

OBJECTIVE MEASUREMENT OF HUNGARIAN NURSES' TRANSFUSION-RELATED KNOWLEDGE WITH USE OF MODERN TEST THEORETICAL INSTRUMENTS (ITEM RESPONSE THEORY: IRT)

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INTRODUCTION

In this day and age, safe blood transfusions are an immediate, global, and extremely important issue in the field of health care system. As with other areas within the health care system, the field of blood transfusion therapy, likewise, encounters unexpected situations within which dangers may undermine patient safety and security, and destabilize the entire system. Blood quality is directly related to the safety of therapy, product safety, as well as the preparative and clinical transfusiology's entire process. The principle actors involved with transfusion therapy, namely the nurses, are professionally, legally and ethically responsible for their own conduct. Foreign professional literature mutually affirms that the increasingly important role of nurses involved in transfusion therapy is not only growing but that the nurses' role is fundamental to the continued maintenance of blood quality and successful therapy. [1, 4, 6, 7, 8]

Within the current national context, nurses' roles and responsibilities should be increased so as to partake and become more involved in the transfusion process. In as such, the nurses' professional role would include a strong corresponding skill set, willingness to perform, and precise work.

In addition to this, it is important that nurses are not only aware of their own competencies but comply with their competency requirements. The understanding and definition of the competencies are unquestionably a key function of nursing standards. The healthcare system's expectations do not focus so much on the memorized or written reproduction of knowledge, but rather on the practical knowledge required to address various types of situations, problems and solutions regarding individual patient cases and situations. [3] The results of training distinct skills – knowledge, practical skills and competencies – are determined by corresponding measurement instruments of those knowledge or proficiency skills. [2]

Although traditional questionnaires and tests provided professionals with a means by which to measure the skill and knowledge sets and levels, by no means do these reflect or provide a clear picture of the 'real' or practical knowledge and skills needed. [9] For this reason, for the successful teaching of these skills, as well as to know how effective the teaching was, a reliable instrument is required and is possible. Current situations

require distinct skills and knowledge sets as an objective, and likewise, reliable measurement (testing) instruments are necessary and possible. The Item Response Theory (IRT) provides a possible solution by addressing and measuring the individual skill competencies required in modern nursing scenarios. [5, 9, 10, 11, 15]

AIM

Using a multi-level research approach— our aim was to focus on the measurement of blood donation and transfusion therapy practical errors which occur due to lack of knowledge. The reason for this aim is to outline those ways in which to improve the training of nurses by focusing on the errors and misunderstanding that take place in daily practice.

Based on the reasons stated earlier, two studies were conducted. We first explored four distinct professional groups in Hungary. The first study related to nurses' knowledge of blood donations as well as their attitudes and habits (preparative transfusiology survey). The second study focused on the measurement of transfusion therapy nurses' knowledge, competencies. These nurses work in **adult transfusion therapy related (inpatient)** institutes. The tests were focused on nurses' knowledge, job description, and local methods (clinical transfusiology survey). We created and validated a distinct measurement instrument for the latter study (clinical) prior to the national study conducted a few months earlier.

The data gathered in this cross-sectional study involved mathematical statistics and different descriptive methods and was presented in cluster analysis and multidimensional scaling tables in our second survey. We found that the use of these latter methods has not yet been used neither in national nor international literature. For these reasons, we anticipate that the results of this unique study adds to the research field in Hungary.

We would like to introduce the process of validation of our questionnaire. In the field of clinical transfusion, it was our aim to measure nurses' transfusion therapy knowledge and practical skills through a survey. Our additional goal in the field of transfusion therapy, was to address and measure nurses' own competencies on a national level. Through comparison and contrast analysis, we aim to uncover the extent to which professionals comply with the existing specifications and requirements outlined in the Transfusion Regulations (2008). [14]

In addition, the national survey was conducted so as to find out whether and to what extent the teaching goals correspond to actual nursing transfusion practice. We sought to exceed the classical test limitations and analyze in detail the nurses' professional transfusion skills. The objectives of instructors are to promote nurses' careers and success in the workplace, however, the results provided by traditional questionnaires are questionable in terms of representation of those skills. Our further goal, thus, was to create a new validated measurement instrument so as to objectively measure nurses' knowledge and skill base.

MATERIAL AND METHODS

The second survey used descriptive statistics, observation, questionnaires and interview approaches. Before the nationwide survey our self-administered questionnaire was tested according to mathematical and statistical methods so as to establish reliability, validity, variation and standard deviation (SD), Cronbach alpha calculation and Pearson correlation determination coefficients. Questionnaire testing and re-testing was between July and August, 2014 ($n_j=29$ and $n_a=27$).

Between November 19, 2014 and February 20, 2015, we conducted a representative national study using our own (tested) questionnaire. Data collection (paper and anonymous web data) of self-administered questionnaires was conducted within standardized conditions using stratified sampling methods. The test samples or participants ($N_{to}=657$) were nurses who worked with adult inpatient transfusion recipients receiving various and regular transfusion therapy. Descriptive statistics were first applied to the cross-sectional study data followed by mathematical statistics. In addition, the mathematical statistics were analyzed according to IBM SPSS (20. version) and the Microsoft Office 2013 program using cluster analysis and multidimensional scaling.

The objective measurement of nurses' skills was measured by a validated measurement instrument (the questionnaire). According to regular tests, we could compare only raw data, but this would not provide an accurate picture of nurses' true knowledge and skill levels. We tried to eliminate the limitations of classical test by not addressing overall performance but by analyzing and focusing in detail (itemizing) their individual performance. The various aspects of transfusion practice were covered in a quiz that used binary (good/bad) scaling. The retrieved data was analyzed according to hierarchical cluster analysis and dichotomous data analysis that was suitable for the one-parameter Rasch model (modern probability, probability test theory, Item Response Theory, IRT method). [13] The data was applied to the SPSS program and the R statistical ltm module.

RESULTS

The survey included 657 nurses as participants. The test sample 42,31% (278 persons) did not know how to do blood group serology testing in terms of blood grouping nor removal of blood. 430 persons (65,45%) did not correctly know the limits of temperature for the blood before giving blood to the patient, and 213 persons (32,42%) didn't know that warmed-blood infusion has to be started immediately. 448 persons (68,19%) did not know the blood sample prior to the transfusion, whereas 444 persons (67,58%) did not know the clinical blood type determination. Except for 83 persons (12,63%) almost the entire sample group (87,36%) lacked knowledge concerning the patient's condition and corresponding transfusion indicators, aside from their lack of knowledge regarding pre-transfusion blood-group serology testing. 488 persons (74,28%) were misinformed regarding 'biological probe', whereas 467 persons (71,08%) were not informed as to what to do after blood transfusion therapy. Within the transfusion therapy group, those who frequently (daily, weekly, bi-weekly) partook

in transfusion therapy, their level of knowledge was 50,53%, whereas those nurses who rarely partook in transfusion therapy (monthly or less) resulted in a knowledge level of 51,66%.

In the nursing functions field there is also a relatively large lack of knowledge among nurses. A majority of nurses completed the following various nursing functions incorrectly: taking blood (466 persons), giving oxygen (402 persons); infusion connection (427 persons), urine sample for laboratory test (507 persons), EKG preparation (517 persons), injection administration (390 persons), medication (374 persons) and heating blood products (539 persons).

In the area of practical blood transfusion practices, the most problems arise in blood product heating (496 situations 75,5% of the time happens irregularly/incorrectly), the blood product connection (346 situations 75,5%-ban – takes place incorrectly), in addition, it was observed that employee duties and functions were not adequately documented (609 situations – 92,7% – inadequate documentation). The execution of the biological probe was not perfect either; the answers of 252 persons (38,35%) were incorrectly answered regarding nursing practice.

The arrival of blood products on wards are also problematic; in 114 situations (17,35%), regulations are not followed properly. Regarding transfusion therapy, nursing documentation, use and management are not unified or consistent, and in 161 (24,5%) situations, was inappropriately done. Among various institutions there are notable differences found concerning blood transfusion and therapy practices especially in regards to how nursing documentation is utilized and applied, how blood grouping is determined, as well as blood heating procedure and the instruments used to do so.

The survey indicated that 70,32%-participating nurses created his or her own hospital transfusion procedural instructions matching and taking into account the hospital's system's transfusion regulations and procedures. 23,9% ward nurses responsible for transfusions work in the wards.

Based on the data gathered by using the Rasch practical model towards the national 'knowledge' survey, we were able to create a picture of the transfusion therapy connected questions based on the distribution of correct and incorrect answers; moreover, on the odds ratio provided a probable likelihood of the correct and incorrect answers. Based on the practical Rasch model, we created the characteristic curve which reflected the difficulty of individual items. (*Figure 1 and Figure 2*)

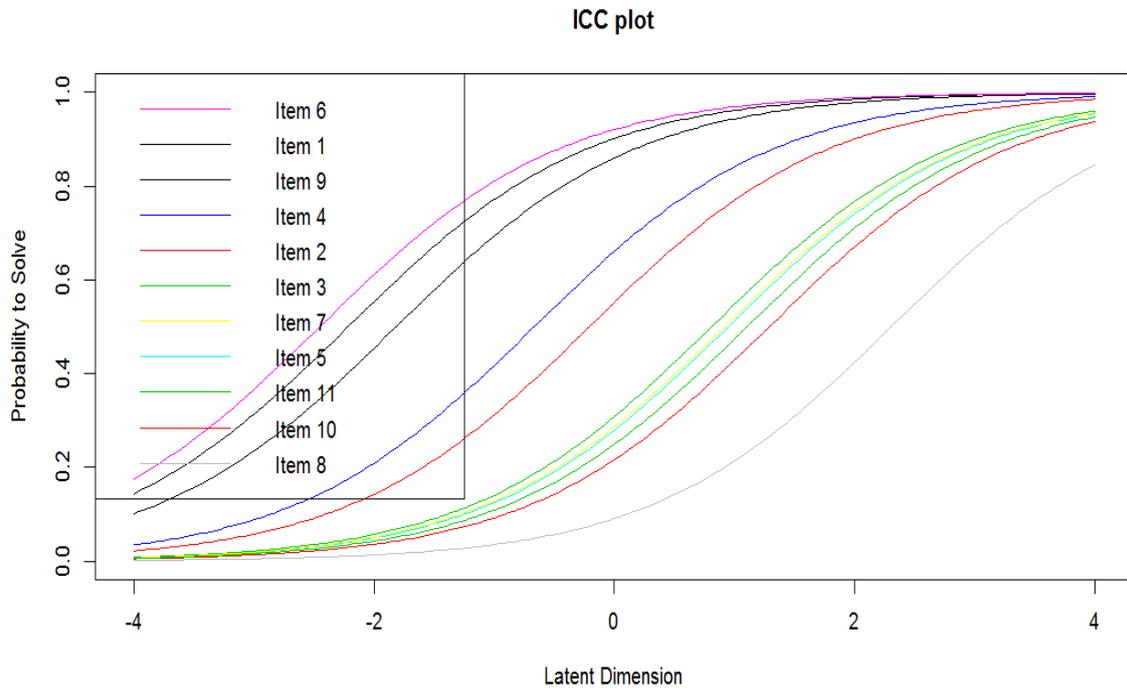


Figure 1: Items' characteristic curve in the case of questions relating to knowledge based on one-parameter Rasch model

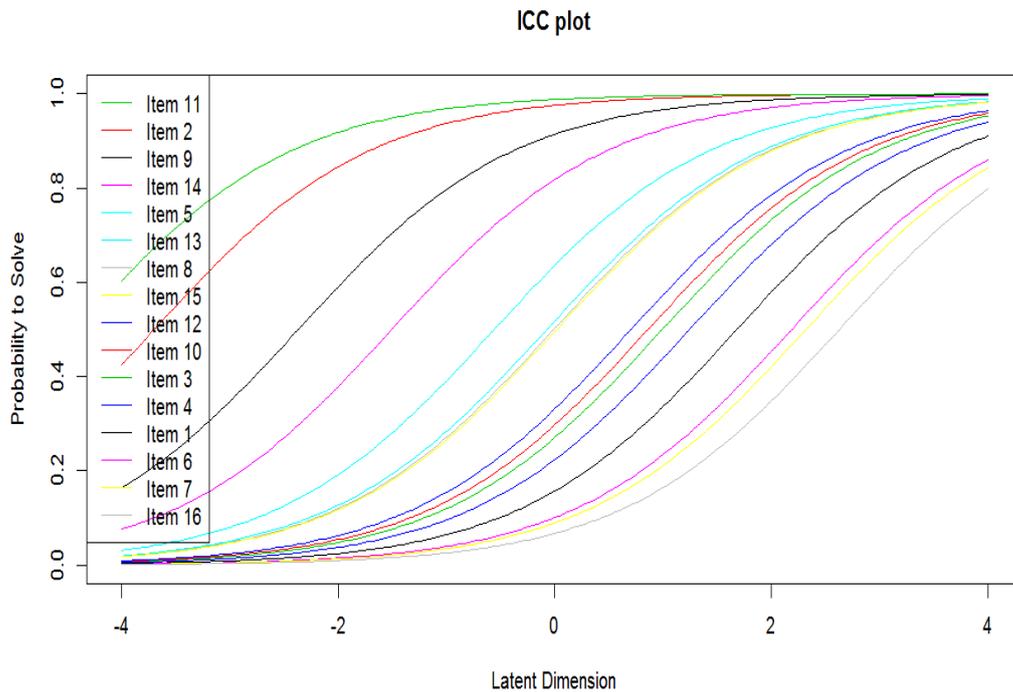


Figure 2: Items' characteristic curve in the case of nursing competencies-related knowledge based on one-parameter Rasch model

We further found out which questions the participants answered easily, with which they had more difficulty, and, we were able to itemize the various question combinations for which nurses typically had the correct answer.

In regards to transfusion therapy related skills and the questions concerning them, the largest ratio of nurses answered the questions concerning pre-transfusion therapy duties such as clinical AB0- and RhD blood group determination, correctly. They did this using the contributed compulsory patient information statement and consent forms. The most difficult question sets for the participants included those relating to pre-transfusion performance questions and the biological probe. These included the least correct answers. With the help of cluster analysis, we were able to isolate two large categories in regards to transfusion therapy related questions upon which we could assess knowledge. (*Figure 3*)

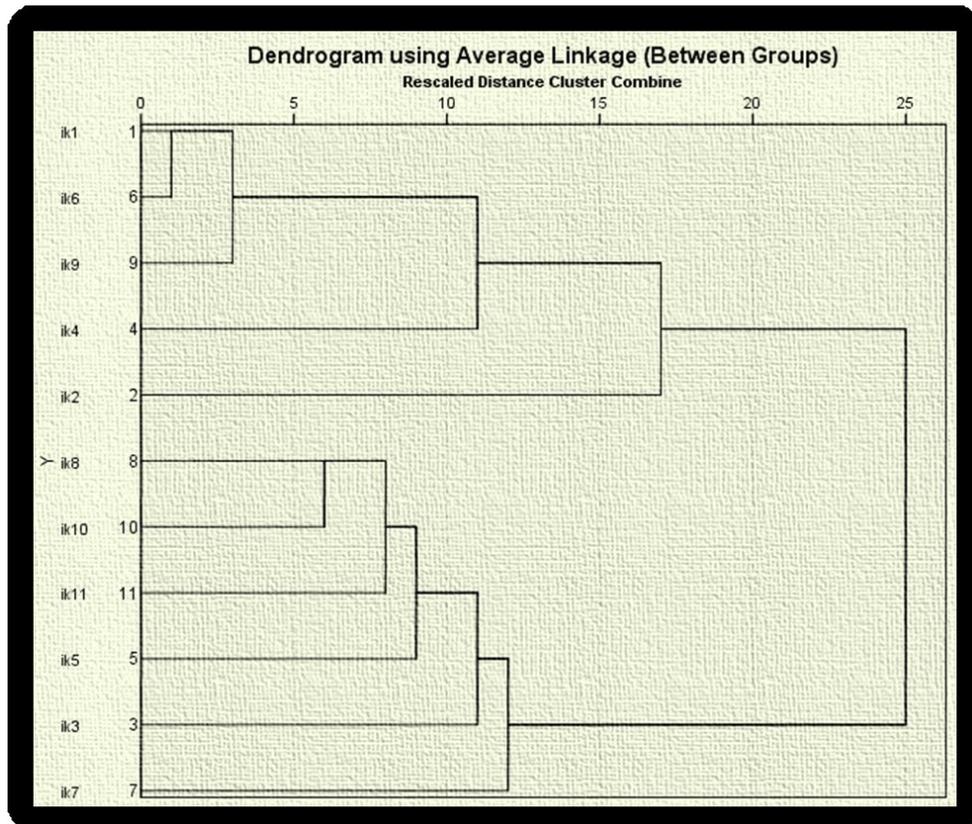


Figure 3: Dendrogram showing the transfusion therapy-related knowledge

The nurses' answers regarding transfusion therapy indicated a medium performance level. Most of them could answer four, five or possibly six questions correctly out of the eleven questions provided. The 'pre-transfusion performance test plus the biological probe' question group indicated a 93% 'do not know' percentage among participants. Considering the entire question group and the answers provided by the nurses, their performance could be considered weak rather than medium level. More than one third of our sample group (39,27%) was unable to answer one correctly from the entire question groups. (*Figure 4*)

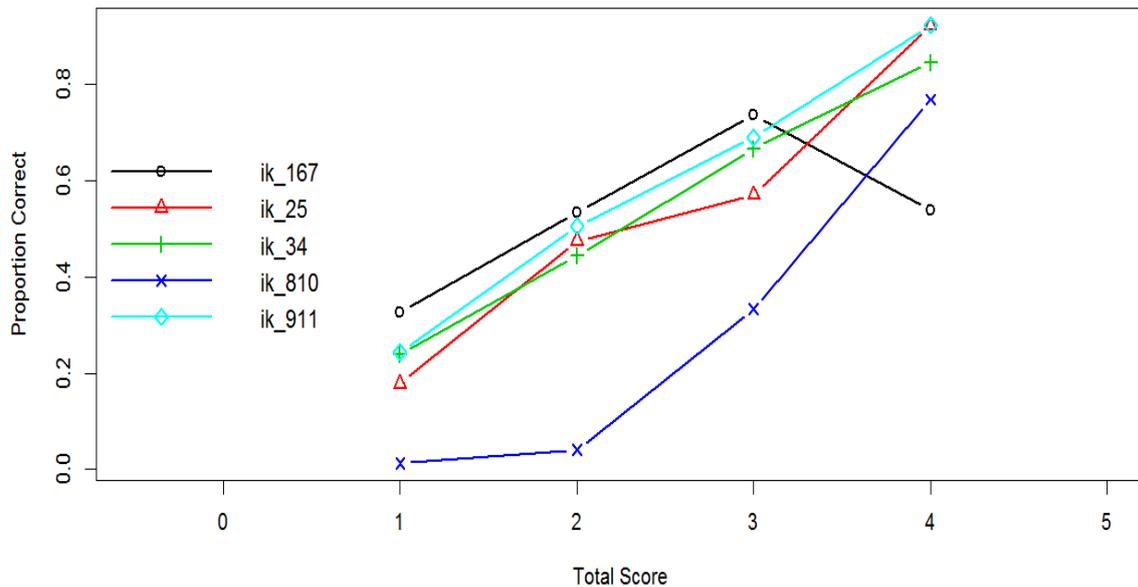


Figure 4: Distribution of correct answers per question group depending on the number of correctly answered question groups

The following transfusion therapy nursing competency skills were successful in ratio in that the correct determinations were made concerning nursing functions; nursing documentation management, cardinal symptoms measurement (blood pressure, pulse, temperature and breathing), and patient observation. Simultaneously, in relation to these activities, the nurses showed the least problems in terms of nursing functions and therefore these were the easiest items to answer. Overall, of the 16 nursing activities complied into 8 pairs, of the correct answer ratio per item, there was a higher ratio of improperly answered items. The nurses' performance in terms of determining nursing care activities could be considered poor because they were only able to provide correct responses to 2-3 pairs of items. Only 9 nurses (1,37%) were able to correctly determine all the activity function pairs. The greatest lack of knowledge observed among the participants was in regards to blood grouping and blood warming procedures. (**Figure 5**)

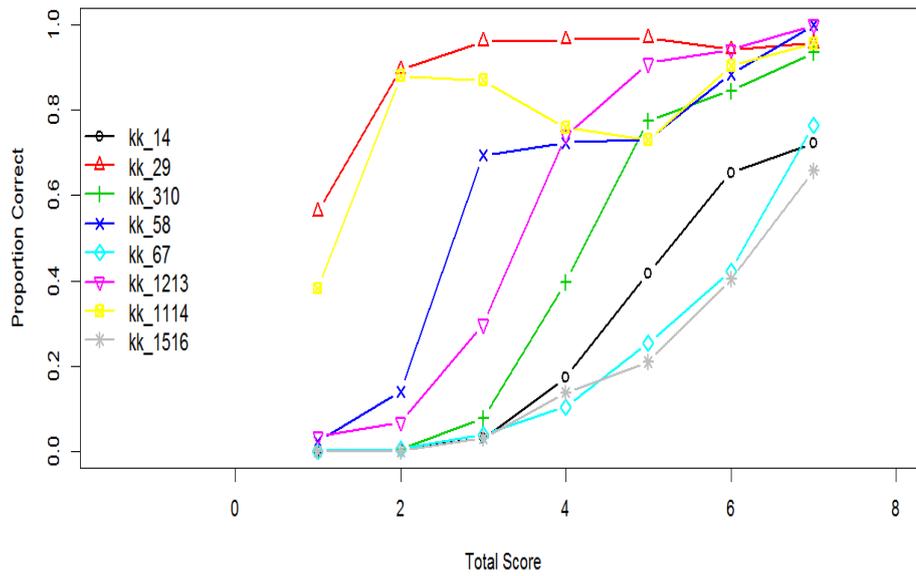


Figure 5: Distribution of correct answers per activity-pair depending on the number of correctly answered activity-pairs

Using cluster analysis, we were able to categorize two large groups in terms of nursing competencies. (**Figure 6**)

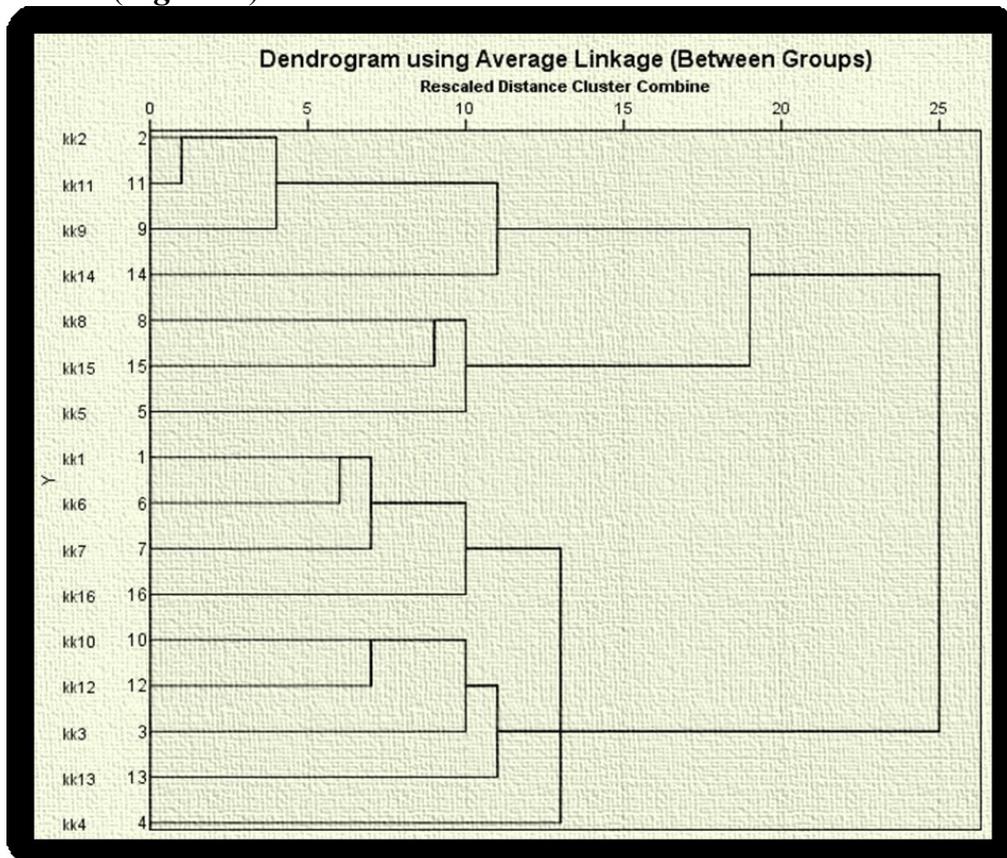


Figure 6: Dendrogram showing the knowledge about determining of nursing functions

DISCUSSION AND CONCLUSIONS

In reference to the results of our survey, important differences between institutions were found in terms of transfusion therapy practice and the management of relevant documents concerning nursing duties.

1. Based on a cross-analysis of professional transfusion therapy's legal and ethical competencies, and data pooled from contingency tables, we found no substantial difference between nurses' proficiency levels and the frequency of nurses' participation in transfusion therapy.
2. Approximately $\frac{3}{4}$ (70,32%) of the institutions follow their own protocol in regards to transfusion therapy.
3. On hospital wards, approximately one fifth (23,9%) of the working nurses are certified in transfusions.
4. Based on obtained results, we found it worrying that transfusion related skills among nurses was lacking (48,905%).
5. It is in our opinion that it is equally worrying that the national institutions' typical practices are irregular or contravene regulations (as was indicated in the pilot study and national survey).
6. The ratio of nurses' lack of knowledge is unacceptably high (47,7%) as is the organization of nursing duties.
7. It is likewise unacceptable that the Transfusion Policy/Regulations were neither known nor it's criteria met.
8. With the use of modern testing instruments, objective measurements were realized.
9. Having used probabilistic methods while conducting our research, we have clearly demonstrated significant shortcomings in nurses' transfusion knowledge.

In regards to the survey we also realized certain goals.

The solution to the problems uncovered in the nursing profession lies in: increasing nurses' responsibilities, increasing the degree and the regular monitoring of aspects of transfusion therapy by head nurses, as well as, by increasing the corresponding transfusiology training and providing regular supplementary training to nurses.

New findings of the survey:

1. Our survey ($N_{to}=657$) was basically exploratory, and although there were only 657, but strong, samples, this number is representative of our national scenario of all active nurses. The relatively limited data obtained from online research, however, was carefully and rigorously evaluated and analyzed with the intention of raising awareness.
2. We have confirmed that in regard to nurses' transfusion therapy evaluations, independent dependent and interdependent nursing competence reports are inconsistent or inharmonious.
3. Earlier national nation-wide studies were likewise not conducted among nurses in regards to transfusion therapy.

4. We initiated an objective knowledge measurement instrument using cluster analysis and multidimensional scaling in research relating to nursing science → the second survey likewise highlighted shortcomings as well as, we hope, provided new relevant information.
5. Using modern test-theory instruments we were able to realize and accomplish objective measurements.
 - we could actually determine the concrete knowledge related to transfusion therapy among nurses,
 - we could determine the nurses' abilities,
 - we could establish the degree of difficulty of the tasks and questions,
 - we were able to create a picture of the transfusion related questions through the distribution of received correct and incorrect answers,
 - furthermore, from these, the calculated logit and odds ratio were based on the possibilities of correct-incorrect responses.

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