consistency |
|------------------------------------------------|----------------------------------|-------------|---------------------------|-------------------------|
| 1. Sufficiency of training in                  |                                  |             |                           |                         |
| ...operation of glucometer                     | 2                                | 1           | 24                        | 1                       |
| ...measurement of patient sample               | 2                                | 3           | 23                        | 0                       |
| ...quality control solution and its handling   | 2                                | 3           | 23                        | 0                       |
| ...evaluation of quality control results and recording | 2                                | 3           | 23                        | 0                       |
| ...maintenance of glucometer                   | 11                               | 8           | 9                         | 0                       |
| ...safety (e.g., use of gloves, disposable lancet) | 7                                | 6           | 15                        | 0                       |
| 2. Practical arrangements                     |                                  |             |                           | 0.51 0.93               |
| We discussed the objectives of training       | 6                                | 4           | 18                        | 0                       |
| I was able to make a suggestion (e.g., contents and methods of training) | 8                                | 11          | 9                         | 0                       |
| I was able to state my views on the objectives of learning about the glucose test. | 12                               | 4           | 12                        | 0                       |
| We discussed what I should learn about the glucose test. | 5                                | 5           | 18                        | 0                       |
| Training motivated me to do glucose testing    | 9                                | 10          | 9                         | 0                       |
| Atmosphere of training was encouraging        | 1                                | 6           | 21                        | 0                       |
| I felt free to express my opinions concerning glucose testing issues. | 2                                | 6           | 20                        | 0                       |
| Contents of training were dealt with as suitable entities. | 2                                | 9           | 17                        | 0                       |
| Time for training was adequate.               | 5                                | 10          | 13                        | 0                       |
| I was encouraged to ask questions related to glucose testing. | 4                                | 4           | 20                        | 0                       |
| I received positive feedback during training.  | 4                                | 13          | 11                        | 0                       |
| I was encouraged to evaluate my learning in training. | 6                                | 12          | 10                        | 0                       |
| 3. Prerequisites of clinical contact persons to provide training |                                  |             |                           |                         |
| Trainer had adequate knowledge (e.g., use of glucometer, sampling). | 0                                | 1           | 27                        | 0                       |
| Trainer had adequate skills (e.g., training was explicit; wishes of trainee were taken into consideration). | 0                                | 4           | 24                        | 0                       |
| Trainer had a positive attitude towards training. | 0                                | 2           | 26                        | 0                       |
| 4. Utility of training                         |                                  |             |                           | 0.75 0.89               |
| Training improved...                           |                                  |             |                           |                         |
| ...quality of my glucose measurements.         | 1                                | 9           | 18                        | 0                       |
| ...understanding the significance of quality control solution. | 5                                | 5           | 18                        | 0                       |
| ...understanding of safety.                   | 4                                | 10          | 14                        | 0                       |
| Training process as a whole                   | 1                                | 4           | 20                        | 3                       | 0.84
are now being evaluated and recorded using computer software. Quality control measurements are being performed and recorded in computer software. The procedures and POC instruments were standardized. Contact nurses felt that patient safety had improved as a result of these actions. The following illustrate the benefits of these changes:

*Everyone is starting to collect samples in the same way.* (Contact nurse 2)

*It has a tremendous effect on the safety of the patients that we can now do the test correctly.* (Contact nurse 1)

**Functional quality of training by the contact persons**

The 2 contact persons trained the rest of the nursing staff in glucose POCT. The satisfaction of these 49 colleagues was studied by using a specifically designed questionnaire. The questionnaire was returned by 28 of the nurses (26 females and 2 males with an average age of 41 years, response rate 57%). Eighteen nurses worked in the ICU and 10 in the normal ward. The nurses' satisfaction with the POCT provided by their contact persons is presented in Table I.

The nurses were very satisfied with the clinical contact persons' prerequisites for training (mean 1.58, sum variable 3 in Table I). The majority of respondents (27 agreed) thought that the contact persons had adequate knowledge of the POCT device and the sample collection. Trainers were able to demonstrate adequate skills for their task and, most importantly, the attitudes of nurses towards the training had been positive (26 agreed). Thus, the contact persons had willingly undertaken the job to train their colleagues. The values of Cronbach's α for all sum variables were good (range 0.80–0.93). These values reflect high internal consistency within sum variables. The means of all single variables were positive.

Training was perceived as sufficient (mean 0.80, sum variable 1). The majority of the nurses thought that the training on operating the device and measuring patient samples was sufficient. After training, their skills in handling quality control issues and interpreting control results (23 agreed) improved markedly. The maintenance of the glucometer and issues of safety were insufficiently addressed during the training.

The respondents felt that the training was useful (mean 0.75, sum variable 4). In the opinion of the respondents, the quality of their glucose measurements was improved. Understanding the significance of quality control in the whole measurement process was the most valuable single item of training (18 agreed). Nonetheless, a relative number of nurses expressed a neutral opinion concerning these issues.

The lowest mean score was obtained for practical arrangements (mean 0.51, variable 2), even though it did remain on the side of agreement. The nurses (21 agreed) felt that the atmosphere was positive and encouraging. They were able to freely express their opinions about issues concerning glucose testing, and they were even encouraged to ask more questions. The purpose and objective of the training was not completely understood by the nurses. Nine of the respondents responded that the training had not motivated them to do glucose testing.

As a whole, the respondents were satisfied with the training process (20 agreed, mean 0.84). The means of all sum variables were also positive, even higher than 0.50, indicating basic satisfaction with training on the part of the nurses. Thus, our IT of glucose testing – from the POC coordinator to the contact nurses, and from these to other nurses – was essentially successful.
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Technical quality improvement
Between-run repeatability showed that the personnel of the Department of Internal Medicine and the ICU achieved an analytical precision comparable to that of the laboratory personnel after training and were able to maintain it in the follow-up period (Table II). Imprecision (CV%) within all personnel groups was low, indicating a similar quality of glucose measurements.

DISCUSSION
Our model explored the idea of establishing standardized operating procedures for everyday practice by interactive training (IT). Standard operating procedures of POC glucose testing were implemented. Quality control and patient results were stored in a computer database. In addition, sample collection, POC devices and batches of reagent strips were standardized. All these procedures improved the quality of glucose POCT, and thereby improved patient health care and safety. The model offers a potential tool for managing POCT in remote northern regions by training the contact persons in health care centres and by reporting the quality control results using electronic data transfer (HL-7 standard) between health care centres and the POC coordinator. Videoconferencing is also an option for interactive training. As a whole, the interactive 2-step training and management model was well suited for training nursing staff in POCT.

Interactive 2-step training improved the knowledge and practical operation skills of nurses. IT enabled interpersonal communication between POC coordinators and contact persons, and further between contact persons and nurses. All participants were pleased with the multifaceted means of communication. Interviews revealed that POC coordinator was intensively involved with the contact persons. However, they expected continuous POCT training, as did the nurses. In order to maintain the quality and procedures of POCT, training should be followed by regular updates with mandatory attendance by the nursing personnel (11).

Qualitative interaction promoted knowledge and improvement of practical operations. It is important to realize that successful training is not necessarily dependent on the personality of the teacher if basic support and training resources focus on interpersonal interactions (24). The most important issue is that the training is learner-centred and based on the learners’ needs. A learner-centred process requires learners to set their own goals and to determine the resources and activities that will help them reach those goals (25). We thus had an opportunity to motivate nurses to assimilate the problems concerning POCT. An encouraging atmosphere, freedom to express one’s opinion, genuine dialogue and attentive participation are the key elements of interpersonal laboratory-clinical communication.

Table II. Repeatability of POC glucose measurements by the personnel of OUH laboratory, the Intensive Care Unit and the in-patient ward of the Department of Internal Medicine with frequent diabetic patients.

| Personnel          | Period 1<sup>a</sup> |          | Period 2<sup>b</sup> |          |
|--------------------|----------------------|----------|----------------------|----------|
|                    | 1 May–31 May 2008    | Mean mmol/L | CV% | n | 1 January–31 January 2009 | Mean mmol/L | CV% | n |
| Laboratory personnel | 6.66                | 2.9      | 300                   | 6.69    | 2.6    | 307 |
| ICU personnel       | 6.64                | 2.4      | 173                   | 6.79    | 2.4    | 180 |
| Ward personnel      | 6.59                | 3.7      | 40                    | 6.68    | 2.8    | 48  |

<sup>a</sup> Period 1: Laboratory: 10 devices, 10 users; ICU: 7 devices, 36 users; Ward: 2 devices, 23 users.
<sup>b</sup> Period 2: Laboratory: 10 devices, 10 users; ICU: 7 devices, 34 users; Ward: 2 devices, 30 users.
<sup>c</sup> CV%, coefficient of variation; n, number of all measurements by different users.
and make up the backbone of interaction under POCT. Laboratory personnel are highly encouraged to interact with the nursing cultures in their hospital environments in order to meet user needs and to tailor their goal-oriented training on POCT.

Above all, nurses and contact persons were satisfied with their trainers’ prerequisites to provide training in glucose POCT (mean of sum variable 3 was 1.58, Table 1). For their own part, nurses felt that their knowledge of POC glucose measurement increased. The trained nurses were confident with their skills to operate the device and analyse the patient samples (sum variable 1, Table I). They had learned how to handle quality control samples and especially to understand the meaning of the control procedures. The contact persons also showed that they had received essential knowledge from the POC coordinator to master the analytical and control procedures (sum variable 4, Table I), despite some limitations in practical arrangements (sum variable 2, Table I). The learning process was supported by structured educational material, open dialogue and the discussion of goals. Similar elements are emphasized in educational literature (24,26).

The challenges of our training model included motivating nurses to use glucose testing, defining the purpose and objective of the training and giving positive feedback to the nurses. These issues were applied in the contact persons’ actions. In the future, POC coordinators have to pay attention to these factors during training of the contact person. Our study attempted to apply the ISO 22870 standard comprehensively (14) by appointing a multidisciplinary POCT management group, by harmonizing equipment and by setting up a quality management system that could store patients’ results and control those results in a database through a local area network.

Some items still need to be considered in the follow-up. The ISO 22870 standard suggests internal audits and in-service training of POCT to recertify nurses and to maintain ongoing development in POCT quality. In clinical wards, appointments must repeatedly be reserved for training sessions of the contact persons by the POC coordinator and for quality reports to be sent to all participants by the clinical biochemist. Systematic identification and control of non-conformities remain to be solved within the framework of the laboratory’s customer organization. Moreover, logistics of supplies to all clinical units must be organized among all participating units. Computerized management of regional POCT data need protected networks between different health care units and the laboratory.

From the managerial point of view, we have to pay attention to several aspects of quality. The key element is the interactive 2-step training because it contributes to the technical quality of POCT. In this study, we used laboratory personnel as a control group to show that the nurses in clinical units can reach the same level of technical quality as those reached by trained laboratory personnel (Table II). Laboratory personnel often focus on “hard data,” that is, technical quality, and overlook the functional quality of POCT management (27). If the functional quality is not addressed, the technical quality of measurement procedures remains beyond our control, due to human factors like poor motivation.

In conclusion, the interactive 2-step training and management model offers a convenient way to develop qualified POCT by the nursing staff with a reasonable output of resources on the part of the laboratory. Despite passing over most of the interactive training sessions to clinical units, the model does require continuous support by the laboratory as well. The interactive 2-step training strategy can be introduced to other units in OUH, to other hospitals and to other areas of primary health care.
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Competing interests
None.

Ethics approval
During the data collection, informed consent was obtained. The nurses were informed about the purpose of the study and its voluntary and anonymous nature.

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