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## Comparison of the international Burn Injury Database nurse dependency tool with the Safer Nursing Care Tool: Observational study

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## ABSTRACT

**Background:** Safe and effective nurse staffing is widely recognised as an important issue to ensure quality patient care and reduce mortality. There are many nurse dependency tools described in the literature but no gold standard tool that can be used in all specialities. In burn care there are even fewer burn specific tools and none reported for use in the UK to date. The international Burn Injury Database contains routinely collected information about burn injuries, including nurse dependency data which so far has not been reported in the literature.

**Objective:** This study aimed to confirm whether the international Burn Injury Database nurse dependency tool can be used to measure nurse dependency in burn services.

**Methods:** Over a two week period, nurses in three burn services scored the nurse dependency of their burn injured patients daily using the international Burn Injury Database Nurse Dependency Tool and the Safer Nursing Care Tool. Additionally all the participating nurses were asked to score three fictional case studies using the same two tools to assess inter-rater reliability.

**Results:** There was a statistically significant positive correlation between the international Burn Injury Database Nurse Dependency Tool and the Safer Nursing Care Tool scores ( $\rho = 0.87$ , 95% CI = 0.82–0.90). The case study scores showed a similar correlation pattern as the daily comparison recordings. The inter-rater reliability between the participants was comparable for both the international Burn Injury Database Nurse Dependency Tool ( $\alpha = 0.74$ , CI = 0.71–0.77) and the Safer Nursing Care Tool ( $\alpha = 0.79$ , CI = 0.76–0.81). Psychological support variable had the weakest correlation with the nurse dependency tools and the lowest agreement between nurses.

**Conclusion:** This is the first report in the literature of the international Burn Injury Database Nurse Dependency Tool, the results of which suggest that it does measure aspects of nurse dependency and thus could be a valuable tool in the battle to ensure safe staffing. The good inter-rater reliability between the nurses, regardless of the nurse dependency tool used, should give confidence to nurses and managers using the dependency data to influence staffing.

## What is known about the topic?

- There is a growing body of evidence that suggests there is a link between registered nurse staffing numbers with mortality and quality of care.
- Currently there is no consensus about what nurse staffing numbers should be, particularly in burn care.

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- There are many reported nurse dependency tools worldwide but currently only one, the Safer Nursing Care Tool in the UK endorsed by the National Institute for Health and Care Excellence.

What this paper adds?

- This is the first reported observational study using the nurse dependency tool developed for use in the international Burn Injury Database (iBID).
- There is a correlation between the Safer Nursing Care Tool and the iBID Nurse Dependency Tool scores suggesting that the international Burn Injury Database Nurse Dependency Tool does measure a degree of nurse dependency.
- There is consistency in the way nurses score the nurse dependency of patients' with a burn injury, using both Safer Nursing Care Tool and international Burn Injury Database Nurse Dependency Tool.

## 1. Background

Inadequate staffing levels linked to reduced quality of care and an increase in mortality has been a concern raised by patients and nurses alike over the years (Francis, 2013; Royal College of Nursing, 2017). Over the last decade this has been supported by a growing worldwide body of evidence demonstrating an association of lower registered nurse numbers with reduced quality of care and increased mortality (Aiken et al., 2014; Ball et al., 2018; Griffiths et al., 2018). In the UK this has been further acknowledged in the National Institute for Health Research's (2019) recent review of the evidence regarding nurse staffing on hospital wards. However, the literature also demonstrates that it is not just a case of increasing the numbers of nurses to gain optimum nurse staffing levels; there are many other factors that affect staffing decisions such as ward environment, patient acuity, nurse staffing skill mix, staff wellbeing, work organisation and planning (Griffiths et al., 2020a; National Institute for Health Research Dissemination Centre, 2019; Smith et al., 2009). This suggests that one workforce planning tool on its own may not be able to take into consideration all these factors. The many influences and factors impacting on nurse staffing may be one of the reasons why research to date highlights the need for correct nurse staffing levels but does not address the more difficult question of what the correct level should be.

Griffiths et al. (2020b) highlight the preponderance of nurse dependency tools and lack of evidence to choose one over the other. They conclude that rather than developing new tools a closer look at those in existence is required. This article discusses the routinely collected nurse dependency data held by the UK's international Burn Injury Database (iBID) that could be used as an adjunct to other workforce planning tools such as the Safer Nursing Care Tool (The Shelford Group, 2014), to aid nurse staffing decisions in burn services. Here we report a study comparing the iBID Nurse Dependency Tool with the Safer Nursing Care Tool and assess the consistency between the participating nurses in the way they scored the nurse dependency of three fictional patient case studies.

### 1.1. Safer Nursing Care Tool

Of the workforce planning methods in existence, the Safer Nursing Care Tool is based upon the workload (acuity) quality method (Flynn et al., 2010; Hurst, 2010), where each patient's dependency is assessed and used in an algorithm to estimate staffing levels. Patient dependency in this context is taken to mean "the level to which the patient is dependent on nursing care to support their physical and psychological needs and activities of daily living" (National Institute for Health and Care Excellence [NICE], 2014; 40). There are multiple dependency tools reported in the literature worldwide but only the Safer Nursing Care Tool, designed for use on acute adult wards in the UK, has been endorsed by NICE (2014).

The Safer Nursing Care Tool was developed over many years building on initial work done in Southampton (Harrison, 2004) designing a dependency acuity tool based on the Department of Health's comprehensive Critical Care Classification System (Department of Health and Social Care, 2000). This tool was further refined, validated and tested (Hurst et al., 2008; Smith, 2009) and then again updated in 2012 (Fenton and Casey, 2015).

There are five categories of dependency in the Safer Nursing Care Tool that patients are allocated to depending on their care requirements: "0- needs are met through normal ward care. 1a – Acutely ill patients requiring intervention or are unstable with a greater potential to deteriorate, 1b – Patients who are in a stable condition but are dependent on nursing care to meet most or all of the activities of daily living, 2 – Patients who may be managed within clearly identified, designated beds, resources with the required expertise and staffing level or may require transfer to a dedicated level 2 facility, 3 – patients needing advanced respiratory support and/or therapeutic support of multiple organs" (The Shelford Group, 2014; 5). Each level has a calculated staffing multiplier to enable the calculation of the number of nurses required. The Safer Nursing Care Tool is designed to be used alongside nurse sensitive quality indicators, such as falls and infection rates, as a measure of optimum staffing levels (Fenton and Casey, 2015).

Since its implementation and NICE's endorsement the Safer Nursing Care Tool is currently used, in one of several iterations, in the majority of acute NHS trusts in England (Ball et al., 2019). Nevertheless, despite it being one of the few tools that has been tested for validity and reliability in the UK there is a lack of evidence for its effectiveness and cost in guiding staffing decisions, like most dependency/ acuity based tools (Griffiths et al., 2020b). The Safer Nursing Care Tool was designed as a generic dependency tool for use in acute adult wards to guide workforce planning on a six-monthly basis. It was not originally designed for daily monitoring of staffing needs nor does it allow for local and speciality factors that might affect workload. Although the tool and its multipliers are being further developed for other care settings, to date burn care is not one of them (The Shelford Group, 2019).

**Table 1**

iBID Nurse Dependency Tool categories and descriptors (iBID, 2019). For each iBID dependency category the relevant level descriptor for the patient is chosen and the scores added up to give an iBID nurse dependency total score between 4 and 25. TBSA – total burned body surface area.

iBID Nurse Dependency category	Level descriptors
Monitoring requirement	<b>B1</b> - surgical ward level <b>B2</b> - high dependency <b>B3</b> - intensive care <b>B4</b> - additional Intensive care <b>B5</b> - complex intensive care
Procedure complexity	<b>P0</b> - no dressing or procedure <b>P1</b> - simple small dressing <5% TBSA or ROS <b>P2</b> - single body segment dressing 5–10% TBSA <b>P3</b> - moderate dressing 10–20% TBSA/small operation <b>P4</b> - multi-segment dressing >20% TBSA/significant operation <b>P5</b> - near full body dressing/major operation
Psychosocial support	<b>S1</b> - ward round contact/social <b>S2</b> - explanatory chat <b>S3</b> - significant support needed <b>S4</b> - in-depth discussion or next of kin support <b>S5</b> - intense observation or next of kin in crisis
Activities of daily living achievement	<b>D1</b> - self-caring/minimal input <b>D2</b> - minimally dep assistance few tasks <b>D3</b> - limited function assistance with some tasks <b>D4</b> - severely limited assistance with most tasks <b>D5</b> - fully dependant assistance with all tasks
Mobility limitation	<b>L1</b> - fully mobile <b>L2</b> - some limitation supervision/assistance needed <b>L3</b> - significant limitation needing 1–2 assistants and walking aid <b>L4</b> - severe limitation hoist/tilting table/standing frame <b>L5</b> - totally immobile high pressure sore risk hoist only

### 1.2. International Burn Injury Database Nurse Dependency Tool

Within the speciality of burns the importance of adequate staffing levels related to the dependency of burn-injured patients for quality care is recognised by the British Burn Association. One of their burn care standards states “The service has the capability to adjust the skill mix and numbers of Registered Nurses to reflect the changes in complexity of the patients cared” (Burn Standards Review Group, 2018: 20), yet this standard is difficult to demonstrate. There are few validated nurse dependency tools available to predict or support staffing numbers, and a paucity of published tools specifically related to burn care. The few tools that there are, were developed for a particular service and not necessarily transferable to other burn services (de Jong et al., 2009). In some burn services their hospitals use the Safer Nursing Care Tool but anecdotally nurses in burn services are concerned that it may not pick up the nuances of burn care such as the time-consuming dressing changes and the particular psychosocial needs of patients who have burn injuries. This appears to be supported by Griffiths et al. (2020b) study, looking at the performance of the Safer Nursing Care Tool in estimating staffing establishments, in which they identified a larger discrepancy between Safer Nursing Care Tool estimates and staffing needs on specialist units compared to more general areas.

The developers of the Safer Nursing Care Tool acknowledge that nursing workload can be influenced by many variables and suggest combining it with other data sources to increase confidence in recommended staffing levels (The Shelford Group, 2014). However, recording patient dependency, alongside the other data that nurses are required to collect, can be time consuming, and perceived by nurses as time taken away from direct patient care (Ball et al., 2019). So, any attempt to address the generalisation of the Safer Nursing Care Tool by using additional information ideally needs to use data that is already routinely collected, such as the iBID nurse dependency data, in order to minimise the demand on nursing staff time.

Within the speciality of burn care there exists a UK repository for burn injury data – iBID. Since 2003 all burn services in England and Wales have been required to routinely input information about all the patients with burn injuries that they admit. This includes patient demographics, type and cause of the burn and a series of treatment outcomes. The purpose of this database is to store information about burn injuries to enable advances to be made in burn prevention, burn research and audit, outcome assessment, burn service provision and quality assurance (iBID, 2019).

The database contains a section on nurse dependency which was originally devised in 2006 from the professional clinical judgement of senior burn speciality nurses on what they thought would specifically identify patients with burns acuity. Since 2012, nationally on a daily basis, burn services have entered information about their patients’ dependency to calculate a nurse dependency score. Table 1 shows the five variables within iBID that make up the nurse dependency score. For example, if a patient is a B2, P3, S3, D2 and L2 this is equivalent to 2 + 3 + 3 + 2 + 2 giving an iBID nurse dependency total score of 12.

To date the nurse dependency information in iBID has not been published and, while the individual dependencies are recorded, the overall dependency score is not routinely used to inform safe staffing levels. Given the daily nature of the iBID entries, it promises

a more responsive reaction to the fluctuating daily staffing needs of a burn service, especially if used alongside the Safer Nursing Care Tool or another nurse dependency tool.

## 2. Aim

The aim of this study was to explore the criterion validity of the iBID Nurse Dependency Tool compared to the commonly used UK Safer Nursing Care Tool. Additionally we sought to identify if nurses were consistent in the way they scored nurse dependency using different nurse dependency tools.

## 3. Methodology

Over a two week period three adult burn services were asked to score their patients with burn injuries daily using both iBID Nurse Dependency Tool and the Safer Nursing Care Tool. The highest dependency score for the day was recorded for each patient late afternoon or early evening. If new admissions arrived before the dependency scores were recorded they were included for that day, otherwise they were scored the following day. As we were not aiming to assess the day's workload it was felt that this did not impact the results. The daily iBID nurse dependency scores were collected and entered into the iBID database in line with the burn services' normal practice. The Safer Nursing Care Tool score was also entered into iBID by the service in an additional field that had been identified specifically for this study. Following the collection period the relevant data was extracted from the iBID database, excluding patient identifiable data, for analysis.

In order to calibrate the inter-rater reliability, a case study approach was employed. It was not logistically possible to get all the participants to individually assess the same patients – therefore, we designed three artificial patient handover profiles that encompassed a range of iBID and Safer Nursing Care Tool scores. This enabled the assessment of nurse dependency by each participant using the same information and same guidance, which could be compared for consistency of answers.

### 3.1. Participants and study setting

The research was carried out in three adult burn services from three of the four burn networks in England and Wales. These burn services were chosen, following an initial analysis of iBID, as they all routinely submitted data to iBID and admitted burns of all sizes. The participants were all senior nurses who had consented to participate in the research and who would normally be in charge of the ward and undertaking dependency scoring.

### 3.2. Case study development

The patients with burn injuries case studies were designed to represent three of the Safer Nursing Care Tool levels and a range of iBID variable scores based on the following profiles.

- 2- Case study 1 – A patient with a new burn, requiring fluid resuscitation but otherwise no complications with an expected Safer Nursing Care Tool score of 1b.
- 2- Case study 2 – An older adult with a small burn, pre-existing comorbidities and psychosocial issues with an expected Safer Nursing Care Tool score of 0.
- 2- Case study 3 – A patient who is ventilated in intensive care with a large burn and smoke inhalation injury with an expected Safer Nursing Care Tool score of 3.

These three case study handover summaries were then piloted by five senior nurses with burns or critical care experience to establish face and content validity. Following the pilot feedback minor amendments were made but no changes to actual medical aspects.

### 3.3. Statistical analysis

Analysis was performed using IBM SPSS Statistics 24. The Safer Nursing Care Tool and iBID nurse dependency scores collected over the two-week period were analysed using a two tailed Spearman correlation test to identify if there was a correlation between the two tools. The Spearman correlation test was used as opposed to Pearson as the data was non-parametric. Additionally the correlation of the case study scores were explored, again using the two tailed Spearman correlation test, to establish whether there was any similar patterns between the daily scores and case study scores. For this study we considered a Spearman correlation coefficient,  $\rho$ , of < 0.19 as a very weak correlation, 0.2–0.39 as weak, 0.40–0.59 as moderate, 0.60–0.79 as strong and 0.80–1 a very strong correlation (BMJ, 2020) .

The case study scores were analysed for inter-rater reliability using the Krippendorff alpha test which quantifies the extent of agreement and reliability between multiple scorers for multiple categories (Hayes and Krippendorff, 2007). As the data was ordinal in nature the corresponding version of Hayes's KALPHA macro (Hayes, 2019) was ran in SPSS. The strength of inter-rater reliability have been interpreted here in line with Altman's (1991) agreement levels as follows: <0.20 = poor; 0.21–0.40 = Fair; 0.41–0.60 = moderate; 0.61–0.80 = good and 0.81–1.00 = very good.

**Table 2**

Spearman correlation coefficient and bootstrapped 95% confidence intervals of the iBID nurse dependency score and Safer Nursing Care Tool score (N= number of cases).

		Safer Nursing Care Tool score	Age group	Location (ward type)	The five categories that make up the iBID Nurse Dependency Tool score				
					Monitoring Requirement	Procedure Complexity	Psychosocial Support	Activities of Daily Living Achievement	Mobility Limitations
iBID Nurse Dependency Tool total score (N=268)	Correlation coefficient	0.87	-0.01	-0.87	0.87	0.45	0.59	0.88	0.88
	sig. (2-tailed) 95% confidence interval	<0.0005 0.82-0.90	0.99 -0.10-0.10	<0.0005 -0.88 to -0.85	<0.0005 0.84-0.88	<0.0005 0.32-0.55	<0.0005 0.49-0.68	<0.0005 0.85-0.90	<0.0005 0.85-0.90
Safer Nursing Care Tool score (N=268)	Correlation coefficient	1.00	0.04	-0.85	0.84	0.20	0.44	0.84	0.84
	sig. (2-tailed) 95% confidence interval	1.00-1.00	0.47 -0.05-0.14	<0.0005 -0.90 to -0.81	<0.0005 0.80-0.87	<0.0005 0.06-0.32	<0.0005 0.33-0.54	<0.0005 0.79-0.89	<0.0005 0.79-0.88

## 4. Results

### 4.1. iBID and Safer Nursing Care Tool scores comparison findings

Following the two week data collection period a combined total of 268 sets of nurse dependency scores were returned for analysis. This was less than expected due to one service having admitted fewer patients with burns than usual during the data collection period and another service deviating from protocol, only collecting data from their intensive care (ICU) area. As the aim of this study was the comparison of two nurse dependency tools the variation in numbers of the patients had minimal effect on the overall results. Additionally, as one of the services did not admit any ICU patients during the data collection period the numbers of patients at ward and ICU level was similar.

The results of the Spearman correlation test between the iBID nurse dependency total score and Safer Nursing Care Tool score are shown in [Table 2](#). There was a strong positive correlation (both increasing together) between the Safer Nursing Care Tool and iBID nurse dependency total score ( $\rho = 0.87$ ,  $p < 0.0005$ , 95% CI = 0.82-0.90) suggesting the iBID Nurse Dependency Tool does measure at least some aspect of nurse dependency. The data showed a strong correlation of both iBID nurse dependency and Safer Nursing Care Tool scores with the location of care – with ICUs reporting the higher dependencies and burn wards the lower dependencies, as expected.

Between the Safer Nursing Care Tool scores and the iBID categorical variables (the five sub-variables that make up the iBID nurse dependency total score) three show very strong correlations, in excess of 0.84, with tighter confidence intervals (CI). The remaining two, “Procedure Complexity” and “Psychosocial Support”, showed weaker correlations with the Safer Nursing Care Tool score ( $\rho = 0.20$ , 95% CI = 0.06-0.32, and  $\rho = 0.44$ , 95% CI = 0.33-0.54 respectively). The weaker correlation of the Safer Nursing Care Tool score with “Procedure Complexity” and “Psychosocial Support” was expected as the Safer Nursing Care Tool does not explicitly differentiate between different levels of dressing needs or psychosocial support required.

The Safer Nursing Care Tool only makes reference to “Psychological Support” in its level 1b category when referring to “patients/carers requiring psychological support due to poor prognosis or clinical outcome”. The Safer Nursing Care Tool level descriptors fail to address the extent to which pre-existing or ongoing psychological and social needs are met. It has been shown that the transformative nature of a burn will lend itself to a greater extent of psychosocial harm than arises from general medical care ([Knol et al., 2020](#)) potentially limiting the Safer Nursing Care Tool’s ability to reflect this aspect of nursing acuity.

With regards to procedure complexity, the Safer Nursing Care Tool only mentions wound care in their level 1b descriptor in reference to “Complex wound management requiring more than one nurse or takes more than an hour to complete”. Within burn care, the level of wound management does not necessarily scale with case complexity. For example a dressing may require several hours for larger burns on a patient in a general burn ward and hence limited to 1b under the Safer Nursing Care Tool descriptors. The same could be argued for patients of increasing levels of Safer Nursing Care Tool, where the addition of a time consuming, complex dressing adds a level of resource drain otherwise absent from the acuity model.

The correlation of the iBID nurse dependency score with its underlying categories mirrors the pattern of the Safer Nursing Care Tool score – again showing weaker correlations to “Procedure Complexity” and “Psychosocial Support”. The weaker correlations were not expected, suggesting other factors may be impacting the scoring with respect to psychosocial support and procedure complexity. A possible cause of the lower than expected correlation between iBID nurse dependency score and “Procedure Complexity” is that dressing changes may not be undertaken every day. A patient with burn injuries with a high nurse dependency will not require a new dressing every day, causing the “Procedure Complexity” to fluctuate between levels.

To understand if the natural fluctuation in “Procedure Complexity” level suppressed its correlation with iBID nurse dependency score, the correlation analysis was repeated having removed patients’ data which had P0 recorded for their procedure complexity.

**Table 3**

Spearman Correlation coefficient and bootstrapped 95% confidence intervals of the iBID nurse dependency score and Safer Nursing Care Tool score with zero “Procedure Complexity” cases removed (N= number of cases).

		Safer Nursing Care Tool score	Age group	Location (ward type)	The five categories that make up the iBID Nurse Dependency Tool total score				
					Monitoring Requirements	Procedure Complexity	Psychosocial Support	Activities of Daily Living Achievement	Mobility Limitations
iBID Nurse Dependency Tool total score (N=167)	Correlation coefficient	0.88	0.04	-0.86	0.87	0.76	0.60	0.90	0.90
	P value	<0.0005	0.57	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	95% confidence interval	0.81–0.92	-0.07–0.16	-0.88 to -0.83	0.83–0.90	0.66–0.83	0.48–0.70	0.87–0.92	0.86–0.92
Safer Nursing Care Tool score (N=167)	correlation coefficient	1.00	0.04	-0.85	0.83	0.61	0.46	0.84	0.85
	P value		0.60	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	95% confidence interval	1.00	-0.08–0.16	-0.89 to -0.78	0.78–0.87	0.50–0.72	0.32–0.58	0.77–0.89	0.79–0.90

**Table 4**

The Spearman correlation results for the case study Safer Nursing Care Tool score against the iBID nurse dependency scores.

		Safer Nursing Care Tool score	The five categories that make up the iBID Nurse Dependency Tool total score				
			Monitoring Requirements	Procedure Complexity	Psychosocial Support	Activities of Daily Living Achievement	Mobility Limitations
iBID Nurse Dependency Tool total score (N = 63)	correlation coefficient	0.82	0.86	0.84	0.54	0.84	0.69
	P value	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	95% confidence interval	0.71–0.89	0.76–0.91	0.74–0.89	0.32–0.70	0.74–0.90	0.51–0.81
Safer Nursing Care Tool score (N = 63)	correlation coefficient	1.00	0.84	0.75	0.33	0.73	0.68
	P value		<0.0005	<0.0005	0.01	<0.0005	<0.0005
	95% confidence interval	1.00	0.73–0.91	0.60–0.86	0.07–0.55	0.54–0.86	0.48–0.82

**Table 5**

Krippendorff alpha statistical test results and bootstrapped 95% confidence intervals for the case study Safer Nursing Care Tool and iBID Nurse Dependency Tool scores.

		Safer Nursing Care Tool score	iBID Nurse Dependency Tool total score	The five categories that make up the iBID Nurse Dependency Tool total score				
				Monitoring Requirement	Procedure Complexity	Psychological Support	Activities of Daily Living Achievement	Mobility limitation
Krippendorff alpha	Coefficient	0.79	0.74	0.76	0.77	0.32	0.67	0.79
	95% confidence interval	[0.76–0.81]	[0.71–0.77]	[0.71–0.80]	[0.73–0.81]	[0.24–0.40]	[0.61–0.71]	[0.77–0.82]

With the P0 values removed from data set, the Spearman correlation results remained similar apart from the correlation between “Procedure Complexity” and iBID nurse dependency total score which increased (with iBID  $\rho$  increased from 0.45 to 0.76 and Safer Nursing Care Tool  $\rho$  increased from 0.20 to 0.61), (see Table 3). The correlation for both nurse dependency tools with the “Psychosocial Support” variable remained low.

4.2. Case studies findings

Sixty percent (16 out of 27) of the participants completed the case studies with 0% missing data from those that responded. These along with the pilot scores generated a total of 21 case study results for analysis.

The Spearman correlation results of the case study data, as summarised in Table 4, were similar to the results from the iBID and Safer Nursing Care Tool comparison data shown in Tables 2 and 3. The Spearman correlation coefficient between iBID and Safer Nursing Care Tool was strong ( $\rho = 0.82$ , 95%CI = 0.71–0.89) demonstrating that there is a relationship between the Safer Nursing Care Tool scores and iBID nurse dependency scores, in agreement with the two nurse dependency tools’ comparison results presented in Section 4.1. Interestingly, the weakest correlation between the nurse dependency scores (iBID nurse dependency and Safer Nursing Care Tool) and the iBID categories was again with Psychosocial Support (iBID:  $\rho = 0.55$ , 95% CI = 0.33–0.69, Safer Nursing Care Tool:  $\rho = 0.33$ , 95%CI = 0.09–0.53).

Table 5 summarizes the level of inter-rater reliability between the individual participants on scoring the case studies, measured via the Krippendorff’s Alpha test. The agreement of scorers for both the Safer Nursing Care Tool and iBID nurse dependency total



score were comparable suggesting that the participants interpreted patient's acuity in a similar manner regardless of the burn service they worked in or the tool they used.

The results show all the metrics, apart from "Psychosocial Support" category, have good agreement (0.67–0.79) with tight confidence intervals. The element with the weakest inter-rater reliability between scorers is the iBID "Psychosocial Support" category ( $\alpha = 0.32$ , CI = 0.24–0.40) which also showed poor correlation with the Safer Nursing Care Tool in both the case studies and the nurse dependency tool comparisons. The Safer Nursing Care Tool appears to have a slightly better inter-rater reliability score ( $\alpha = 0.79$ , CI = 0.76–0.81) than the iBID Nurse Dependency Tool total score ( $\alpha = 0.74$ , CI = 0.71–0.77). This could be because there are only five categories to choose from whereas the iBID Nurse Dependency Tool total score is made up of more variables giving a larger range for agreement. Nonetheless both show a good agreement between the nurses.

## 5. Discussion

This study aimed to establish whether the iBID Nurse Dependency Tool measures nurse dependency by comparing the daily nurse dependency scores undertaken on patients with burn injuries with the validated generic Safer Nursing Care Tool. The results showed a very strong positive correlation between the Safer Nursing Care Tool and the overall iBID nurse dependency score, indicating that they both capture a similar phenomenon. As the Safer Nursing Care Tool was designed specifically to measure nurse dependency it can be argued that the iBID Nurse Dependency Tool also measures aspects of nurse dependency. When comparing the Safer Nursing Care Tool correlation with the five variables that make up the iBID nurse dependency total score there was a weaker correlation with "Psychosocial Support" and "Procedure Complexity". This was not surprising because, as previously discussed, the Safer Nursing Care Tool does not explicitly differentiate between the different levels of these needs in the same way it may link to the other categories.

Considering that the "Psychosocial Support" score makes up part of the overall iBID nurse dependency total score, an unexpected finding was that the iBID nurse dependency total score also had a weaker correlation with the "Psychosocial Support" category. One possible reason for this is that the "Psychosocial Support" score is influenced by different external factors compared to the other iBID variables. It may be that the "Psychosocial Support" score is correlated to the iBID total, but in a non-linear manner – and hence not detectable using the Spearman correlation. For example, a patient with a large burn and requiring a high level of monitoring and support with daily living activities may have a resilient nature and family support, thus requiring less support from nurses. Whereas a patient with a small burn and social difficulties may require more psychological support from nurses but not so much monitoring and support with daily living activities.

The other aim of the study was to investigate whether there was consistency in the way nurses score nurse dependency. The findings showed that there was good agreement between the nurses in scoring patient dependency using both the Safer Nursing Care Tool and iBID Nurse Dependency Tool. The agreement suggests that there is consistency between nurses in the way they score dependency regardless of which of the tools they used. This is consistent with other studies (Liljamo et al., 2017; Perroca, 2013; Smith et al., 2009), particularly Smith et al.'s (2009) Safer Nursing Care Tool development study. During their development of the Safer Nursing Care Tool they used one case study to assess student nurses agreement using an earlier version of Safer Nursing Care Tool and the Leeds acuity-quality rating system. In our study a wider population was canvassed (using three case studies and three burn services) hence giving more chance of disagreement. Despite an increased risk of disagreement, this did not appear to be the case, giving more confidence in the consistency of nurses when scoring dependency. Furthermore this consistency in agreement supports the value of taking professional judgement into account when considering staffing needs, as nursing is more than a list of tasks (Griffiths et al., 2020a).

The importance of psychosocial care needs in patients with burn injuries is widely reported in the literature due to the psychological and social challenges of the trauma and resultant scarring that occur following a burn injury (Heath et al., 2018; Herndon, 2012; Wisely et al., 2007). Furthermore it has been shown that good psychosocial support can reduce pain and improve patient outcomes (Chen et al., 2017). The National Burn Care Standards (Burn Standards Review Group, 2018) emphasise the need for psychosocial training for all members of the multi-professional team to enable patients with burn injuries psychosocial needs to be met in a timely manner. Yet a key finding from this study was the lower correlation of the "Psychosocial Support" category with the nurse dependency total scores and the weak inter-rater reliability for the "Psychosocial Support" score.

The weaker correlation of the iBID "Psychosocial Support" score and Safer Nursing Care Tool may not have been unexpected. However, the weak agreement between the nurses for the "Psychosocial Support" score was not expected. Nonetheless the literature suggests this may not be so surprising. Pehlivan and Kucuk (2016) and Chen et al. (2017) found that nurses recognised the importance of psychosocial care but did not always have the time, confidence, knowledge and skills to assess and meet their patients' psychosocial needs adequately. In addition, the NHS England (2019) specialist services quality dashboard has an outcome stating that all patients following burn injuries should have their psychosocial needs assessed (BRN07) further highlighting the importance of psychosocial care for these patients. Despite agreement of the importance of this outcome it is not always met, suggesting that the issue of patients' with burn injuries psychosocial needs may be complex. From this study it is not possible to identify the reason for this poor agreement between nurses in "Psychosocial Support" scoring; whether it is due to the case study design, nurses being inconsistent with their categorising of psychosocial needs or lack of understanding. Nonetheless, a first step in exploring this further would be more training over the meaning of the category and how to allocate the score is required to eliminate different interpretations as a reason for the inconsistency.

In a recent study on the use of the Safer Nursing Care Tool in four hospitals, Griffiths et al. (2020a) explored the feasibility of using the Safer Nursing Care Tool to set nurse staffing establishments. The daily staffing though would often be based on the calculated average staffing requirement and thus would not meet the staffing requirements every day. They also found evidence that wards

with a higher number of side rooms, surgical wards and specialist wards were more likely to report missed care and less likely report enough staff for quality. Burn services would fit into each of these categories suggesting that the Safer Nursing Care Tool may not always be an optimum nurse dependency tool for burn services. As the only NICE validated nurse dependency tool and the most widely used tool in the UK, the Safer Nursing Care Tool does provide a starting point to work out ward staffing requirements; remembering that on a daily basis it does not consider other factors not directly measured by the tool (such as burn dressings) that may affect the perceived adequacy of staffing (Griffiths et al., 2020a). The iBID Nurse Dependency Tool, on the other hand is not validated to identify how many staff are required, but it can give an indication of changes to nurse dependency requirements on a daily shift basis. Griffiths et al. (2020a) suggest near real time information about nurse dependency could be beneficial to identify *changes* to the baseline staffing level, especially if the data is already being collected. Therefore, it is proposed that the iBID Nurse Dependency Tool could be used in conjunction with another nurse dependency tool to identify changes in the daily nurse dependency and nuances related specifically to burn care. Thus supporting the professional judgement of nurses on the ward when they are advocating for more staff on that shift.

### 5.1. Limitations

This was a small scale study. Although burns is a relatively small specialist area, three burn centres from three out of the four networks is arguably representative. This was a snapshot taken over a short time period of two weeks so the number of participants was small but represents all those nurses who would normally score nurse dependency in those units. Additionally due to the nature of burn injuries these patients can have long lengths of stay leading to resampling of the same patient with less variation of dependency needs. Therefore, despite this study having shown good correlation in scoring between the tools, the results pose the risk of not generalizing outside of this time period and further research over different time periods would be of benefit.

One could argue that the design of the case studies could have added bias. Nevertheless as all participants scored all the case studies the bias would be the same for all. One of the burn services only scored their ITU patients which could have added location bias but this was potentially counteracted as another of the burn centres did not have any ITU patients.

There is no recognised gold standard validated tool to measure nurse dependency and so to compare the iBID Nurse Dependency Tool to. Although it has been validated against the best UK tool available, the Safer Nursing Care Tool, we do not know exactly what the ideal score should be. Therefore, the findings of this study need to be considered in light of this.

## 6. Conclusion and future recommendations

Being able to measure nurse dependency to help inform daily staffing needs of burn services is essential. This paper, although a small scale study, indicates that on the whole there is good inter-rater reliability between nurses when scoring dependency, using both nurse dependency tools. This should give confidence to managers relying on nurse dependency data to influence staffing requirements. There is a correlation between the Safer Nursing Care Tool scores and the iBID Nurse Dependency Tool scores suggesting that the iBID Nurse Dependency Tool score could be a valuable tool in the battle to ensure safe staffing and quality patient care when applied to the unique needs of patients with burn injuries. The dependency that arises from psychosocial support appears to be inconsistently considered by nurses, suggesting that more training on the iBID variables and their meaning may be required. More research would be required to identify whether changes to the iBID Nurse Dependency Tool would make it more sensitive to daily changes in nurse dependency requirements compared to Safer Nursing Care Tool.

### Ethics

Ethical approval for this study was gained through both the University ethics committee and the Health Research Authority.

### Credit author statement

All authors meet the ICMJE recommended criteria for authorship.

They have:

- 1a) made a substantial contribution to the conception and design
- 1b) the acquisition, analysis, or interpretation of the data,
- 2a) Contributed to drafting the article or
- 2b) critical revision for important intellectual content
3. They have given (or undertake to give) final approval of the version to be published.
4. Have agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the article are appropriately investigated and resolved.

Jane Leaver meets 1a, 1b, 2a, 3, & 4

Robert Cook meets 1a, 1b, 2a, 3, & 4

Ken Dunn meets 1a, 1b, 2b, 3, & 4

Philip Dee meets 1a, 1b, 2a, 3, & 4

Hora Ejtehadi meets 1a, 1b, 2a, 3, & 4



## Declaration of Competing Interest

None.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.ijnnsa.2020.100018](https://doi.org/10.1016/j.ijnnsa.2020.100018).

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