European study of the reliability of the EPUAP classification system for pressure ulcers

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ABSTRACT

Aim: To study the inter-observer reliability of the European Pressure Ulcer Advisory Panel (EPUAP) pressure ulcer classification system and of the differential diagnosis between moisture lesions and pressure ulcers.

Background: Pressure ulcer classification is a valuable tool to provide a common description of ulcer severity for the purposes of clinical practice, audit and research. Despite the everyday use of the EPUAP system, only a limited number of studies evaluated the reliability.

Methods: A convenience sample of 1452 nurses from 5 European countries classified 20 validated photographs as normal skin, blanchable erythema, pressure ulcers (4 grades), moisture lesion or combined lesion. The nurses were familiar with the use of the EPUAP classification scale.

Results: Pressure ulcers were often classified erroneously ($\kappa = 0.33$) and only a minority of the nurses reached a substantial level of agreement. Grade 3 lesions were regularly classified as grade 2 lesions. Non-blanchable erythema was frequently assessed incorrect as blanchable erythema. Furthermore, the differential diagnosis between moisture lesions and pressure ulcers appeared to be complicated.

Conclusion: The inter-observer reliability of the EPUAP classification system was found to be low. Evaluation thus needs to focus on both the clarity and the complexity of the system. Definitions and unambiguous descriptions of the pressure ulcer grades and of the distinction between moisture lesions will probably enhance clarity. To simplify the current classification system, a reduction of the number of grades is suggested.

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INTRODUCTION

A pressure ulcer is a localised area of tissue destruction occuring when soft tissue is compressed over bony prominences for prolonged periods of time. Tissue destruction occurs when the compressed tissue is deprived of oxygen (Wound, Ostomy and Continence Nurses Society, 2003). A pressure ulcer is caused primarily by unrelieved pressure, shearing, friction or a combination of these forces (European Pressure Ulcer Advisory Panel, 1999). The severity of pressure ulcers varies from erythema of intact skin to tissue destruction involving skin, subcutaneous fat, muscle and bone.

Since the first classification system for pressure ulcers, depeloped by Shea in 1975, numerous systems have been developed with varying numbers for grades ranging from a 0-5 grade classification to a 1-7 grade classification for describing the diffrent degrees of tissue damage (Witkowski & Parish, 1981; Dealey & Lindholm, 2006). In the United States, the National Pressure Ulcer Advisory Panel (NPUAP) developed in 1989 a classification using 4 grades. This classification was adopted by the European Pressure Ulcer Advisory Panel (EPUAP) in 1999 with some minor textual changes (Defloor & Schoonhoven, 2004) (Table 1). The purpose of a classification system is to standardise record-keeping and provide a common description of ulcer severity for the purposes of clinical practice, audit and research (Nixon et al., 2005).

The major weakness of pressure ulcer classification systems is the lack of evidence to support their use, the most important factor being the reliability (Dealey & Lindholm, 2006). The reliablity respresents the variation of a classification system,

produced in repeated measurements. The less variation a classification system produces, the higher the reliability is. Both inter-observer and intra-observer reliability can be measured. The inter-observer reliability is a reflection of the degree in which two or more independent assessors assign an equal value during an observation or measurement (Polit & Beck, 2003). The intra-observer reliability measures the degree of reliability of a test score of one assessor over time (Guggenmoos-Holzmann, 1993).

BACKGROUND

Despite the everyday use by nurses, there are only a limited number of recent studies evaluating the inter-observer reliability of the EPUAP classification system (Bours et al., 1999; Russell & Reynolds, 2001; Pedley, 2004; Defloor & Schoonhoven, 2004; Defloor et al., 2006). Intra-observer reliability is seldom studied (Defloor et al., 2006). Wide variability can be found in both simple percentage agreement and chance-corrected rater agreement (κ= Cohen's Kappa).

In the study of Bours et al. (1999), pairs of nurses were asked to observe and classify, the skin at the pressure points on 23 hospital patients and 45 nursing home patients using the EPUAP system. Inter-observer reliablity was high (κ= 0.81 - 0.97). However, the observations were not made independently. When observing independently of each other the reliability was found to be much lower (κ= 0.49).

In a study by Russell & Reynolds (2001), the 2-digit Stirling classification (percentage agreement= 30.2%) was found less reliable than the simpler EPUAP system (percentage agreement= 61.9%) when 12 pressure ulcer photographs were assessed by 200 nurses.

Defloor & Schoonhoven (2004) found a high reliability of the EPUAP classification system when 56 photographs of pressure ulcers and moisture lesions were presented to 44 pressure ulcer experts (κ= 0.80). The authors concluded that it is likely that there would be less agreement amongst those with little experience.

Pedley (2004) measured inter-observer agreement of the Stirling scale (1-digit and 2-digit version) and the EPUAP scale when 35 observations were made by 2 registered nurses on 30 patients within an elderly unit of an acute hospital. The levels of agreement obtained were poor (2-digit Stirling scale: κ=0.46; 1-digit Stirling scale: κ=0.37; EPUAP scale: κ=0.31).

Defloor et al. (2006) report a study examining the inter-observer and intra-observer reliability of the EPUAP system and the ability of making correct differentiation between moisture lesions and pressure ulcers. Moisture lesions were defined as a result of prolonged exposure of the skin to excessive fluid due to urinary or fecal incontinence, profuse sweating or wound exudate (Maklebust & Sieggreen, 1995). Photographs were presented to 473 nurses. Both the inter-rater (κ= 0.37) and intra-rater reliability (κ= 0.38) were low. If only pressure ulcer photographs were considered, the average Kappa varied between 0.41 and 0.51. Ascertaining the differential diagnoses for pressure ulcers and other types of lesions appeared to be difficult.

When summarizing actual research, the results are similar. Inter-observer reliability is low, however some variability can be found. In the present study, inter-rater reliability of the EPUAP classification system will be tested at large, with an additional focus on the differential diagnosis between pressure ulcers and moisture lesions.

AIMS AND OBJECTIVES

To measure inter-observer reliability of classifying pressure ulcers according to the EPUAP classification system using photographs of pressure ulcers and moisture lesions. The aim is to study potential difficulties and indistinctness when classifying pressure ulcers and to differentiate between pressure ulces and moisture lesions.

METHODS

A survey among 1452 nurses was performed in Belgium, The Netherlands, Portugal, Sweden, and The United Kingdom. The method of convenience sampling was used to select the participants. The study took place between September 2005 and February 2006.

For the study, a random selection of 40 photographs was divided in two sets (set A and set B). Both sets contained one photograph of normal skin, one photograph of blanchable erythema, three photographs for each pressure ulcer grade, three photographs of moisture lesions and three photographs of combined lesions. In a combined lesion a pressure ulcer is combined with a moisture lesion. The photographs were graded and discussed by 12 trustees of the EPUAP, whose opinion is considered the gold standard. All experts had an extended experience in the care of pressure ulcers and in pressure ulcer classification.

The two sets of photographs were randomly presented to the nurses in the participating European countries. The nurses were asked to classify the photographs as normal skin, blanchable erythema, non-blanchable erythema (grade 1 pressure ulcer), blister (grade 2 pressure ulcer), superficial pressure ulcer (grade 3), deep pressure ulcer (grade 4), moisture lesion or combined lesion. A combined lesion is

defined as the combination of a pressure ulcer and a moisture lesion. No further information was given.

Data analysis

For each nurse, the percentage of agreement and the Cohen's Kappa statistic (κ) were calculated based on the comparison between nurses' assessment and the gold standard of all photographs. The median Cohen's Kappa and the median percentage of agreement were used as the summary of the inter-observer reliability.

In contrast to percentage agreement which measures the total number of occasions on which the raters agreed – including random guesses and chance agreements, the Kappa statistic measures the degree of agreement over and above that which may be expected by chance alone. A κ of 0.0 represents agreement equivalent with random chance alone, whereas a κ of 1.0 represents perfect agreement. The criteria for the κ statistic by Landis and Koch (1977) were used for the interpretation of the results (Table 2).

The median Cohen's Kappa, the interquartile range (IQR), and the median percentage of agreement were calculated with SPSS® 12.0 (SPSS® Inc., Chicago, IL, USA). Analyses included Mann-Whitney U-test and Kruskal-Wallis test because of the non-Gaussian distribution of the results. For categorical data the Chi-square test was used. To describe the relationship between two variables, Spearman's rho (r_s) was calculated. Microsoft Office Excel® 2003 (Microsoft Corporation®, Redmond, WA, USA) was used for the graphical presentation of the results. An α level of 0.05 was used for all statistical tests.

RESULTS

A total of 1452 nurses from Belgium (45.9%; n=666), The Netherlands (28.3%; n=411), The United Kingdom (15.2%; n=221), Sweden (7.4%; n=107), and Portugal (3.2%; n=47) were involved in this study. About 70% of the nurses was between 20 and 45 years old. A quarter was over the age of 45 years. Approximately 70% had more than ten years of experience and 30.1% was active in nursing practice for more than 20 years (Table 3). All participants stated being familiar with the use of the EPUAP classification scale.

The median Cohen's Kappa for the entire group of nurses was 0.33 when they were asked to assess the total set of photographs (Table 4). To examine the level of inter-observer reliability, the nurses were divided into 6 groups, based on the criteria for the κ statistic by Landis and Koch. About 22% of the participants achieved a slight assessor agreement ($0 \leq \kappa \leq 0.20$); approximately one third (37.3%) achieved a fair agreement ($0.20 < \kappa \leq 0.40$), another third (33.3%) achieved a moderate agreement ($0.40 < \kappa \leq 0.60$) and merely 5.0% reached a substantial level ($0.60 < \kappa \leq 0.80$). An overview of the results is presented in Table 5.

Inter-observer reliability was found higher in more experienced nurses when assessing the differential diagnosis between moisture lesions and pressure ulcers (Table 4).

Differences were statistically significant between the classification skills of nurses working in a hospital environment, homecare, a nursing home and an educational setting (Table 4). Nurses who were active in an educational setting reached a significantly lower inter-observer agreement ($\kappa = 0.30$) than the nurses who were active in a clinical setting (hospital environment, homecare and nursing home)

(κ= 0.35, IQR= 0.22-0.47) when classifying the total set of photographs (Mann-Whitney U-test= -2.037, p= 0.04).

Differences were found between the level of basic nursing education and the classification skills (Table 4). Nurses with an undergraduate degree (κ= 0.32) achieved a significant lower inter-observer agreement than the nurses with a master degree (κ= 0.39) (Mann-Whitney U-test= -2.334, p= 0.02).

Nurses who stated themselves to be an expert reached a median Kappa value of 0.47 (Table 4). Those who stated to have basic experience obtained a significantly lower median Kappa value of 0.33 was obtained (Mann-Whitney U-test= -5.464; $p < 0.001$).

When making the differential diagnosis between moisture lesions and pressure ulcers, the nurses who attended training in wound care reached a slightly higher median Cohen's Kappa than the nurses who did not attend this specific training (κ= 0.37 vs. κ= 0.34; Mann-Whitney U-test= -2.877, p= 0.004). No correlation was found between the duration of the education and the classification skills of the nurses (r_s = 0.005, p= 0.88). The classification skills of nurses who frequently (at least once a month) read literature concerning pressure ulcers were significantly better than those from nurses who never read this type of literature (κ= 0.36 vs. κ= 0. 28; Mann- Whitney U-test= -3.551, $p < 0.001$).

If only pressure ulcer photographs were considered, the median Cohen's Kappa was 0.29 (Table 4). Approximately one third of the photographs was scored one grade too low. Grade 3 was most frequently classified incorrectly (64.5%; 2717/4211). In 33.5% of the observations the nurses classified a grade 3 lesion as a grade 2 (blister). Non-blanchable erythema (grade 1) was assessed incorrect in

39.9% (1694/4273) of the observations. In approximately 40% of the observations, the grade 1 lesions were confused with blanchable erythema (Figure 1).

In 72.7% (12300/16913) of the observations of pressure ulcer photographs, the lesions were assessed correctly as a pressure ulcer. In merely 22.0% (932/4231) of the observations of moisture lesion photographs, the moisture lesions were assessed correctly. In 22.0% of the observations, they were seen as a combined lesion, in 19.9% as a grade 2, in 16.2% as a grade 3 and in 10.2% as a grade 1 pressure ulcer.

DISCUSSION

The inter-observer reliability of the EPUAP classification system was found to be low. Pressure ulcer photographs were often classified erroneously and only a minority of the nurses was able to reach a substantial level of agreement. Equal results were found for the differential diagnosis between moisture lesions and pressure ulcers. The discussion will focus on three hypotheses for debate. A first hypothesis will focus on the clarity of the EPUAP classification system. A second hypothesis will concentrate on the complexity of the system. In a third hypothesis, the familiarity of the nurses with the use of the EPUAP classification system will be considered.

The first hypothesis is based on the prominent confusion between reactive hyperaemia (blanchable erythema) and non-blanchable erythema (grade 1) and on the confusion between moisture lesions and pressure ulcers. This confusion might be caused by unclear definitions of blanchable erythema and grade 1 pressure ulcers, provided in the actual classification system.

The distinction between a grade 1 pressure ulcer and blanchable erythema is based on the reaction of the tissue to pressure and shearing forces. Blanchable erytema is defined as a normal reactive hyperemic response of the skin after an arterial occlusion. Microcirculation stays intact and tissue damage has not yet occured (Collier, 1999). On the contrary, a grade 1 pressure ulcer indicates clinically visible damage due to pressure and shearing forces and is defined as an abnormal response, presenting as a 'persistent redness' of the intact skin. Warmth, oedema, induration or hardness may also be used as an indicator, particularly in individuals with a dark skin (Derre et al., 1999; EPUAP, 1999).

Non-blanchable erythema is significantly associated with the development of pressure ulcers (Allman et al., 1995). As reported in a study by Vanderwee et al. (2007), preventive measures have to be taken as soon as non-blanchable erythema occurs. Prevention must be predominantly aimed at the protection or the repair of the oxygen supply to the tissue by reducing the intensity and/or duration of pressure and shearing forces. The confusion between a grade 1 pressure ulcer and blanchable erythema might result in a delayed application of preventive interventions.

A moisture lesion is characterised by the erosion of the epidermis and the macerated appearance of the skin. It is caused by the sustained presence of urine, faeces, perspiration or wound fluid, and not by a deficiency of oxygen within the tissue. A correct distinction between pressure ulcers and moisture lesions is important in practice because preventive measures to be taken are different. Skin protection, hygiene, and micturition training are indicated for moisture lesions (Maklebust & Sieggreen, 1995; Bennett et al., 1998). As mentioned above, the protection or the repair of oxygen supply to the tissue is indicated for the prevention of pressure ulcers. Unambiguous clinical descriptors about the distinction between moisture

lesions and pressure ulcers will probably avoid the inadequate application of preventive interventions. Yet, those descriptors are not provided within the current classification system.

The second hypothesis concerns the complexity of the EPUAP system. This hypothesis is based on the confusion between pressure ulcers grade 3 and grade 2. Grade 3 pressure ulcers were often classified as grade 2 pressure ulcers. The distinction between these grades is based on the type of skin loss: partial-thickness and full-thickness skin loss. Partial-thickness skin loss is defined as a shallow crater, involving a loss of the epidermis and/or dermis, and includes grade 2 pressure ulcers (EPUAP, 1999). A full-thickness skin loss involves all tissue layers, and includes grade 3 and grade 4 pressure ulcers (EPUAP, 1999). The observation of the different tissue layers involved appeared to be difficult.

The complexity of the current classification system is an important topic in an international pressure ulcer debate (Donnely, 2005; National Pressure Ulcer Advisory Panel 10th National Conference, 2007). Both the European Pressure Ulcer Advisory Panel (EPUAP) and the National Pressure Ulcer Advisory Panel (NPAUP) strike out on a different course.

The discussion within the EPUAP concerns the reduction of the number of pressure ulcer grades. The distinction between a grade 2, grade 3 and grade 4 pressure ulcer is of little relevance for the treatment of pressure ulcers. Suggestions about possible treatment approaches should be more defined. For the prevention and timely detection of pressure ulcers, it would be preferable to use a less complex, three-grade classification system, which makes the distinction between non-blanchable erythema, a superficial and a deep pressure ulcer. The identification of non-blanchable erythema is particularly critical in differentiating early pressure-induced

damage from a normal response to external pressure and for starting timely prevention. If a pressure ulcer develops wound assessment and -evaluation tools, such as the “TIME”-framework (Fletcher, 2005), the “MEASURE”-framework (Keast et al., 2004) or the Pressure Sore Status Tool (PSST) (Bates-Jensen, 1997), can be used. By means of these tools, the characteristics of a wound can be assessed and treatment determined.

The NPUAP has raised the number of pressure ulcer grades by adding 2 more grades: “deep tissue injury” and “can not be staged”. Deep tissue injury is defined as a purple or maroon intact skin area or a blood-blister. The lesion is characterised as firm, gentle, gelatinous, warmer, colder or more painful than the surrounding tissue. The surrounding tissue can be damaged rapidly, even if the treatment is optimal. “Can not be staged” is defined as a pressure ulcer which is impossible to assess because of the presence of softened necrosis (yellow, beige, grey, green or brown) and/or a necrotic crust (beige, brown or black) in the woundbed. (Black et al., 2007; National Pressure Ulcer Advisory Panel, 2007). The addition of these two stages is a resulted of the statement that re-classification is not accepted, even though the tissue damage appears to be more extensive than initially thought. The reduction of the risk of receiving no re-imbursement or being litigated if a pressure ulcer deteriorates, despite optimal care, should probably also to be taken into account.

The familiarity of the nurses with the use of the EPUAP classification system will be considered as a third hypothesis. The impact of basic nursing education and additional training will be discussed in turn.

Poor inter-observer agreement was found within all levels of basic nursing education. Although the inter-observer agreement in the nurses with a master degree was found higher than in the nurses with an undergraduate degree, the results were anything

but optimal. The slightly higher inter-observer agreement might be the result of a more profound attitude of life-long learning among nurses with a master degree. This group of nurses is possibly more stimulated by their educational background to read supplementary evidence-based literature and to reflect more thoroughly about daily practice. The development of the attitude of life-long learning seems to be important and needs to be fully supported. Creating high quality educational programs, allowing nurses to learn how to classify pressure ulcers and how to differentiate other lesions, requires a extended knowledge and level of experience in the field of pressure ulcers. The nurses working in the educational field should be encouraged to design such programs. In this respect, the significantly lower inter-observer agreement of the nurses, working in the educational field, is rather worrying.

Even though the higher inter-observer agreement in nurses who stated themselves as an expert in woundcare, the results were not yet optimal. Expertise can be obtained by training. Training was defined as reading evidence-based literature and following courses about woundcare. Both the attitude of reading evidence-based publications and following courses resulted in better classification skills. Also within this respect, the existence of a positive attitude towards life-long learning might be of importance to reach higher classification skills.

The EPUAP appears to be aware of the limitations concerning the current classification system. Efforts to clarify the diferentiation between moisture lesions and pressure ulcers are being made. In a recent position statement, the EPUAP defined wound related characteristics (causes, location, shape, depth, edges, and colour) and patient related characteristics to clarify the differentiation between a pressure ulcer and a moisture lesions (EPUAP Open meeting in Aberdeen, 2005; EPUAP statement, 2005). In addition, an e-learning program has been developed to spread

out the insights (www.epuap.org/epuap). To reduce the dificulties experienced in the present classification system, numerous efforts still have to be done.

LIMITATIONS

A first limitation of this study is the use of the method of convenience sampling. The nurses all stated that they were familiar with the EPUAP classification system. Therefore it is reasonable to assume that the results presented in this study are rather too 'positive'.

A second limitation might be the use of photographs. Photographs provide merely a static, two-dimensional image of the wound. The visibility of the different tissue layers might be limited. Whether assessment in practice is easier than with photographs is unknown. In practice, more aspects can be involved in the assessment, such as the medical history of the patient, the wound history, the mobility, the incontinence status and the nutritional condition.

CONCLUSIONS

Pressure ulcer grading is useful for defining the severity of pressure ulcers. However, the current classification system does not provide the information necessary to recognise the severity of the pressure ulcer. Furthermore, the assessment of the differntial diagnosis with a moisture lesion appeared to be hazardous.

A profound evaluation of the current classification system needs to focus on both the clarity and the complexity of the system. The inclusion of unambiguous definitions and clear clinical descriptors about the different pressure ulcer grades and about the distinction with moisture lesions will probably raise clarity. In an

international debate, a discussion concerning the complexity of the system is ongoing. A change of the number of pressure ulcer grades is suggested by both the EPUAP and the NPUAP. Nevertheless, they strike out on a different course. The discussion within the EPUAP concerns a reduction of the number of grades, while the NPUAP suggests a more complex 6-grades system. Reflection and discussion about the key objective of the system must be carried out prior to decisions being made.

It is obvious that education and training are essential to ensure that grades are correctly identified and that moisture lesions are not mistaken for pressure ulcers. The attitude of life-long learning needs to be explored and supported by high quality educational programs.

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Table 1

Pressure Ulcer Classification (EPUAP, 1999)

Grade 1	Non-blanchable erythema of intact skin. Discolouration of the skin, warmth, oedema, induration or hardness may also be used as indicators, particularly in individuals with darker skin.*
Grade 2	Partial thickness skin loss involving epidermis, dermis, or both. The ulcer is superficial and presents clinically as an abrasion or blister.
Grade 3	Full thickness skin loss involving damage to or necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia.
Grade 4	Extensive destruction, tissue necrosis, or damage to muscle, bone, or supporting structures with or without full thickness skin loss.

* Whether the erythema can be blanched or not (by means of a finger or a transparent disk) is the most important distinction between a normal physiological reaction of the tissue to pressure and shearing forces, and grade 1 pressure ulcer.

Table 2
Interpretation of Cohen's kappa according to Landis and Koch (1977)

< 0.00	Poor
0.00 – 0.20	Slight
> 0.20 – 0.40	Fair
> 0.40 – 0.60	Moderate
> 0.60 – 0.80	Substantial
> 0.80 – 1.00	Almost perfect

Table 3
Basic characteristics of the participating nurses

	Total	Belgium	Netherlands	Portugal	Sweden	United Kingdom
n	1452	666	411	47	107	221
Gender (%)						
Female	1245 (85.7)	554 (83.2)	353 (85.9)	37 (78.7)	95 (88.8)	206 (93.2)
Age (SD)	38.7 (10.1)	37.1 (9.7)	40.1 (10.8)	34.7 (8.2)	41.1 (11.6)	40.5 (8.8)
Experience (%)						
< 5 years	244 (17.1)	131 (20.0)	61 (15.3)	8 (17.0)	19 (18.3)	25 (11.5)
5 –10 years	228 (16.0)	112 (17.1)	58 (14.6)	12 (25.5)	18 (17.3)	28 (12.8)
10 – 20 years	523 (36.8)	234 (35.7)	155 (38.8)	20 (42.6)	30 (28.8)	84 (38.5)
> 20 years	428 (30.1)	178 (27.2)	125 (31.3)	7 (14.9)	37 (35.6)	81 (37.2)
Education (%)						
Undergraduate	711 (49.0)	275 (41.4)	264 (64.2)	41 (87.2)	29 (27.1)	102 (46.1)
Bachelor	667 (46.1)	365 (55.1)	120 (29.2)	6 (12.8)	72 (67.3)	104 (47.1)
Master	71 (4.9)	23 (3.5)	27 (6.6)	0 (0)	6 (5.6)	15 (6.8)
Expertise (%)						
Expert	57 (4.0)	12 (1.9)	35 (8.8)	0 (0)	1 (1.0)	9 (4.1)
Extensive	372 (26.4)	120 (18.6)	116 (29.0)	3 (6.4)	17 (16.2)	116 (54.0)
Basic	792 (56.1)	427 (66.3)	201 (50.2)	36 (76.6)	55 (52.3)	73 (34.0)
Limited	190 (13.5)	85 (13.2)	48 (12.0)	8 (17.0)	32 (30.5)	17 (7.9)
Work location (%)						
Hospital	727 (55.0)	344 (53.2)	201 (57.3)	6 (13.0)	70 (68.0)	106 (60.9)
Nursing home	245 (18.5)	134 (20.7)	85 (24.2)	1 (2.2)	11 (10.6)	14 (8.1)
Home care	286 (21.7)	149 (23.0)	48 (13.7)	38 (82.6)	8 (7.8)	43 (24.7)
Education	63 (4.8)	20 (3.1)	17 (4.8)	1 (2.2)	14 (13.6)	11 (6.3)

Table 4
Comparison of the inter-rater reliablity by country, experience, level of education and work location.

	Classification of the total set of photographs		Distinction between pressure ulcers and moisture lesions*		Classification of the pressure ulcer photographs	
	K (IQR)	Kruskal-Wallis X^2 p- value	K (IQR)	Kruskal-Wallis X^2 p- value	K (IQR)	Kruskal-Wallis X^2 p- value
Total group	0.33 (0.21-0.47)		0.36 (0.20-0.51)		0.29 (0.14-0.47)	
Country		X^2 = 111.92 p < 0.001		X^2 = 63.86 p < 0.001		X^2 = 83.93 p < 0.001
Belgium	0.36 (0.24-0.48)		0.38 (0.20-0.53)		0.28 (0.14-0.47)	
Netherlands	0.38 (0.25-0.47)		0.37 (0.23-0.51)		0.37 (0.23-0.48)	
Portugal	0.37 (0.30-0.53)		0.46 (0.36-0.57)		0.27 (0.12-0.49)	
Sweden	0.23 (0.12-0.30)		0.26 (0.12-0.37)		0.19 (0.09-0.29)	
United Kingdom	0.24 (0.13-0.37)		0.28 (0.15-0.46)		0.20 (0.05-0.37)	
Experience		X^2 = 6.48 p= 0.09		X^2 = 9.03 p= 0.03		X^2 = 1.91 p= 0.59
< 5 years	0.30 (0.18-0.45)		0.31 (0.18-0.46)		0.29 (0.09-0.47)	
5 – 10 years	0.32 (0.19-0.44)		0.35 (0.18-0.49)		0.27 (0.11-0.46)	
10 – 20 years	0.35 (0.24-0.47)		0.37 (0.21-0.51)		0.29 (0.15-0.48)	
> 20 years	0.33 (0.21-0.47)		0.37 (0.19-0.52)		0.29 (0.15-0.44)	
Education		X^2 = 11.87 p= 0.04		X^2 = 9.36 p= 0.009		X^2 = 3.32 p= 0.19
Undergraduate	0.32 (0.19-0.45)		0.34 (0.18-0.49)		0.29 (0.13-0.47)	
Bachelor	0.35 (0.21-0.47)		0.38 (0.22-0.52)		0.28 (0.14-0.47)	
Master	0.39 (0.26-0.53)		0.42 (0.20-0.56)		0.34 (0.19-0.48)	
Expertise		X^2 = 63.33 p < 0.001		X^2 = 65.01 p < 0.001		X^2 = 36.19 p < 0.001
Expert	0.47 (0.36-0.53)		0.51 (0.36-0.59)		0.47 (0.32-0.56)	
Extensive	0.36 (0.24-0.48)		0.41 (0.25-0.54)		0.31 (0.16-0.47)	
Basic	0.33 (0.19-0.45)		0.35 (0.19-0.49)		0.28 (0.12-0.47)	
Limited	0.26 (0.14-0.37)		0.27 (0.14-0.42)		0.25 (0.09-0.38)	
Work location		X^2 = 14.23 p=0.003		X^2 = 22.41 p<0.001		X^2 = 3.30 P = 0.35
Hospital	0.35 (0.20-0.47)		0.35 (0.19-0.51)		0.29 (0.14-0.48)	
Nursing home	0.31 (0.23-0.42)		0.32 (0.20-0.49)		0.29 (0.15-0.42)	
Home care	0.36 (0.25-0.48)		0.42 (0.28-0.57)		0.29 (0.12-0.47)	
Education	0.30 (0.18-0.41)		0.33 (0.15-0.46)		0.25 (0.10-0.43)	

Note. κ = Cohen's kappa; IQR=Interquartile range
* The 4 pressure ulcer grades were considered as 'pressure ulcers'. The different grades were not taken in account.

Table 5
The inter-oberserver agreement (Landis & Koch, 1977) presented for the total group by country, experience, level of education, self-attributed experise in woundcare and work location.

n (%)	Poor ($\kappa < 0$)	Slight ($0 \leq \kappa \leq 0.20$)	Fair ($0.20 < \kappa \leq 0.40$)	Moderate ($0.40 < \kappa \leq 0.60$)	Substantial ($0.60 < \kappa \leq 0.80$)	Almost perfect ($0.80 < \kappa \leq 1.00$)
Total group	29 (2.0)	324 (22.3)	541 (37.3)	484 (33.3)	72 (5.0)	2 (0.1)
Country						
Belgium	5 (0.8)	143 (21.5)	236 (35.4)	233 (35.0)	48 (7.2)	1 (0.2)
Netherlands	6 (1.5)	63 (15.3)	149 (36.3)	175 (42.6)	17 (4.1)	1 (0.2)
Portugal	0 (0.0)	5 (10.6)	21 (44.7)	20 (42.6)	1 (2.1)	0 (0.0)
Sweden	5 (4.7)	43 (40.2)	45 (42.1)	13 (12.1)	1 (0.9)	0 (0.0)
United Kingdom	13 (5.9)	70 (31.7)	90 (40.7)	43 (19.5)	5 (2.3)	0 (0.0)
Experience						
< 5 years	5 (1.0)	71 (29.1)	80 (32.8)	78 (32.0)	10 (4.1)	0 (0.0)
5 – 10 years	7 (3.1)	51 (22.4)	91 (39.9)	67 (29.4)	12 (5.3)	0 (0.0)
10 – 20 years	7 (1.3)	103 (19.7)	201 (38.4)	188 (35.9)	22 (4.2)	2 (0.4)
> 20 years	9 (2.1)	94 (22.0)	158 (36.9)	139 (32.5)	28 (6.5)	0 (0.0)
Education						
Undergraduate	12 (1.7)	172 (24.2)	270 (38.0)	229 (32.2)	27 (3.8)	1 (0.1)
Bachelor	13 (1.9)	137 (20.5)	252 (37.8)	229 (34.3)	35 (5.2)	1 (0.1)
Master	3 (4.2)	14 (19.7)	19 (26.8)	25 (35.2)	10 (14.1)	0 (0.0)
Expertise						
Expert	1 (1.8)	2 (3.5)	13 (22.8)	32 (56.1)	9 (15.8)	0 (0.0)
Extensive	5 (1.3)	61 (16.4)	143 (38.4)	139 (37.4)	24 (6.5)	0 (0.0)
Basic	16 (2.0)	189 (23.9)	289 (36.5)	263 (33.2)	34 (4.3)	1 (0.1)
Limited	7 (3.7)	63 (33.2)	76 (40.0)	39 (20.5)	4 (2.1)	1 (0.5)
Work location						
Hospital	16 (2.2)	165 (22.7)	255 (35.1)	256 (35.2)	34 (4.7)	1 (0.1)
Nursing home	0 (0.0)	54 (22.0)	111 (45.3)	70 (28.6)	9 (3.7)	1 (0.4)
Home care	5 (1.7)	47 (16.4)	104 (36.4)	108 (37.8)	22 (7.7)	0 (0.0)
Education	3 (4.8)	16 (25.4)	27 (42.9)	14 (22.2)	3 (4.8)	0 (0.0)

Figure 1
Classification by the nurses (n=1452) compared with the correct classification. The size of the grey circles represents the number of correct classifications, the size of the black circles represents the number of incorrect classifications.