Research article

Identification and Validation of an Instrument to Measure Physicians' and Nurses' Knowledge, Attitudes, and Practices Regarding Antibiotic Resistance and Antimicrobial Stewardship

Irene Zainaghi, PhD, RN,ICN[12]; Silvia Cilluffo, PhD, RN[2]; Maura Lusignani[3]

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[1] Department of Anesthesia, Intensive Care and Emergency; Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico, Milan, Italy.
[2] School of Nursing, University of Milan, Milan, Italy
[3] Department of Biomedical Sciences for Health, University of Milan, Milan, Italy

Corresponding author: Irene Zainaghi, at irene.zainaghi@policlinico.mi.it or ireneleo1986@gmail.com

ABSTRACT

Background: In Italy, the presence of a suitable instrument to measure the knowledge, attitudes, and practices of intensive care physicians and nurses with respect to antibiotic resistance and antimicrobial stewardship could not be identified

Objectives: To validate the Italian version of the Ashiru-Oredope tool used by the European Centre for Disease Prevention and Control (ECDC) in 2019 to investigate intensive care nurses' and physicians' knowledge, attitudes, and practices (KAP) regarding antibiotic resistance.

Methods: Content validity was assessed using the Item-Content Validity Index (I-CVI), Scale Level-Content Validity Index/Universal Agreement (S-CVI/UA) score, Scale Level-Content Validity Index/Average (S-CVI/Ave) score, and Average Content Validity Ratio (CVR). Multiple correspondence analysis (MCA) was then carried out together with cluster analysis (CA) to check the correspondence of the items with the eight subdivision domains of the scale.

Results: The final version consisted of 55/60 deemed relevant items, with Item-Content Validity Index (I-CVI) scores ranging from 0,625 to 1. The Scale Level-Content Validity Index/Universal Agreement (S-CVI/UA) score was 0.43; the Scale Level-Content Validity Index/Average (S-CVI/Ave) 0.90. The mean CVR of the scale was 0.43. The inter-rater reliability (Cohen's K) was between good and excellent. The combination of MCA and CA confirmed the correspondence of the items with the domains.

Conclusion: The Italian version is a reliable and valid instrument for investigating antibiotic resistance and antimicrobial stewardship among Italian intensive care nurses and physicians.

Keywords: Italian, antibiotic stewardship, scale validation, knowledge-attitude, nurse, physician

BACKGROUND

In the context of prudent use of antibiotics and antibiotic resistance, many studies have been conducted since the end of the 90s, investigating healthcare students of medicine and nursing, veterinarians, and the general population. In the past decade, approximately 20 surveys involving both physicians and nurses have been conducted (Adegbite et al, 2022; Kimbowa et al, 2022; Zainaghi et al. 2022) using purpose-built instruments. Among these, a more comprehensive survey was conducted in 2019 by the European Centre for Disease Prevention and Control (ECDC) using a tool constructed following a theoretical model of behaviour change (COM-B) and evaluated through a double Delphi process involving 87 experts to assess the clarity and correlation between items and survey topics. This group conducted a study on knowledge, attitudes, and practices (KAP) regarding antibiotic use and antibiotic resistance (AMR) among multiple healthcare professionals at a European level (30 countries) (Ashiru-Oredope et al., 2021). The questionnaire was developed to target physicians of any specialty, surgeons, nurses and midwives, pharmacists, dentists, pharmacy technicians, physiotherapists, biomedical scientists, and so on.

There are no validated tools in Italy to assess KAPs by physicians and nurses. Ashiru-Oredope et al.'s (2021) instrument included both, but their data were absent. This study aimed to confirm the validity of the Italian instrument in a group of intensive care unit physicians and nurses.

MATERIAL AND METHODS

Description of the Instrument

Ashiru-Oredope et al. (2021) developed a tool with 43 questions based on the capacity, opportunity, motivation, and behaviour (COM-B) model. The tool was created by 87 experts after a systematic literature review, double Delphi process, and pilot test with 224 professionals from various countries. Most questions required a level of agreement on a 5-point Likert scale. The questionnaire included the following categories: A. Demographics; B. Capacity; C. Opportunities; D. Motivation; E. One Health; F. Hand hygiene; G. Info on antibiotic use/resistance; H. Info/training campaign; I. Future contacts; L. Questions for prescribers. It assessed perceived or actual knowledge, access to guidelines/materials, agreement with personal role in controlling antibiotic resistance, agreement with environmental/animal health factors, knowledge of the WHO's five moments of hand hygiene, awareness of European/World Antibiotic Day, and confidence in making antibiotic prescription decisions. The

authors obtained permission to use the Italian version of the instrument developed by the translation team at the European Centre for Disease Control (ECDC), which the Italian members of the panel then reviewed for clarity. In this study, since the original study included healthcare students (who were excluded in the present study), the final section was not administered, reducing the instrument's total number of questions from 43 to 27. (Supplement 1: tool in Italian).

Setting

The Ministry of Health (2019) provided a list of public national hospitals with AEDs. Italian National Association of Critical Care Nurses (ANIARTI) was also consulted to reach personnel. The largest reference centre in each region was contacted first. From February to mid-April 2022, preparations were made. An email with a presentation, research proposal, and questionnaire was sent to medical managers and chief nurses to distribute to their staff. Twenty Italian ICUs took part in the study. A confidential online questionnaire was sent to physicians and nurses from the ICUs via Google Forms for four weeks, from April to May 2022. Social health workers, resident doctors, and medical and nursing students were excluded from the survey. Health directors and department heads authorised the study and survey.

Ethics consideration

The Ethics Committee Lombardy 3 consulted considered that its approval was not necessary as the survey only collected anonymized and non-identifiable data.

Instrument validation method

Content validity

We evaluated the items' alignment and representation of their domains using the content validity index (CVI). We calculated the item-CVI (I-CVI), scale-level CVI (S-CVI), and content validity ratio (CVR). The S-CVI was calculated using universal agreement (UA) and average CVI (S-CVI/Ave). Eight experts (ICU physicians and nurses) from a teaching hospital in Northwest Italy evaluated the instrument. The literature suggests two to 20 experts, with a minimum of five needed for satisfactory agreement (Rodrigues et al., 2017). Eight experts were chosen to evaluate the questions with a CVR of 0.75 (Lawshe, 1975). Each expert was given a form with four queries about the questions' relevance, clarity, and pertinence, plus suggestions for improvement (Rodrigues et al., 2017). Rodrigues et al. (2017) used to rate relevance as "not relevant," "somewhat relevant," "quite relevant," and "very relevant," clarity as "not clear," "somewhat clear," and "very clear," and pertinence as "not essential," "useful, but not essential," and "essential."

Statistical analysis: multiple correspondence analysis (MCA) and cluster analysis (CA)

To guarantee the instrument's psychometric properties, we consulted a statistician. Multi-dimensional techniques combined data from multiple variables related to the phenomenon. MCA analysed nominal and ordinal qualitative variables. Cluster Analysis (CA) was used to check if the tool's questions were correctly structured in the relevant constructs/domains, based on MCA factors. This enabled us to categorise the dataset into 'natural' groups that were both internally cohesive and externally separated.

Data were analysed using MS Excel and IBM SPSS Statistics version 25 (SPSS Inc., Chicago, IL, USA).

RESULTS

Presentation of the participating sample

Of the 700 professionals invited to participate in the study, 148 (21.14%) responded. Five incomplete questionnaires were discarded, leaving a total of 143 questionnaires. Among those who responded, 79.7% were nurses, 21.3% were physicians, and the majority (62.9%) belonged to the 26–45 age group. Some 39.9% had a service tenure ranging between six and 15 years, whereas 31.5% had served for 16 years or more. Of those who responded, 45.5% were from one of several tertiary-level teaching hospitals in Northwest Italy.

Relevance of the individual items: I-CVI

Out of 60 items, 57 with values above 0.75 were deemed relevant, nine needed revisions, and I-CVI ranged from 0.625 to 1.00. Twenty-six items scored a perfect 1.00 I-CVI, 21 scored 0.875, 10 scored 0.75, and three scored 0.625. Table 1 lists all item I-CVI values.

Relevance of the entire questionnaire: S-CVI

The S-CVI/UA was 0.43, and the S-CVI/Ave was 0.90. Universal Agreement was calculated from all items with I-CVI = 1.00 (26) out of 60 total items. The average value was calculated from all I-CVI values (53.75) divided by 60 items. The results suggest poor content validity for the Universal Agreement method and excellent content validity for the average method.

Table 1

Item Content Validity Index (CVI) and Cohen's Kappa Values for Individual Items on the Italian Version of the Ashiru-Oredope Instrument

Item	I-CVI (Relevancy)	Interpretation	Kappa	Interpretation
1a	1	Relevant	1	Excellent
1b	1	Relevant	1	Excellent
1c	1	Relevant	1	Excellent
1d	1	Relevant	1	Excellent
1e	1	Relevant	1	Excellent
2a	1	Relevant	1	Excellent
2b	1	Relevant	1	Excellent
2c	0.875	Relevant	0.87	Excellent
2d	0.875	Relevant	0.87	Excellent
2e	1	Relevant	1	Excellent
2f	0.875	Relevant	0.87	Excellent
2g	1	Relevant	1	Excellent
2h	0.75	Relevant	0.72	Good
3a	0.875	Relevant	0.87	Excellent
3b	0.75	To be revised	0.72	Good
3c	0.75	To be revised	0.72	Good
4a	0.875	Relevant	0.87	Excellent
4b	0.75	To be revised	0.72	Good
4c	0.875	Relevant	0.87	Excellent
5	0.625	To be eliminated	0.52	To be eliminated
6a	0.625	To be eliminated	0.52	To be eliminated
6b	0.625	To be eliminated	0.52	To be eliminated
7	1	Relevant	1	Excellent
8a	1	Relevant	1	Excellent
8b	1	Relevant	1	Excellent
9	1	Relevant	1	Excellent
10	0.875	Relevant	0.87	Excellent
11	0.875	Relevant	0.87	Excellent
12	0.875	Relevant	0.87	Excellent
13	0.875	Relevant	0.87	Excellent
14	0.875	Relevant	0.87	Excellent
15	0.875	Relevant	0.87	Excellent
16	0.875	Relevant	0.87	Excellent
17	0.75	To be revised	0.72	Good
18a	0.75	To be revised	0.72	Good
18b	0.75	To be revised	0.72	Good
19	0.875	Relevant	0.87	Excellent
20a	0.875	Relevant	0.87	Excellent

20b	0.875	Relevant	0.87	Excellent
21a	0.875	Relevant	0.87	Excellent
21b	1	Relevant	1	Excellent
22	0.875	Relevant	0.87	Excellent
23	0.75	To be revised	0.72	Good
24	1	Relevant	1	Excellent
25a	1	Relevant	1	Excellent
25b	1	Relevant	1	Excellent
25c	1	Relevant	1	Excellent
25d	1	Relevant	1	Excellent
25e	1	Relevant	1	Excellent
25f	1	Relevant	1	Excellent
26a	0.875	Relevant	0.87	Excellent
26b	0.875	Relevant	0.87	Excellent
26c	1	Relevant	1	Excellent
26d	1	Relevant	1	Excellent
26e	0.875	Relevant	0.87	Excellent
26f	0.75	To be revised	0.72	Good
26g	1	Relevant	1	Excellent
26h	1	Relevant	1	Excellent
26i	1	Relevant	1	Excellent
27	0.75	To be revised	0.72	Good

Relevance according to inter-rater reliability: Cohen's Kappa

Although the CVI is the most widely used method to estimate the validity of a tool, Rodrigues et al. (2017) reported how Wyndt et al., in their 2003 work regarding the two quantitative approaches to describe content validity, suggested the need to introduce another balanced index that reduces the randomness of the CVI value obtained: Cohen's kappa is useful for testing reliability among evaluators. Regarding our instrument, the kappa values of various items were between 0.52 and 1. The Kappa reference ranges consider the items above 0.74 to be excellent, good those between 0.60 and 0.74, and poor those between 0.40 and 0.59 (Rodrigues et al., 2017): based on these values, three items were found to be eliminated (K=0.52), ten were considered to be good (K= 0.72) and the remaining considered excellent (0.87<K<1) (Table 1).

Relevance of the items: Content Validity Ratio (CVR)

The CVR was calculated for all 60 items of the scale. As stated by Lawshe (1975) in his work, a value below 0.75 is considered significant. Eight experts were involved in the analysis, and it was found that most questions needed to be removed. Only 20 questions exceeded or equaled the critical value, while the remaining items had values between -0.25 and 0.5. The mean CVR on the scale was 0.43. The individual item values are listed in Table 2.

Table 2

Content Validity Ratio Values (CVR) of Individual Items Italian Version of the Ashiru-Oredope Instrument

Item	CVR	Interpretation
1a	0.75	Relevant
1b	0.75	Relevant
1c	0.75	Relevant
1d	0.75	Relevant
1e	0.5	To be eliminated
2a	1	Relevant
2b	0.5	To be eliminated
2c	1	Relevant
2d	-0.25	To be eliminated
2e	1	Relevant
2f	1	Relevant
2g	0	To be eliminated
2h	-0.25	To be eliminated
3a	0.25	To be eliminated
3b	-0.25	To be eliminated
3c	-0.25	To be eliminated
4a	0.5	To be eliminated
4b	-0.5	To be eliminated
4c	0.25	To be eliminated
5	-0.25	To be eliminated
6a	0.25	To be eliminated
6b	0.25	To be eliminated
7	0.75	Relevant
8a	0.75	Relevant
8b	1	Relevant
9	0.75	Relevant
10	0.25	To be eliminated
11	0.25	To be eliminated
12	0.25	To be eliminated
13	0.75	Relevant
14	0.5	To be eliminated

15	0.25	To be eliminated
16	0	To be eliminated
17	0.25	To be eliminated
18a	0.5	To be eliminated
18b	0.25	To be eliminated
19	0.5	To be eliminated
20a	-0.25	To be eliminated
20b	-0.25	To be eliminated
21a	-0.25	To be eliminated
21b	0	To be eliminated
22	0.5	To be eliminated
23	0.25	To be eliminated
24	0.75	To be eliminated
25a	0.5	To be eliminated
25b	0.5	To be eliminated
25c	0.75	Relevant
25d	0.5	To be eliminated
25e	0.75	Relevant
25f	0.5	To be eliminated
26a	0.5	To be eliminated
26b	0.75	Relevant
26c	0.5	To be eliminated
26d	0.75	Relevant
26e	0.25	To be eliminated
26f	0.5	To be eliminated
26g	0.75	Relevant
26h	1	Relevant
26i	1	Relevant
27	0.5	To be eliminated

Clarity of individual items

On a 1-3 clarity scale, scores varied from 2.38 to 3.00, with 16% of items rated very clear. Twenty-six items scored 2.88, eighteen 2.75, two 2.5, two 2.63, and two 2.38. Two physicians noted issues with question length and the instrument's suitability for healthcare professionals outside intensive care.

Multiple correspondence analysis, cluster analysis

The dataset lacks standardisation; some questions were open-ended, making the

data unusable because of high heterogeneity and lack of frequency counts. Some questions were excluded, and others were censored due to missing data. The analysis evaluated eight constructs: questions 1 (A-D) and 2 (A-G) assessed perceived skills and knowledge (section 1); questions 3 (A-C) and 4 (A-C) evaluated opportunities, plus question 5 (section 2); questions 1B and 1E examined motivation (section 3); questions 6 (A-B) and 2H looked at the One Health strategy (section 4); question 8 (A-B) addressed hand hygiene (section 5); questions 7, 9, 11,12,13,15 (10 and 14 excluded) examined antibiotic use, resistance, and infection management (section 6); questions 16,17,18,19,20,21,22 investigated information campaigns and training (section 7); and questions 23,24,25 (A-F),26 (A-I),27 were directed at physicians (section 8). The analysis of multiple correspondences highlighted how the items are arranged in an entirely varied way on the factorial plane, for which we found excellent Cronbach's alpha values (95%).

We also observed that for the 143 individuals who responded, there was a clear separation regarding the opinions expressed about the phenomena investigated in the questionnaires, indicating that we correctly investigated the discrimination induced by the series of items identified in the constructs with the MCA.

The K-means Cluster Analysis was non-hierarchical, with preset groups. Three-step cluster analysis divided the dataset into clusters of similar participants with varied inter-cluster differences. The algorithm grouped items significantly different from 0, as the ANOVA test results in Tables 3 and 4 showed (p-values close to zero). However, the utilisation of this outcome is not inferential but rather descriptive. Of the 72 item questions incorporated into the MCA, we noticed the frequency distribution within the eight gatherings that the algorithm was solicited to shape.

Table 3

Cluster Analysis to Evaluate Relevant Constructs/Domains Based on Multiple Correspondence Analysis Factors of Items on the Italian Version of the Ashiru-Oredope Instrument

Iteration	Change in cluster centres							
	1	2	3	4	5	6	7	8
1	85533214	49817175	25212186	53520206	84881468	20767160	33022544	.00
2	.00	6006025	15794941	.00	12414299	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00

Table 4

ANOVA Test to Evaluate the Difference Between Two Algorithm Based Groupings of Items on the Italian Version of the Ashiru-Oredope Instrument

	Cluster		Error		F	p-value
	Mean Square	df	Mean Square	df		
Factor 1	78387759288162675 0.00	7	1860794930432609.8	64	421.26	.00
Factor 2	94645919515322704.00	7	1656482149153388.5	64	57.14	.00

Table 5 analyzed the main characteristics of the eight constructs obtained through MCA+CA. The map showed a green gradient. indicating that most constructs were validated. although the intensity varied. Clusters 6-7-8. related to physicians. should be examined in more detail. We observed an overlap between "perceived skill and current knowledge" and "hand hygiene" and a weak overlap between "One Health" and "Campaign and training".

Table 5

Pivot Table About the Main Results of Multiple Correspondence Analysis and Cluster Analysis

	Item	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8
1	Item_12								
	Item_16								
2	Item_2A								
	Item_2B								
	Item_2C								
	Item_2D								
	Item_2E								
	Item_2F								
	Item_2G								

	Item_2H								
	Item_4B								
	Item_8A								
	Item_8B								
	Item1A_bis								
	Item1E_bis								
	Item7_Clinical experience								
	Item7_Scientific article								
	Item7_Specialist in infection								
	Item7_Other								
	Item17_Guideline								
	Item22_Antibiotic usage								
	Item22 Human Health + Animal + Environment								
	Item22_Antibiotic resistance								
	Item22_Other								
3	Item_9								
	Item_18B								
	Item_19								
	Item_20A								
	Item_20B								
	Item_26D								
	Item1B_bis								
	Item1D_bis								
	Item3A_bis								
	Item6A_bis								
	Item6B_bis								
	Item17_Tools and Resources								
	Item17_Conference								
	Item17_Other								

4	Item_18A								
	Item_21A								
	Item_21B								
	Item3B_bis								
5	Item_4A								
	Item_4C								
	Item_11								
	Item_13								
	Item_15								
	Item3C_bis								
6	Item_24								
	Item_26A								
	Item_26F								
	Item25B_bis								
	Item25C_bis								
	Item25D_bis								
	Item25F_bis								
7	Item_26B								
	Item_26C								
	Item_26E								
	Item_26G								
	Item_26H								
	Item_26I								
	Item25A_bis								
	Item25E_bis								
8	Item_23								

Based on the statistical analysis results. it was determined that Question 5. regarding the delivery of information brochures on antibiotic resistance. should

be removed from the questionnaire. as it is not relevant for a population of professionals working in intensive care units where the assisted person is often unconscious during the administration of life-saving antibiotic therapies.

DISCUSSION

This study evaluated the psychometric properties of the Italian version of the 2019 ECDC tool for a European survey of healthcare professionals' knowledge. attitudes. and practices regarding antibiotic resistance. The psychometric evaluation demonstrated the tool's validity and reliability in measuring these aspects. The results show good content validity and reliability. A panel of eight experts conducted content analysis. and three items should have been eliminated because of a CVI lower than 0.75. Over two-thirds of the items should have been eliminated due to an S-CVI/UA lower than 0.80 (Rodrigues et al, 2017). Cohen's kappa (inter-rater reliability) returned a value of 0.74. which doesn't indicate an overestimated valuation (Sim et al, 2005). Most items were deemed satisfactory; therefore. no changes were made.

Cluster Analysis. which examined multiple correlations. confirmed the tool's ability to assess physicians' and nurses' knowledge. attitudes. and practices on antibiotic resistance.

After Cohen's kappa without overestimation. item clarity. and MCA results - also considering two Delphi rounds and a project advisory group- only one question was removed. This item was difficult to apply in an intensive setting. had an I-CVI of 0.625 and a Cohen's Kappa of 0.52 - below the minimum acceptability threshold- (Rodrigues et al, 2017), and was an open-type item, thus unsuitable for MCA with Cluster Analysis.

Numerous studies have examined healthcare professionals' knowledge and attitudes towards antibiotic resistance and antimicrobial stewardship. However. comparing different studies is challenging because of their unique designs. the use of different measurement tools. different construction and validation methods making it difficult to ensure question equivalence. (Abera et al, 2014; Balliram et al, 2021; Baraka et al, 2019; Cotta et al, 2014; Firouzabadi et al, 2020; Hayat et al, 2020; Herawati et al, 2021; Keizer et al, 2019; Mane et al, 2021; Nair et al, 2019; Sutthiruk et al, 2018; Tahoon et al, 2020; Tegagn et al, 2017).

LIMITATIONS

The restrictions of this research include the modest size of the sample. the limited response from physicians. the utilization of an online questionnaire for data collection. and the predominant participation of intensive care units located in Northern Italy.

CONCLUSIONS

The Italian version of Ashiru-Oredope et al.'s (2021) tool has been confirmed to be a multi-dimensional. multi-item scale with strong psychometric properties. The confirmatory analysis yielded positive results, thus, validating the survey questionnaire. This tool can be used in surveys in Italy to collect data on strategies to fight AMR.

Author Bios:

Irene Zainaghi, PhD, RN, ICN works in the intensive care unit at Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico, Milan, Italy

Silvia Cilluffo, PhD, RN, is a tutor at School of Nursing, University of Milan, section ASST Grande Ospedale Metropolitano Niguarda, Milan, Italy

Maura Lusignani is an associate professor at the University of Milan, Milan, Italy.

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