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## **Effects of Healthcare Worker's Perception of Hygiene on Hand Hygiene Practices**

Edith Salès-Wuillemin: Laboratory LAPPS (University of Paris 8), Parisian Social Psychology Laboratory (LAPPS, EA4386), & Laboratory Psy-DREPI (University of Burgundy) Psychology, Interpersonal Dynamics and Identity Processes (Psy-DREPI EA 74-58), University of Burgundy.

Rachel Morlot: LPCS (University of Burgundy), Laboratory of Social Psychology and Sport Management (SPMS, EA 4180), University of Bourgogne.

Auréli Fontaine: LAPPS (University of Paris 8) Parisian Social Psychology Laboratory (LAPPS; EA4386), University of Paris 8.

Daniel Talon: REFCLIN (Besançon University Hospital) UMR 6249 Chrono-environnement, University of Franche-Comté

Correspondence address:

Edith Salès-Wuillemin, Université Paris 8, UFR PPCS-Psychologie, LAPPS, 2 rue de la liberté, F-93526 Saint-Denis Cedex, FRANCE. Tel: +33 (0)1.49.40.65.07, email: [Edith.Sales-Wuillemin@univ-paris8.fr](mailto:Edith.Sales-Wuillemin@univ-paris8.fr)

## ABSTRACT

Hospital-Acquired Infections (HAI) significantly affect patients, prolong hospital stays and present a major challenge for the quality of patient care. In France, around 4,500 individuals die every year from an HAI (Government Statistics, 2010). Hand hygiene studies focusing on beliefs and practices may be helpful for reducing hospital-acquired infections and promoting long-term compliance with appropriate hand hygiene practices (Salès-Wuillemin et al. 2010). This chapter presents the findings of three studies investigating social representations of hygiene among healthcare workers (nurses and healthcare assistants). The central purpose of this research is to understand the core beliefs and practices associated with hygiene. The first study is based on self-reported questionnaires, including a verbal association task aimed at measuring beliefs (N=145). The second study is based on explanatory interviews (Salès-Wuillemin et al. 2009) examining the core beliefs expressed in the questionnaires (N=26). The third study is based on individual observations of the hand hygiene practices used by healthcare workers during routine patient care (N=32). The questionnaire responses underlined representations structured around two items common to both groups of healthcare workers: 'cleanliness' and 'hand-washing'. An analysis of the interviews conducted as part of this research indicates that 'cleanliness' means 'without germs or microbes' for nurses and 'clean, without traces' for healthcare assistants. An analysis of the hand-washing practices used by participants (conducted with the help of an infection control nurse specialist) indicates that the use of hydro-alcoholic solutions is problematic. Because hydro-alcoholic solutions do not require the use of water and do not lather, there is a low acceptance of hand hygiene techniques based on hydro-alcoholic solutions. Hydro-alcoholic solutions are used to comply with hand-washing regulations since they enable quick hand-washing, and tend to be used solely for care procedures that are assumed to be low-risk for healthcare professionals. Healthcare worker compliance with hand hygiene practices is associated with specific work and system constraints, as well as a number of key factors related to knowledge and social representations.

Keywords: Hospital Hygiene; Hospital Acquired Infection; Hand Hygiene.

## INTRODUCTION

In France, 4,500 people die every year as a result of a hospital-acquired infection. The fight against hospital-acquired infections is one of the key priorities of the *Haute Autorité de Santé* (HAS, High Health Authority). Recently, the emphasis has been on the provision of training for healthcare professionals. Yet despite these efforts, there remains a significant gap between official recommendations and actual hygiene practices<sup>1</sup>. The purpose of this research is to examine the explanatory factors that may account for this gap.

This chapter presents the findings of three studies. Study 1 is an analysis of social representations among healthcare workers based on a verbal association questionnaire. Study 2 aims to refine the results of the analysis performed in study 1 by using the results of explanatory interviews. Finally, study 3 is based on an observation of the behaviors exhibited by healthcare workers in a work context.

### 1. THEORETICAL FRAMEWORK

#### 1.1. Social representations and professional representations

Professional representations are a subset of social representations. Social representations are common sense forms of knowledge that have a practical aim and differ from scientific knowledge. Social representations are developed by a social group as a result of its history, culture, and practices, but also its attitudes. They serve to decipher information from the environment, to shape behaviors, and to facilitate communication between individuals (Flick, 1994; Jodelet, 2001; Moscovici, 2000; Wagner & Hayes, 2005). The structural approach to representations posits that these kinds of knowledge are structured around a limited number of knowledge items defined as central or core elements. The core elements serve to structure and direct the representation, and need to be distinguished from the peripheral elements of the representation, which enable concrete expression and adaptation (Flament, 1994; Abric, 1993; Moliner, 2001). This explains why it is necessary to compare items appearing in the target area of the core in order to compare two distinct representations (Abric, 1994). Professional representations operate like social representations, but pertain specifically to objects belonging to a particular professional context or milieu. The social visibility and implications of the object are connected to the position of the group within a work organization, as well as the place of the object within the professional activity. The analysis of professional representations helps to understand how knowledge is incorporated by individuals and teams in processing information and organizing work activity (Bataille, Blin, Mias & Piasser, 1997; Labbé, Ratineau & Lac, 2007; Salès-Wuillemin, Morlot, Fontaine et al., 2011).

Although a number of studies have examined professional representations in nursing, no studies have so far been conducted on hospital hygiene. Guimelli & Rouquette (1992) examined nurses' representation of their work and showed that representations were structured around the role proper, i.e. the nursing diagnosis. It was found that hygiene did not appear in

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<sup>1</sup> Government statistics – see [http://www.sante.gouv.fr/htm/pointsur/nosoco/34\\_980901.htm](http://www.sante.gouv.fr/htm/pointsur/nosoco/34_980901.htm)

the representation. Zérillo (1998) conducted interviews with nursing students on hygiene-related matters and showed that representations were structured around *the prevention of illnesses, well-being, the respect of others and avoiding bad smells*, i.e. the objectives of the implementation of hygiene practices. However, students' representations tended to emphasize daily body hygiene, which needs to be distinguished from hospital hygiene. It is also important to note that the study conducted by Zérillo was not realized with healthcare *professionals*. Of more direct relevance are a number of recent studies examining the representation of hospital-acquired infections among healthcare workers conducted by Quintard et al. (Quintard, Lecigne, Rogues & Parneix, 2003; Quintard, Lecigne, Parneix, Rogues, Vezin, Labadie, Gachie, Zarogoni & Bruchon-Schweitzer, 2004). The studies by Quintard et al. showed that a distinction must be drawn between two sub-groups within the targeted population: doctors and nurses on the one hand, healthcare assistants and hospital agents on the other. In the first sub-group, representations were found to be structured around the core elements *staff training and prevention*, while the second sub-group structured their representations around three core elements: *training, questioning of healthcare workers and management issues*. The study showed that the former tended to focus on issues related to prevention objectives, while the latter tended to emphasize issues involved in implementing established procedures.

A greater number of studies have examined the question of attitudes toward hygiene. Their aim is to determine whether attitudes account for the gap between a proper knowledge of hygiene protocols and the implementation of established hygiene practices by healthcare staff.

#### 1.2. Hygiene attitudes and behaviors observed among healthcare staff

The emphasis of this study is on the chief vector of hospital-acquired infections – i.e. hands. The measurements focused on the perception of hand hygiene and hand hygiene practices.

There is significant evidence of a gap between attitudes (largely favorable) and behaviors (generally not in compliance with established practices). Pittet, Simon, Hugonnet, Pessoa-Silva, Sauvan & Perneger (2004), Akyol (2007), Pessoa-Silva, Posfay-Barbe, Pfister, Touveneau, Perneger & Pittet (2005) conducted interviews with healthcare professionals to determine the explanatory factors of non-compliance. The results highlighted five main factors reported by participants: working conditions (lack of time), infrastructures (lack of equipment), training (insufficient or inadequate), the human environment (unscrupulous superiors, colleagues, patients...) and staff health (skin irritation caused by frequent hand-washing). The presence of a conscientious supervisor was found to be the most significant determinant of compliance with protocols. Other factors were also highlighted, including an awareness of being observed, the feeling of serving as a model for other colleagues, the need to implement hand hygiene protocols after contact with a patient, and finally ease of access to hydro-alcoholic solutions. Other studies based on observations of actual behaviors have gone even further. McGuckin, Waterman & Govednik (2009) found a generally low rate of compliance with hand-hygiene practices (< 30%). Pittet, Simon, Hugonnet, Pessoa-Silva, Sauvan & Perneger (2004) argued that a lack of equipment at hand-washing facilities or of hydro-alcoholic solution is not the only explanatory factor since the rate of compliance remains low even when hospitals are correctly equipped (57%).

The studies presented above suggest that the work environment is not the only factor determining non-compliance since even under favorable conditions, there is no significant increase of the rate of compliance. It is also important to note that compliance is not governed by a belief in the legitimacy or validity of the norms embodied by protocols, but is driven instead by social desirability – i.e. when an individual produces the expected behavior, it is because s/he is adjusting to a social norm (in this instance, the expectations of superiors).

It is important therefore to consider the reasons that may account for non-compliance by examining naïve knowledge, a potential obstacle hindering the implementation of hygiene protocols. These issues pertain more specifically to the articulation of scientific knowledge and naïve knowledge and the dynamics subtending the relation between these two kinds of knowledge (Moscovici & Hewstone, 1983).

Two specific groups of healthcare staff were targeted in this research: nurses and healthcare assistants. Nurses and healthcare assistants are the two groups most frequently in contact with patients and may therefore be said to play a determining role in the provision of healthcare and the transmission of hospital-acquired infections. However, it is important to note that the work performed by nurses and healthcare assistants (i.e. staff practices) and their level of training (staff knowledge) are not comparable. It is hypothesized that social representations of hygiene are likely to differ between the two groups.

## 2. STUDY 1: QUESTIONNAIRES ASSESSING REPRESENTATIONS OF HYGIENE AMONG NURSES AND HEALTHCARE ASSISTANTS

### 2.1. Method and design

The study was based on verbal association task included in questionnaires. The aim was to highlight the key concepts structuring representations of hygiene.

### 2.2. Population

114 nurses and 35 healthcare assistants were interviewed as part of this study. At the time of the study, all participants had been working in a healthcare institution for at least 3 years and were aged between 26 and 57 (average age: 37.2). 95% of participants were women. Participants practiced hygiene protocols on a regular basis and had taken part in a hygiene training session at least once since entering the profession.

### 2.3. Questionnaires

The questionnaire was a 3-page document divided into two sections. Section one focused on questions concerning the identity of participants (age, gender, number of years in the profession, etc.). Section two involved a verbal association question. Participants were asked to write down as quickly as possible the first words that came to mind when seeing the term 'hygiene' (the inductor) and to cite a maximum of ten associated words. Verbal association involves the activation of knowledge present in the memory and organized into semantic networks. The activation is triggered by the inductor, which acts as a stimulus.

#### 2.4. Method used to analyze the associated words: prototypical analysis

Prototypical analysis was initially developed by Vergès (1992) and is used to highlight the most frequently and most rapidly cited items. Prototypical analysis involves two key criteria: citation frequency (number of individuals citing the term) and average citation rank (average order of citation in the chain of association). The most frequently cited words (high frequency) and the earliest words in the chain of association (low rank) are retained on the grounds that they refer to the most typical items of the representation. These words constitute target elements with a strong probability of being central.

A probability calculation based on the binomial law was performed to establish the thresholds used to distinguish between low and high citation frequencies (Salès-Wuillemin, 2005; Morlot & Salès-Wuillemin, 2008). For every population, the test considers the following factors: the number of subjects, the average number of words that can potentially be associated, and the number of words actually associated by subjects. The probability  $p$  that  $k$  individuals will cite the same associated word can be measured based on these parameters. Only the words with a probability of  $p < .000001$  were retained. In table 1, the  $k$  threshold is 28.27% (32 participants). In table 2, the  $k$  threshold is 48.4% (17 participants). This means that the words associated by at least  $N$  participants are cited at a level significantly different from chance. We may therefore conclude that these words are shared socially by the members of the group.

An arbitrary threshold was determined to establish the citation thresholds used to distinguish between high and low average ranks. Since participants were allowed to cite up to 10 associated words, it was deemed that the words with an average rank below 4 could be viewed as precocious in the chain of association and therefore quickly activated.

#### 2.5. Results of the prototypical analysis

144 different words were cited by the two groups of participants (129 words by the group of nurses and 66 words by the group of healthcare assistants). The words were divided into four areas. The target area is the area containing the most typical words.

*Insert Table 1 and Table 2*

Tables 1 and 2 clearly highlight a common core of knowledge in the target area shared by both groups of healthcare professionals – i.e. cleanliness. However, a number of differences are also apparent – for example ‘disinfection’ (healthcare assistants) and ‘sanitization’ and ‘hand-washing’ (nurses).

The results of study 1 suggest that there is a shared concept structuring representations of hygiene: ‘cleanliness’. However, in the group of nurses the term is associated with ‘sanitization’ in the target area, while in the group of healthcare assistants the term is associated with ‘disinfection’. The results suggest that the term ‘cleanliness’ has a different meaning in the two populations.

### 3. STUDY 2: INTERVIEWS FOCUSING ON THE REPRESENTATION OF HYGIENE AMONG NURSES AND HEALTHCARE ASSISTANTS

#### 3.1. Method and design

The study was based on explanatory interviews aimed at highlighting the connections between the concepts structuring representations of hygiene among nurses and healthcare assistants. The interviews focused on the four concepts located in the target area – i.e. ‘cleanliness’, ‘hand-washing’, ‘sanitization’, and ‘disinfection’.

#### 3.2. Population

32 participants distributed into two groups (16 nurses and 16 healthcare assistants) were interviewed as part of this research. At the time of the study, all participants had been working in a healthcare institution for at least 3 years and were aged between 32 and 57 (average age: 33.5). 93% of participants were women.

#### 3.3. Interviews

All of the interviews conducted in study 2 were performed by the same interviewer and involved a specific interview technique: the explanatory interview (see Salès-Wuillemin, Morlot, Masse & Kohler, 2009; Salès-Wuillemin, 2007). The interviews were conducted in two stages. Every interview began with a free stage during which interviewees were encouraged to express themselves spontaneously after reading an instruction asking them to describe their image of hygiene in the context of their work. Every interviewee was invited to position themselves from their particular professional perspective, i.e. as healthcare assistants or nurses. In the second stage, the interviewer returned systematically to each of the four target items identified in study 1. To introduce the target items, the interview followed a pre-defined interview guide that included as many questions as there were target items. The questions introduced every item in a general manner, for example: ‘Now, if I say to you ‘cleanliness’ in referring to hygiene, what does the word evoke for you as a healthcare assistant (as opposed to a nurse)?’. Participants’ responses were submitted to systematic questioning aimed at generating explanations about: 1/ the relation between two items (e.g. ‘You said that hygiene automatically involves *cleanliness*; what exactly do you mean by *automatically*?’); 2/ the referents cited by participants (e.g. ‘You said that *cleanliness* involves sanitization practices;

what exactly do you mean by *sanitization?*’); or 3/ the rules of practice, reasoning or decision-making stated by participants, with a view to understanding the subtending logic (e.g. ‘You said that if you provide care to the same patient, you might easily apply a dose of hydro-alcoholic solution to continue with another care procedure rather than using hand-washing; could you tell me why it is that *in this particular case, i.e. when you provide care to the same patient, you may use the hydro-alcoholic solution?*’).

#### 3.4. Method used to analyze the interviews: Basic Cognitive Schemas

An analysis based on basic cognitive schemas was performed on the material generated by the interviews. The 28 connectors<sup>2</sup> described by Guimelli & Rouquette (1992) in a study conducted among nurses and by Guimelli (1993) in a study conducted on a group of friends were used as an analytical framework. The key difference with these studies is that participants were required to respond to a questionnaire. In the present study, a coding was carried out based on the transcribed interviews. A valence index was calculated for each target item in order to highlight the items of the representation with the highest probability of being central. The index takes account of the number of times participants connected the target item with another item in the representation, whatever its position (in the central or peripheral area), using one of the 28 possible connectors.

#### 3.5. Results of interviews on valence

*Insert Table 3 and Table 4*

In the group of nurses, the words ‘sanitization’ and ‘cleanliness’ were found to be the items with the strongest valence, i.e. the strongest probability of being central, while the item with the strongest valence among healthcare assistants was ‘disinfection’ (see tables 3 and 4).

#### 3.6. Results of the semantic analysis of ‘Cleanliness’

A semantic analysis of the common items found in the representations generated by both groups (‘cleanliness’) was performed based on the interviews. All synonyms and associated definitions were identified to conduct the analysis.

A qualitative analysis indicates that among healthcare assistants, cleanliness is primarily synonymous with ‘clean and without trace’, i.e. ‘impeccable’. By contrast, among nurses, cleanliness refers above all to a whole range of technical gestures complying with protocols (‘working within the norms’, ‘complying with rules’) and involving the use of adequate equipment (‘wearing gloves’, ‘using sterile gauze-dressing’). The results suggest that while ‘cleanliness’ occupies a central position in the representation of both groups, a significant difference is nevertheless apparent: for healthcare assistants, cleanliness is a state and a

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<sup>2</sup> The 28 connectors are grouped into three metaschemas:

- Descriptive: connectors that indicate a descriptive relation between two items (definition, synonymy, part-whole relation, etc.);
- Praxis: connectors that indicate a relation of action between two items (use, action, etc.);
- Evaluation: connectors that indicate a relation of judgement between two items (characterization, evaluation, etc.).



characteristic ('being clean') that can be assessed based on visual indicators. By contrast, for nurses, cleanliness refers above all to a specific procedure and the equipment used to 'work cleanly'. A third study was conducted to highlight the relations between the representation of hygiene and the actual practices implemented by healthcare professionals. Study 3 was based on observations of professionals at work. Based on the assumption that hand hygiene is one of the key techniques for working cleanly, the observations made in study 3 focused more specifically on the techniques used to ensure hand hygiene.

#### 4. STUDY 3: HYGIENE PRACTICES AMONG HEALTHCARE PROFESSIONALS, NURSES AND HEALTHCARE ASSISTANTS

##### 4.1. Objectives

The aim of the study was to understand hand-hygiene practices among healthcare professionals. A comparative analysis of a simple washing technique (soap and water) and friction (using hydro-alcoholic solution) was performed.

Studies examining hygiene have found that lack of time is a significant obstacle to compliance with hand-washing protocols. The effect of non-compliance is a decrease of washing time. Furthermore, traditional hand-washing presupposes access to washing facilities. However, patient rooms are often not appropriately equipped. For instance, washing facilities may be located in corridors or treatment rooms, causing significant time loss. This explains why the emphasis in recent years has been on the use of hydro-alcoholic solutions. Through rapid friction (lasting less than a minute), better results can be achieved using hydro-alcoholic solutions than through simple washing (lasting 1 minute). Hydro-alcoholic solutions also produce the same results as antiseptic cleaning (lasting 1 minute) and surgical cleaning (lasting 1 minute), without requiring the use of washing facilities. However, given its specific conditions of use, friction can serve as a substitute for traditional hand-washing. Friction can only be applied on clean hands (i.e. without any trace of biological or other products) without talc (after wearing gloves). This explains why healthcare professionals are required to use both techniques and to select a particular technique based on the specific parameters of the situation.

The aim of study 3 was to conduct an error assessment of the hand-hygiene technique used and to identify the decision rules governing the choice of hand-hygiene techniques.

##### 4.2. Method and design

The study was based on systematic observations conducted using an observation chart. The observations were accompanied by concomitant verbalizations. Healthcare professionals were observed at work while delivering treatment and care to patients.

##### 4.3. Population

Two groups of healthcare professionals participated in the study: 15 nurses and 13 healthcare assistants. At the time of the study, all participants had been working in a healthcare institution for at least three years and were aged between 30 and 46 (average age: 32.8). 91% of participants were women.

#### 4.4. Observation chart

An observation chart was used to record the number of patients and the type of treatment dispensed. The chart included the following information: whether treatment was interrupted; the hygiene technique used before and after the treatment was delivered; whether there was a mistake committed in applying the technique, and if so, the type of mistake; finally, whether gloves were used.

#### 4.5. Results of observations

No significant differences in the number of mistakes committed by nurses ( $m = 3.4$ ) and healthcare assistants ( $m = 2.9$ ) were found in the first analysis.

$F(1,24) = 2.49, p < .12$ . The two groups of healthcare professionals were therefore grouped together for the remainder of the treatments. For both groups, the aim was to highlight the impact of the specific hand-hygiene technique used on the number of mistakes committed and the impact of the contamination risk factor on the choice of technique. Finally, the decision rules governing the choice of hand-hygiene technique were analyzed.

*Insert Figure 1*

The results presented in figure 1 show that more mistakes were committed using friction based on a hydro-alcoholic solution than in the use of simple hand-washing: ( $\chi^2=3,56, ddl=1, p < .06$ ).

Analysis indicates that dosage errors were the most common type of mistake committed by healthcare professionals. Healthcare professionals used a lower amount of hydro-alcoholic than necessary. By contrast, participants using a simple hand-washing technique tended to use more product than was strictly necessary. Based on the dosage results, it is hypothesized that dosage errors may result from a feeling that simple hand-washing offers less protection than friction. Two different types of situation were therefore compared: situations with a significant risk of contamination (high-risk treatment) and situations with a low risk of contamination (low-risk treatment). In both cases, the technique chosen by healthcare professionals was analyzed.

*Insert Figure 2*

Analysis of figure 2 indicates that the use of friction involving a hydro-alcoholic solution is significantly more frequent when there is a low risk of contamination than when there is a high risk of contamination ( $\chi^2=7,36$ ,  $ddl=1$ ,  $p<.007$ ). By contrast, there is no difference in the case of simple washing (an unexpected result). Friction is included in the category of antiseptic and surgical cleaning, i.e. techniques combining products that involve antimicrobial activity. Therefore, healthcare professionals might have been expected to use these techniques more frequently in situations involving a high risk of contamination. The verbalizations of healthcare professionals were analyzed to highlight the decision rules governing the choice of hand-washing technique.

#### Qualitative analysis of verbalizations

A qualitative analysis of verbalizations serves to explain this result, indicating that friction based on a hydro-alcoholic solution is viewed negatively by the majority of healthcare professionals. Participants expressed a marked preference for simple hand-washing (which was deemed to be safer, more efficient, and more in compliance with their idea of (true) hand-washing). Soap lathers and removes impurities, while water serves to rinse hands and eliminate impurities. Despite being described as quick and practical, the use of a hydro-alcoholic solution tends to be perceived negatively since healthcare professionals feel that impurities remain on the skin and that their skin is not clean. Some solutions may also leave a sticky deposit, increasing the feeling that hands are dirty.

This explains why, since friction using a hydro-alcoholic solution can be used to perform the necessary hygiene procedures required by healthcare practice without significant time loss, it is used in all situations in which the level of perceived risk is low. However, whenever there is a perceived risk of contamination, healthcare professionals tend to favor traditional hand-washing using water and soap – a washing technique that is deemed to be more efficient.

#### Interpretation

The three studies conducted as part of this research indicate that the concept of cleanliness is central in representations of hygiene observed among healthcare professionals. However, significant differences were also apparent in the network of meanings associated with the term 'cleanliness'. Analysis of the hygiene practices used by healthcare professionals improves our understanding of the factors determining non-compliance with established practices. The use of hydro-alcoholic solutions is clearly an issue among healthcare professionals. Hydro-alcoholic solutions are used more frequently than simple washing – in itself a positive finding. However, their use also involves a high rate of error. The most common mistakes are under-dosage errors, which makes them inefficient. Finally, a qualitative analysis indicated that healthcare professionals place more trust in simple hand-washing techniques than friction, a technique that appears not to comply with their idea of a 'true' wash. Healthcare professionals use friction more frequently than simple hand-washing when a care procedure is deemed to involve a low level of risk. However, when the level of perceived risk is high, simple hand-washing tends to be the favored technique.

This final result merits particular attention, as do its effects on hospital-acquired infections. The consumption of hydro-alcoholic solutions is not enough to guarantee its acceptance among healthcare professionals. The study showed that while hydro-alcoholic solutions are used more frequently than in the past, they are not always used for the right reasons.

This finding also raises a number of questions concerning staff training. The initial measures implemented between 2000 and 2008 were designed to encourage healthcare professionals to apply a simple hand-washing protocol before using hydro-alcoholic friction, in the case of antiseptic cleaning. However, official recommendations have changed since 2008. Healthcare professionals are now required to use friction only as long as their hands are not dirty. This study has shown that it is precisely in such instances that the obstacle is greatest. Healthcare professionals tend to feel that hand hygiene protocols are not properly implemented because they are applied on hands that are not strictly speaking clean.

## CONCLUSION

Beyond these results and their usefulness in developing measures aimed at promoting prevention and hygiene education in hospitals, this research also has a specific theoretical and methodological value. In theoretical terms, this research advances our understanding of professional representations through increased understanding of the decision rules resulting in a specific behavior. In methodological terms, the research was based on the application of a method involving a comprehensive process of data collection, starting from an assessment of the representation as evoked by interviewees, and ending with an analysis of the impact of the representation on the actual practices implemented by individuals.

Further research will need to be conducted among nursing students using a method similar to the method applied among healthcare professionals. This research in progress has shown that since students have been trained by IFSI in the use of hydro-alcoholic friction, it is predicted that fewer obstacles will impede the use of this particular hand-hygiene technique.

**Table 1:** Words associated by nurses based on average citation frequency and average citation rank

Citation frequency/ Citation rank	Low average citation rank	High average citation rank
	Words with a rank < general average rank (<4)	Words with a rank ≥ general average rank (≥4)
High average citation frequency > Binomial Threshold BT=28.27%	<b>Cleanliness (71.9% ; 2.17) ; Hand-washing (58.7% ; 3.20) ; Sanitization (44.73% ; 3.43)</b> <b>TARGET AREA</b>	
Low average citation frequency ≤ 28.27% and > 13%	Washing (20.17% ; 3.5); Precautions (16.6% ; 3.3); Decontamination (17.1% ; 3.7); Security (13.15% ; 3.86)	Disinfection (28.07% ; 4,3) ; Isolation (24.5% ; 4.86) ; Prevention (22.8% ; 5); Cleaning (18.4% ; 4.43); Protocol (14.03% ; 4.87%); Soap (13.15% ; 4)

**Table 2:** Words associated by healthcare assistants based on average citation rank and average citation frequency

Citation frequency/ Citation rank	Low average citation rank	High average citation rank
	Words with a rank < general average rank (<4)	Words with a rank ≥ general average rank (≥4)
High average citation frequency > Binomial Threshold BT=48.4%	<b>Cleanliness (80% ; 1.75) ; Disinfection (48.6% ; 2.82)</b> <b>TARGET AREA</b>	
Low average citation frequency ≤ 48.4% et 28.5%	Hand-washing (37.2%; 3.8).	Sanitization (28.6% ; 4.3)

**Table 3:** Valence of target items, average number of connectors associated by nurses with each of the target elements

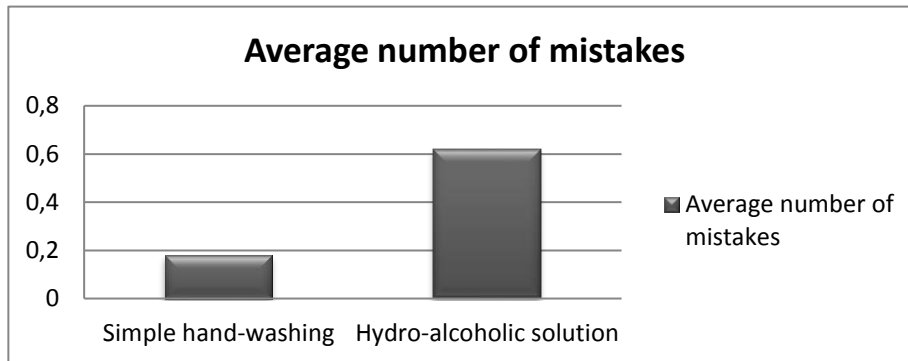
Target items	Valence	ANOVA comparisons 1/2/3 F = ; p<
1- Hand-washing	0.06 ( $\sigma=0.007$ )	<b>1-3</b> F(1.15)=19.34, p<.000001
<b>2- Sanitization</b>	<b>0.12**</b> ( $\sigma=0.05$ )	<b>1-2</b> NS
<b>3- Cleanliness</b>	<b>0.18**</b> ( $\sigma=0.09$ )	<b>2-3</b> F(1.15)=8.25, p<.012

**Table 4:** Valence of target items, average number of connectors associated by healthcare assistants, with each of the target items

Target items	Valence	ANOVA comparisons 1/2 F = ; p<
<b>1-Disinfection</b>	0.13 ( $\sigma=0.08$ )	<b>1-2</b> F(1.15)=12.80, p<.003
<b>2-Cleanliness</b>	<b>0.18**</b> ( $\sigma=0,07$ )	

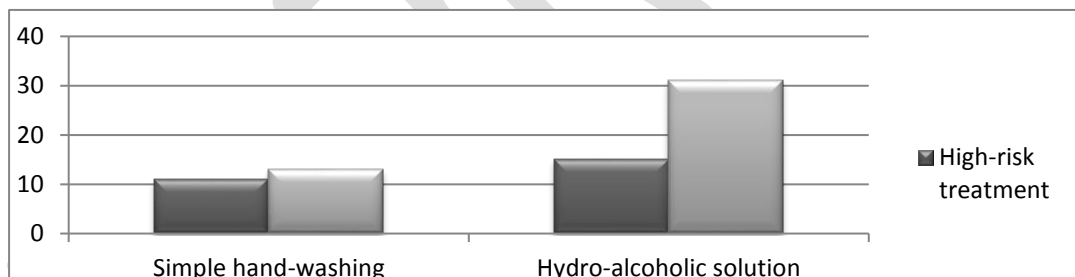
**Figure 1:** Impact of the hand-washing technique used

Number of mistakes according to the hand-hygiene technique used – comparison of the use of a hydro-alcoholic solution and simple hand-washing



**Figure 2:** Impact of the risk of contamination on the technique used

Number of uses of friction and simple hand-washing according to the risk of contamination



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