



DU: Hygiene des mains 2023



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MEPHI équipe 8, AMU/IRD/CNRS/INSERM /APHM

Plan

- Introduction
 - Observational (OMS) HH recording and the Hawthorne effect
 - HH AR solution usage
 - Innovative technical solutions
 - Without RTLS
 - RTLS
- What automated HH monitoring highlighted ?
 - Monitoring 24/24 7/7
 - HH is an individual behavior
 - The Hawthorne effect
 - HH behavior of HCP studies and understanding
- Is automated HH monitoring enhancing HH disinfection ?
 - SMS, Nudges,
- Is automated HH monitoring reduce HAI ?
- How automated HH monitoring perceived by HCW ?
- The future of HH monitoring
 - Risk assessment
 - Guidelines and regulations

Observational (OMS) HH recording and the Hawthorne effect

Is Structured Observation a Valid Technique to Measure Handwashing Behavior? Use of Acceleration Sensors Embedded in Soap to Assess Reactivity to Structured Observation

Pavani K. Ram,* Amal K. Halder, Stewart P. Granger, Therese Jones, Peter Hall, David Hitchcock, Richard Wright, Benjamin Nygren, M. Sirajul Islam, John W. Molyneaux, and Stephen P. Luby

- Pitfalls
 - Behaviour bias (Hawthorne effect)
 - Only one shot
 - Low number of opportunity
 - Auto questionnaire (doubt on quality record)
 - Time consuming and costly (Million Euros !!)
 - Do not allow in the time of work evaluation of interventions taken to improve HH
- Benefits
 - It precisely analyse risk exposure +++ and HHO +++ (such as video)

What OMS observational studies can highlight ?

Hospital hand hygiene opportunities: Where and when (HOW2)? The HOW2 Benchmark Study

Connie Steed, MSN, RN, CIC,^a J. William Kelly, MD,^{a,b} Dawn Blackhurst, DrPH,^c Sue Boeker, BSN, RN, CIC,^a
Thomas Diller, MD, MMM,^d Paul Alper, BA,^e and Elaine Larson, RN, PhD, FAAN, CIC^f
Greenville, South Carolina; Stanley, North Carolina; and New York, New York

Estimate HHOs in general medical wards and emergency departments. These data can be used as denominator estimates to calculate hand hygiene compliance rates when product utilization data are available.

Table 3. Average estimated HHOs (95% CI) by hospital, unit, shift, and 24-hour period

HHOs per patient-day	Large teaching hospital		Small community hospital	
	Adult medical-surgical ICU	Adult medical ward	Adult medical-surgical ICU	Adult medical ward
Shift 1 total (7:00 AM-6:59 PM)	87.1 (79.8-94.4)	33.3 (30.3-36.3)	39.1 (32.4-45.7)	16.6 (12.7-20.6)
Shift 2 total (7:00 PM-6:59 AM)	93.5 (81.4-105.5)	40.7 (32.9-48.5)	29.2 (20.1-38.3)	12.7 (9.1-16.2)
24-hour period total	178.8 (168-189)	71.6 (64.9-78.3)	70.9 (61.0-80.7)	30.3 (24.6-35.9)
HHOs per bed-hour	Critical/intermediate ED		General ED	
Shift 1 average (7:00 AM-6:59 PM)	4.83 (4.2-5.5)		1.90 (1.4-2.4)	
Shift 2 average (7:00 PM-6:59 AM)	5.39 (4.8-5.9)		1.76 (1.3-2.2)	
24-hour period average per bed-hour	5.03 (4.6-5.5)		1.84 (1.5-2.2)	

ARH compliance using HOW2 and alcohol consumption/HR

Hand hygiene compliance monitoring in anaesthetics: Feasibility and validity

Journal of Infection Prevention
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DOI: 10.1177/1521774818753366
jip.sagepub.com
SAGE

A Jeanes¹, J Dick², P Coen¹, N Drey³ and DJ Gould⁴

State of the Science Review

Electronic monitoring in combination with direct observation as
a means to significantly improve hand hygiene compliance

John M. Boyce MD *

J.M. Boyce Consulting, LLC, Middletown, CT

Table 1

Number of hand hygiene opportunities (HHOs) observed, time spent on observa-
tions, and number of HHOs per hour of observation in 23 published studies

Study authors	Publication year	Number of HHOs observed	Observation time (h)	No. of HHOs/h
Pittet et al ¹⁸	1999	2,834	105	27.0
Pittet et al ¹⁹	2000	20,082	833.9	24.1
Bischoff et al ²⁰	2000	1,575	120	13.1
Hugonnet et al ²¹	2002	2,743	84	32.7
Rosenthal et al ²²	2003	15,531	807	19.2
Pittet et al ²³	2004	887	125	7.1
Larson et al ²⁴	2005	5,586	306	18.3
Girou et al ²⁵	2006	952	38	25.1
Noritomi et al ²⁶	2007	727	32	22.7
Santana et al ²⁷	2007	3,476	120	29.0
Rupp et al ²⁸	2008	3,678	299.9	12.3
Scheithauer et al ²⁹	2009	1,897	288	6.6
Boscart et al ³⁰	2010	1,093	94	11.6
Edmond et al ³¹	2010	1,646	100	16.5
Allegranzi et al ³²	2010	3,571	93.6	38.2
Steed et al ³³	2011	6,640	436.7	15.2
Mestre et al ³⁴	2012	11,714	409.5	28.6
Lebovic et al ¹⁰	2013	7,364	393	18.7
Yin et al ³⁵	2014	11,444	3432	3.3
Goodliffe et al ³⁶	2014	1,605	267	6.0
Hagel et al ³⁷	2015	3,978	96	41.1
Tschudin-Sutter et al ⁷	2015	2,662	520	5.1
Sanchez-Carrillo et al ³⁸	2016	201	19.67	10.2

ICSHA 3 :

French objectives in AHR/Day/patient

According to HOW2 Critical care are 120 AHR/day/patient
and medical ward 71/Day/patient

Activités	Nb
HOSPITALISATION COMPLETE ET DE SEMAINE	
Médecine	10
Chirurgie	12
Réanimation	43
USI-USC	28
Obstétrique	12
Accouchement sans césarienne	14
Accouchement avec césarienne (accouchement : 12, SSPI : 4)	16
Soins de suite et Réadaptation fonctionnelle	8
Soins de longue durée	7
Psychiatrie	4
Hémodialyse (par séance)	11
HAD (par jour)	6
Urgences (par passage)	5
Séance de chimiothérapie (par séance)	6
HOSPITALISATION DE JOUR	
Hôpital de jour de médecine	5
Hôpital de jour de chirurgie	5
Hôpital de jour d'obstétrique	6
Hôpital de jour de psychiatrie	2
Hôpital de jour de soins de suite et Réadaptation fonctionnelle	5
Séance de chimiothérapie (par séance)	6
ACTES MÉDICO-TECHNIQUES	
Actes de radiologie conventionnelle, hors radiologie vasculaire (par acte)	2
Actes de radiologie vasculaire (dont coronarographie) (par acte)	5
Bloc chirurgical (acte interventionnel et/ou exploration : 10 + SSPI : 4)	14

HH AR solution usage

Alcohol hand rub consumption objectives in European hospitals need to be revisited

P. Brouqui and A. Soto Aladro

*Institut Hospitalo Universitaire Méditerranée Infection, Aix-Marseille
Université, Unité de Recherche sur les Maladies Infectieuses et Tropicales
Emergentes, Marseille, France*

- Alcohol consumption (ordered)
 - Very good maker for evaluation of intervention in one place (Base line) (one ward for example). “Dynamic evaluation”
 - Easy working International marker
- But
 - Correlation with “Observation” is moderate
 - Bias “order # use”
 - Misuse
 - Do not allow evaluate use at the point of care
 - Do not allow to identify individuals behaviour
 - Baseline too low : it should be at least X 3 (60 ml/p/D)
- Hopes in the future
 - Usable to evaluate HH compliance with HOW2 data

Correlation of Hand Hygiene Compliance Measured by Direct Observation with Estimates Obtained from Product Usage

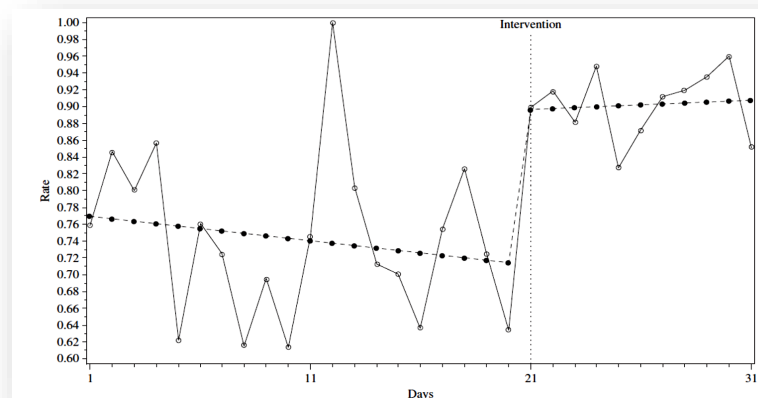
Westyn Branch-Elliman, MD, MPH;^{1,2,3} Graham M. Snyder, MD, SM;^{2,4,5} Aleah D. King, RN, BSN;⁴ Linda M. Baldini, RN;⁴ Kaitlyn M. Dooley, RN, BSN, MSPAS, PA-C;⁵ David S. Yassa, MD, MPH;^{2,6} Sharon B. Wright, MD, MPH^{2,4,6}

- Without Real Time Location System (RTLS)
 - Main objectives
 - Measure real HH solution at the point of care *
 - Remote control HH monitoring **
 - Benefits
 - Allows Real time surveillance **
 - Allows evaluating IC intervention in real time **
 - Evaluate the quality of HH (Volume)
 - ID of Patient (Room) **
 - Robust */**
 - Costless *
 - Pitfalls
 - No ID of HCW
 - Records the act (volume) only **not the compliance except if associated with calculated HHO**
 - No risk assessment (targeted HH)

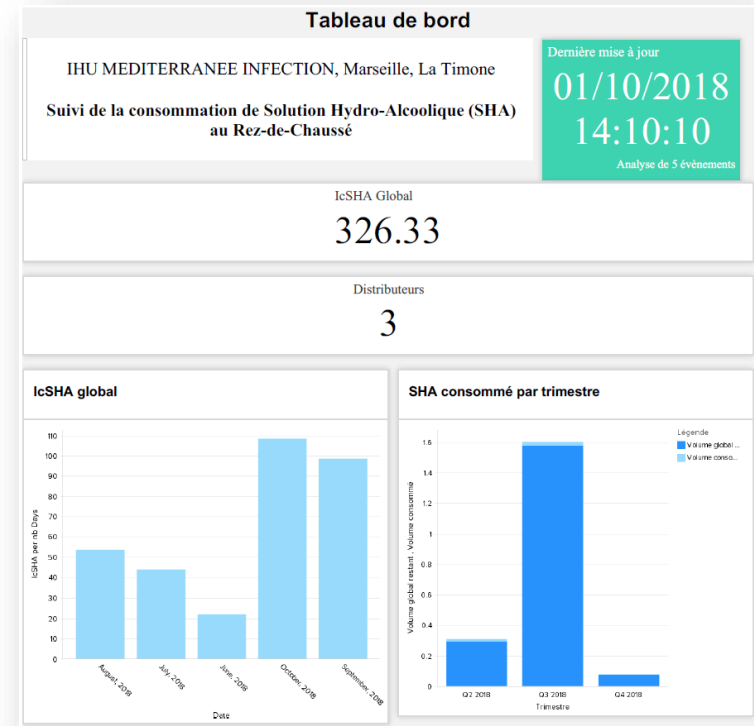
Non RTLS : electronic bed side or individual dispensers (1)

Measuring Rates of Hand Hygiene Adherence in the Intensive Care Setting: A Comparative Study of Direct Observation, Product Usage, and Electronic Counting Devices

Alexandre R. Marra, MD; Denis Faria Moura, Jr, RN; Ângela Tavares Paes, PhD;
Oscar Fernando Pavão dos Santos, MD; Michael B. Edmond, MD, MPH, MPA



Non RTLS : electronic **bed side** or individual dispensers (2)



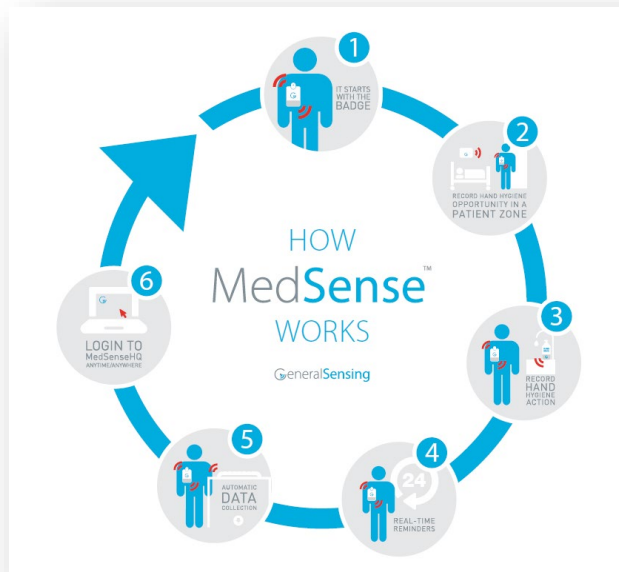
Non RTLS - Bracelet Sensor



- Real Time Location System (RTLS)
 - Main objectives
 - Measure real HH solution at the point of care
 - Remote control HH monitoring
 - HWC ID for behavioral studies and intervention
 - Measure HH compliance (Beacon / Antenna at bedside = opportunity)
 - Benefits
 - Allows Real time surveillance (HH and solution consumption)
 - Allows evaluating Infection Control intervention in real time
 - Evaluate the quality of HH (Volume)
 - ID of HCW and Patient (Room)
 - Pitfalls
 - Expensive X 10 (Non RTLS)
 - Some have batteries (active badges)
 - ID of HCW
 - Accuracy variable (especially when several HCW in the room)
 - Modestly robust and maintenance needed (Hotline)
 - No risk assessment (targeted HH)

Real Time Location Systems

- Technical support
 - RFID passive/active
 - UHF, IR, US
 - WIFI, ZigBee



Real Time Location Systems



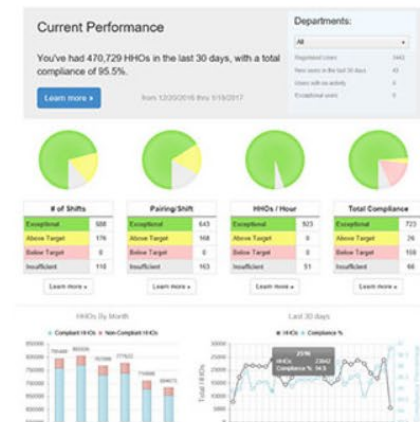
Our System Components



Base Station



Badge



BioVigil Data Suite

Automated HH monitoring pitfalls

Accuracy of a radiofrequency identification (RFID) badge system to monitor hand hygiene behavior during routine clinical activities

Lisa L. Pineles MA^{a,*}, Daniel J. Morgan MD, MS^{a,b}, Heather M. Limper MPH^c,
Stephen G. Weber MD, MSc^c, Kerri A. Thom MD, MS^a, Eli N. Perencevich MD, MS^d,
Anthony D. Harris MD, MPH^a, Emily Landon MD^c

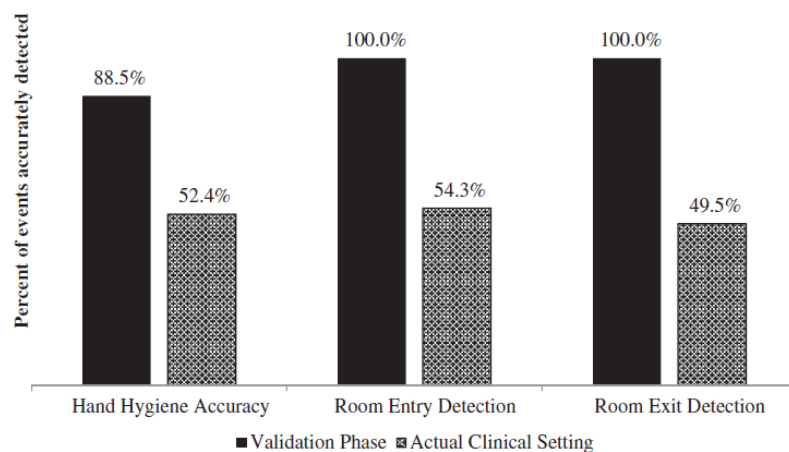


Fig 2. Radiofrequency identification detection hand hygiene system accuracy in simulated validation phase versus real-life clinical practice.

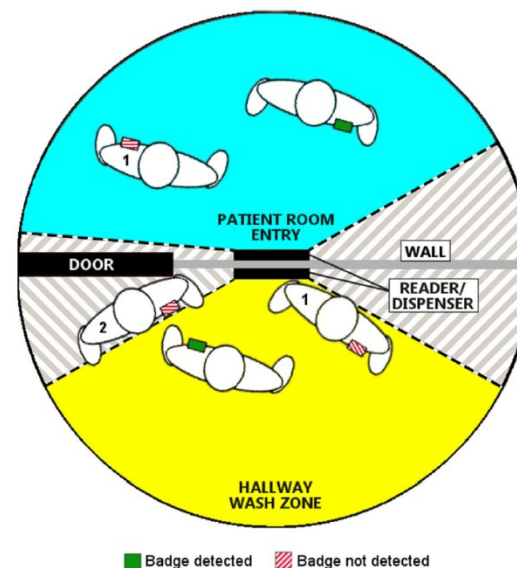
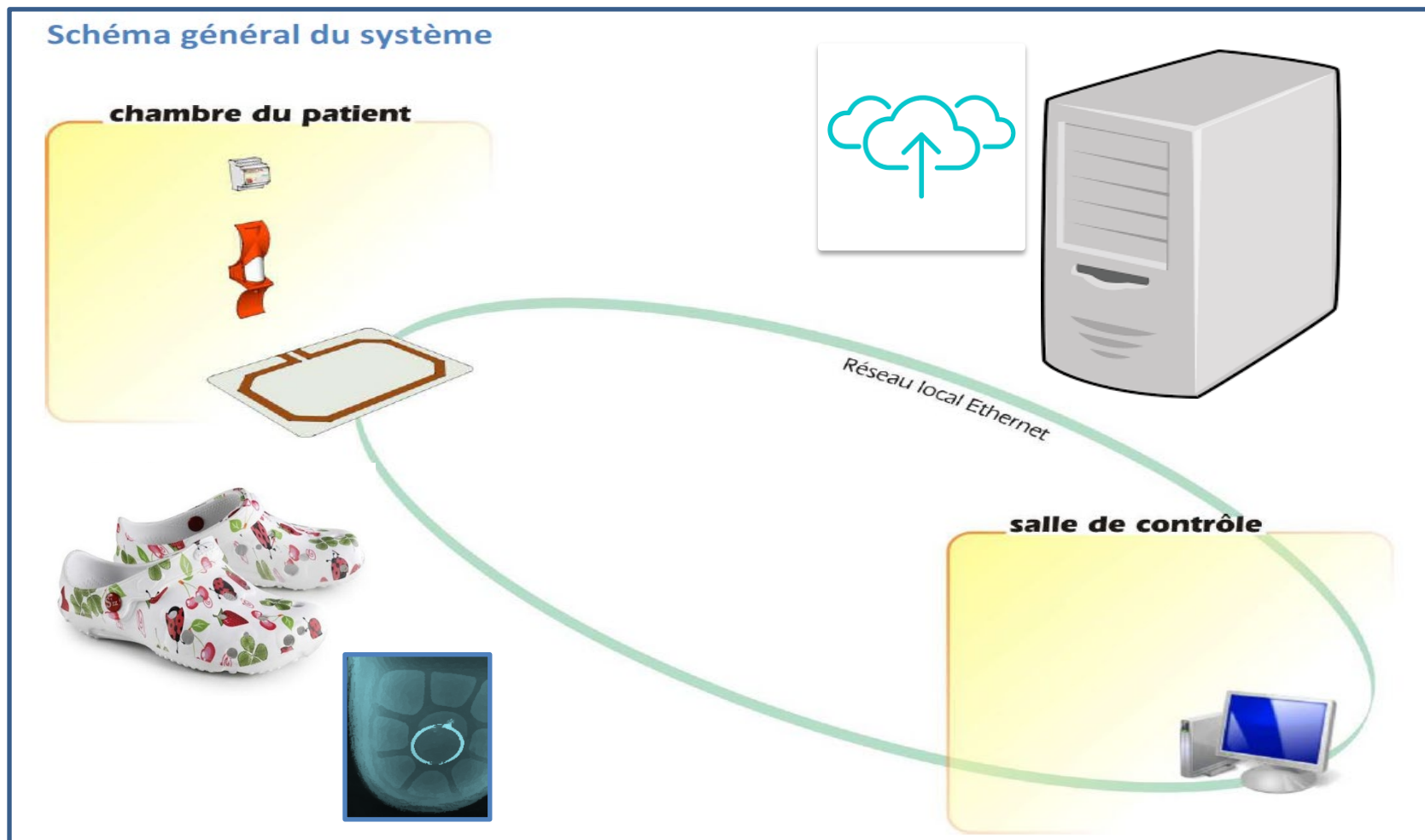


Fig 3. Example of radiofrequency identification (RFID) badge detection system used in a hospital unit with fields detecting HCP in a patient room (blue) and when using a hand hygiene dispenser (yellow). Multiple sample HCPs are depicted with a badge in place on their left breast pocket. The badge is green when HCP are accurately positioned to be recognized by the system for room entry or hand hygiene. Reasons for misreading include badge being blocked by HCP bodies (1) and being outside the field of detection (2).

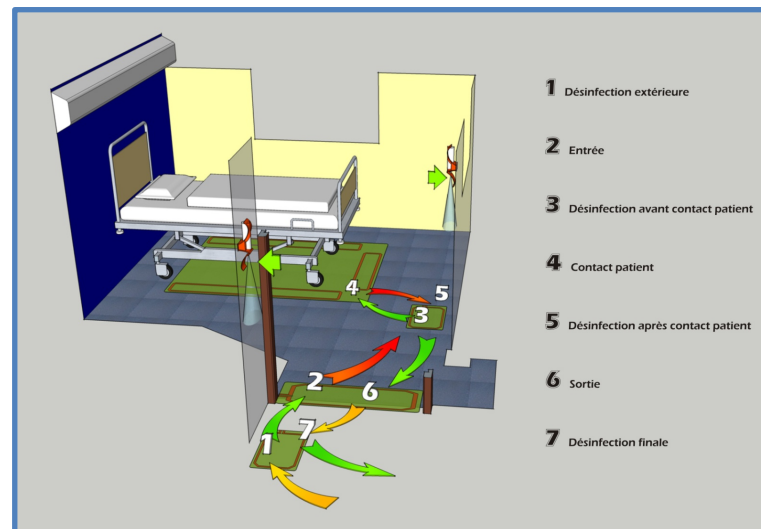
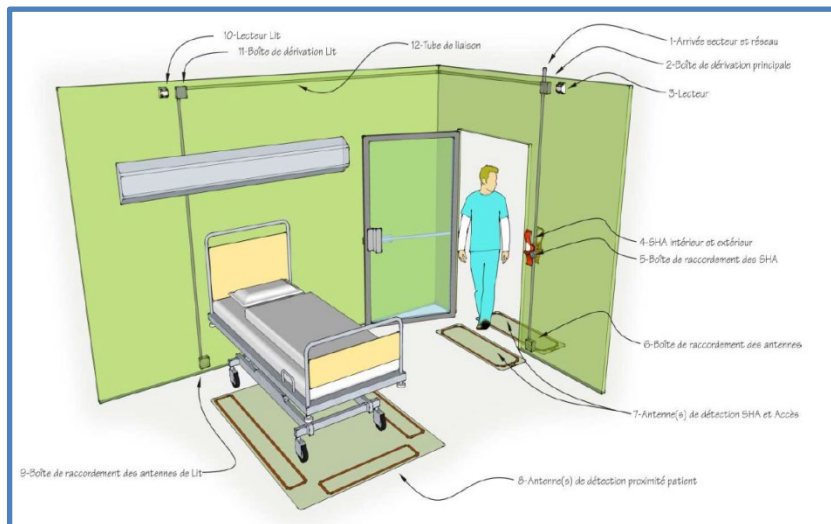
Passive RFID RTLS systems

MHT 1.0 Kit



Passive RFID RTLS systems

MHT 1.0 Kit



REVIEW

10.1111/1469-0691.12471

MediHandTrace[®]: a tool for measuring and understanding hand hygiene adherence

S. Boudjema^{1,2}, J. C. Dufour³, A. S. Aladro², I. Desquerres² and P. Brouqui^{1,2}

1) Aix Marseille University, URMITE, UM63, CNRS 7278, IRD 198, Inserm 1095, 2) Infectious Disease Unit CHU Nord, Institut Hospitalo-Universitaire Méditerranée Infection and 3) LERTIM Laboratoire d'Enseignement et de Recherche sur le Traitement de l'Information Médicale EA 3283, Institut Hospitalo-Universitaire Méditerranée Infection, Marseille, France

STEPS 3, 4 AND 5

	GS +	GS -	
RFID +	66	0	66
RFID -	3	237	240
	69	237	306
Accuracy:	99.02 % [97,16 ; 99,80]		
Sensitivity:	95.65 % [87,82 ; 99,09]		
Specificity:	100 % [98,46 ; 100]		
FN			

1 Non detection

2 Contact less than 3 seconds

3 TOTAL

Passive RFID RTLS systems

MHT 2.0 mobile Kit

Objective-Reduce the cost
Solution-Only One antenna

Objective-mobile reusable
Solution-adhesive antenna

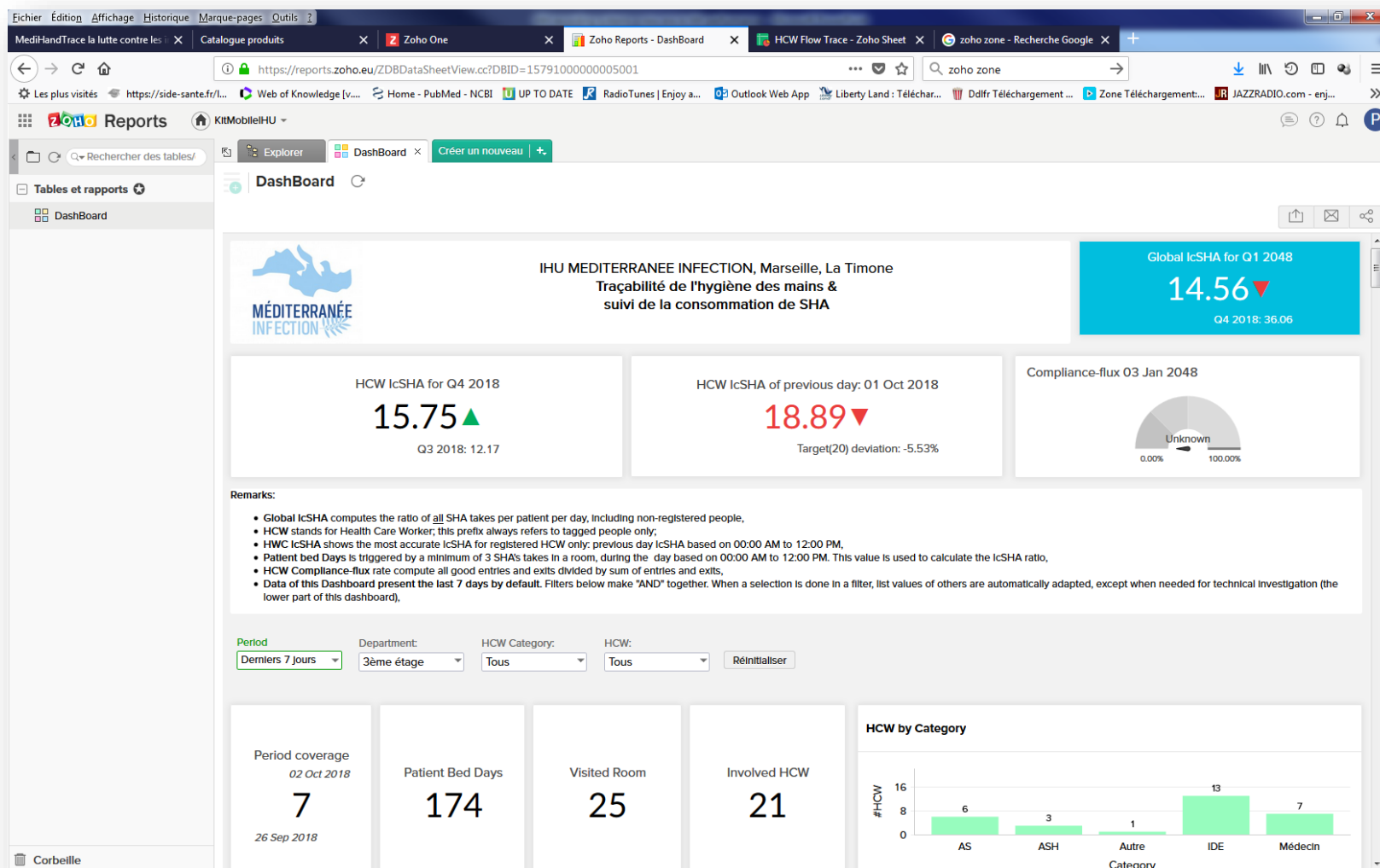
Objective-improve HH
Solution-reminders



Reporting data

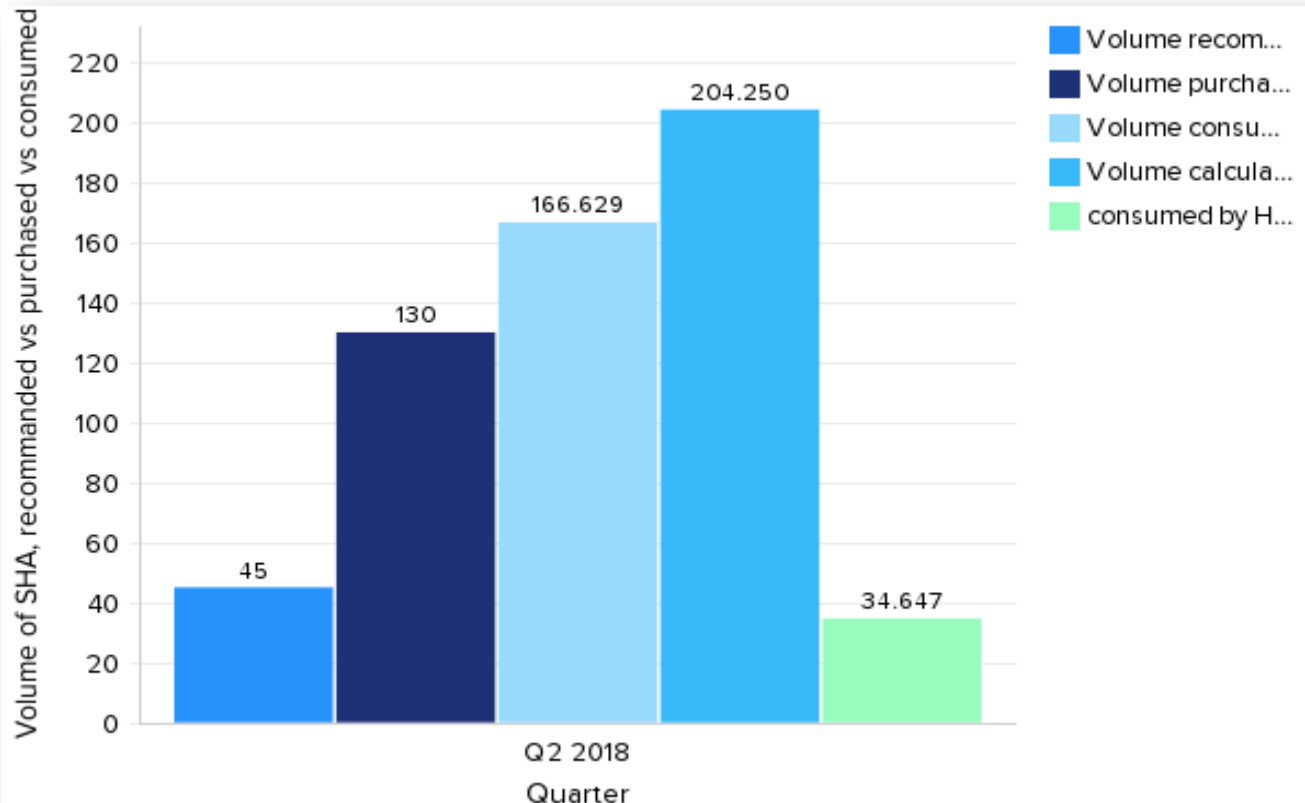


MHT 2.0 Dashboard

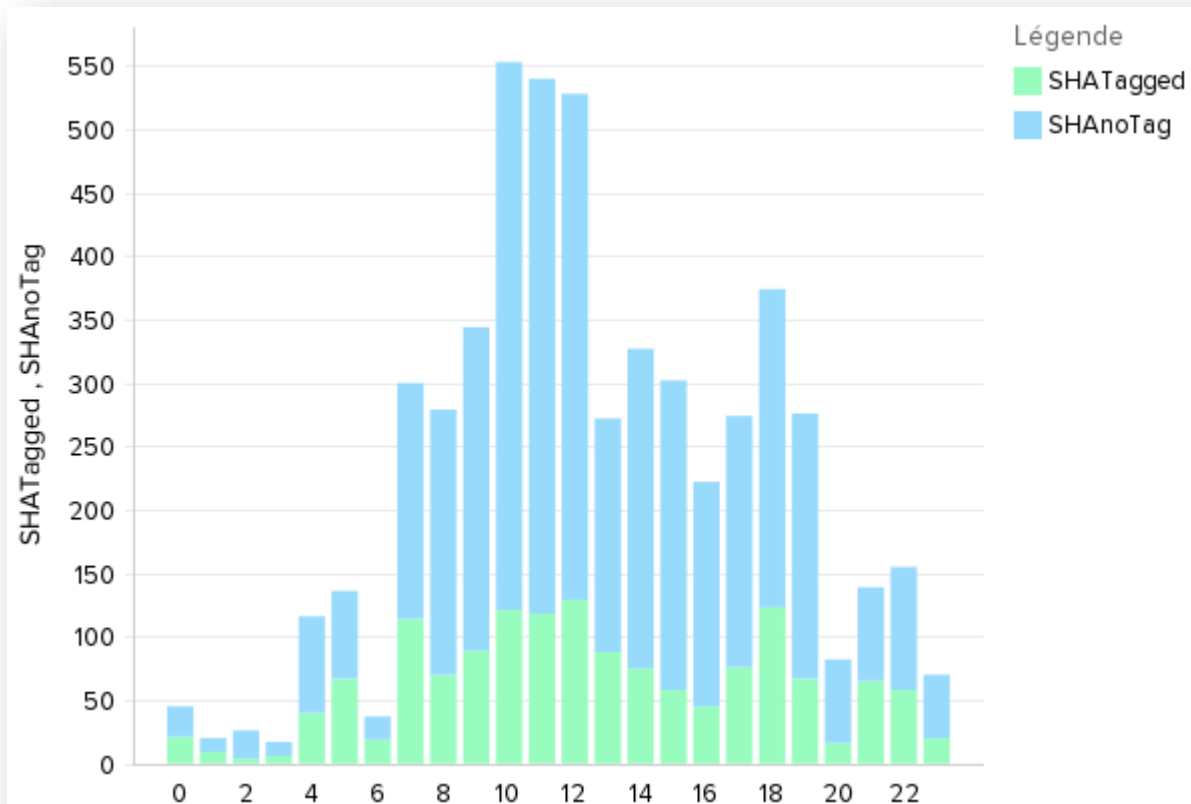


Alcohol consumption last 3 month

Volume consumed : number of hit X 3 ml (Experimental data)
Volume calculated : number of bottle of 250ml used as recorded by the system



Time distribution of HH activity as record by AHR

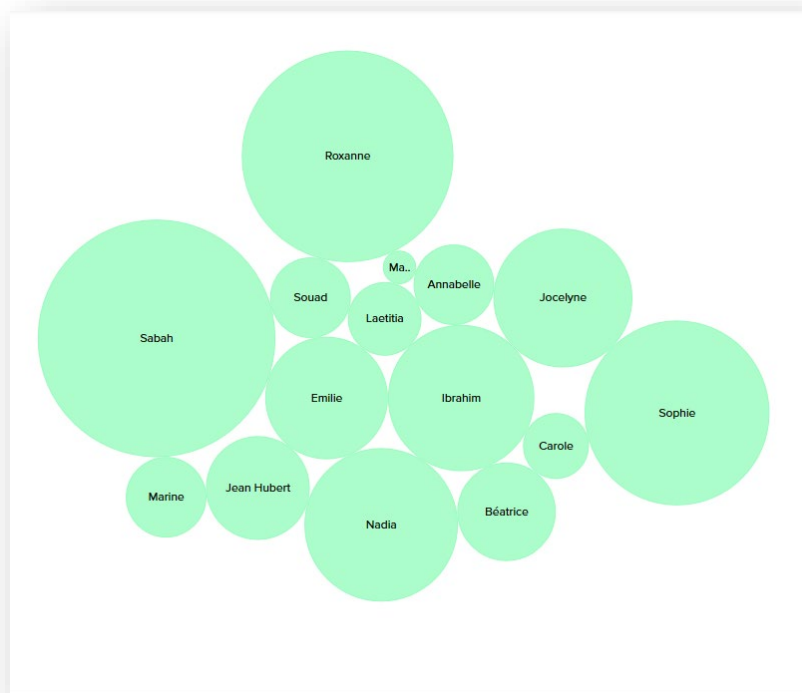


Consumption / Compliance

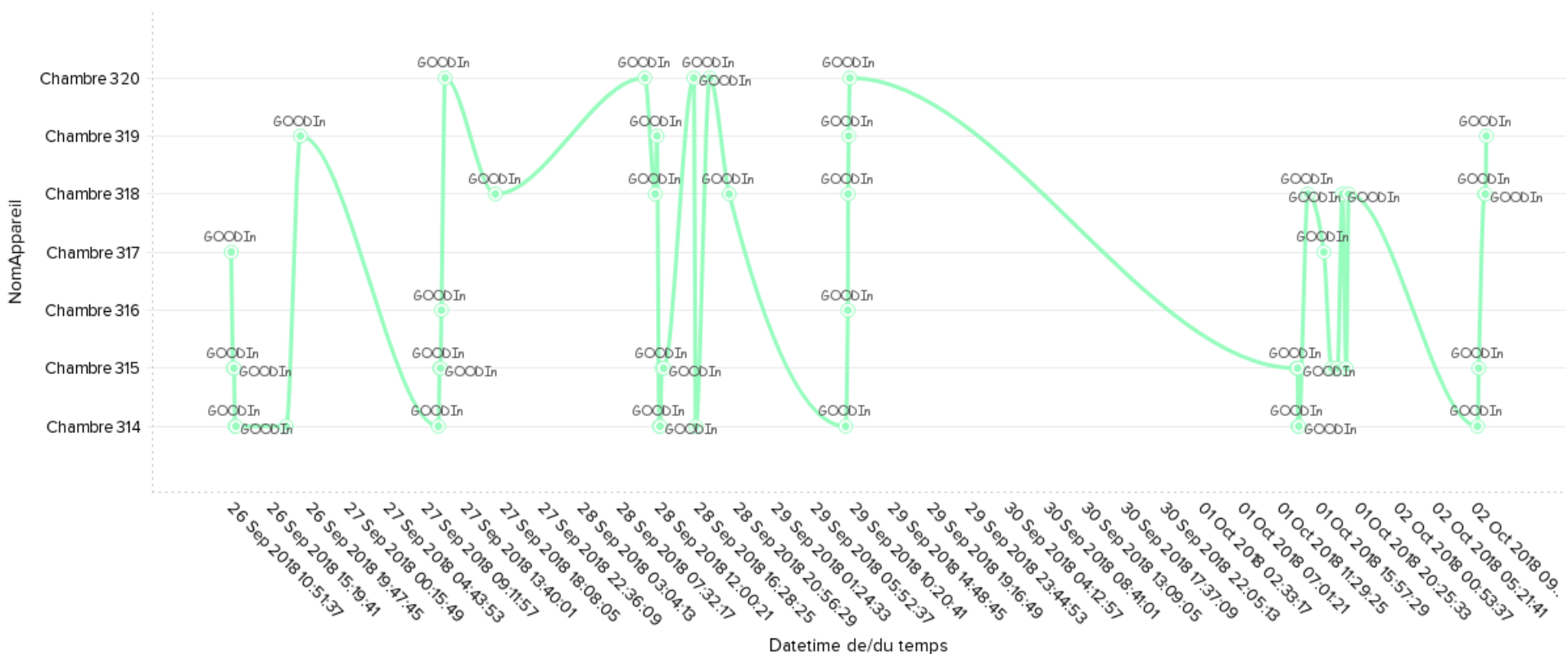
7 days

AHR solution consumption :
volume/Rub by HCW

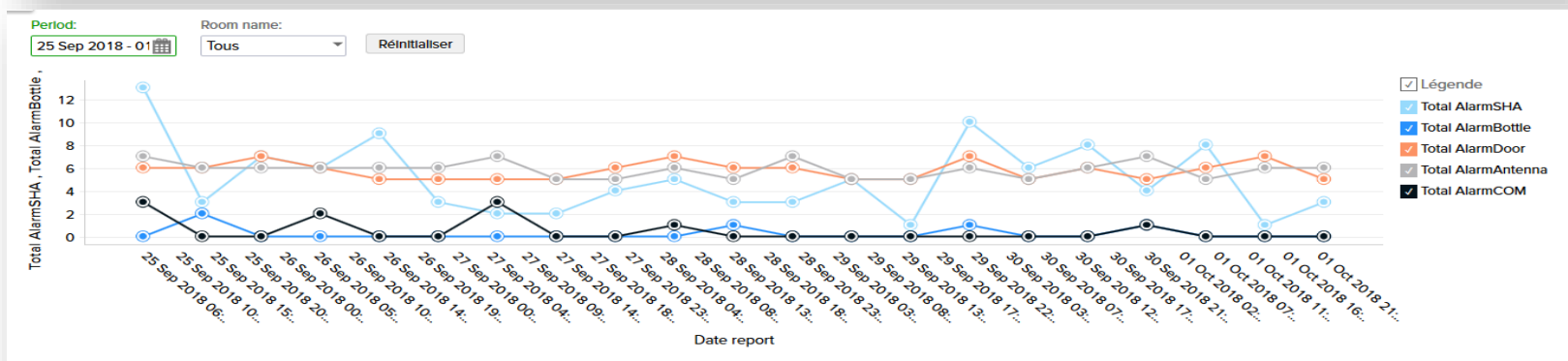
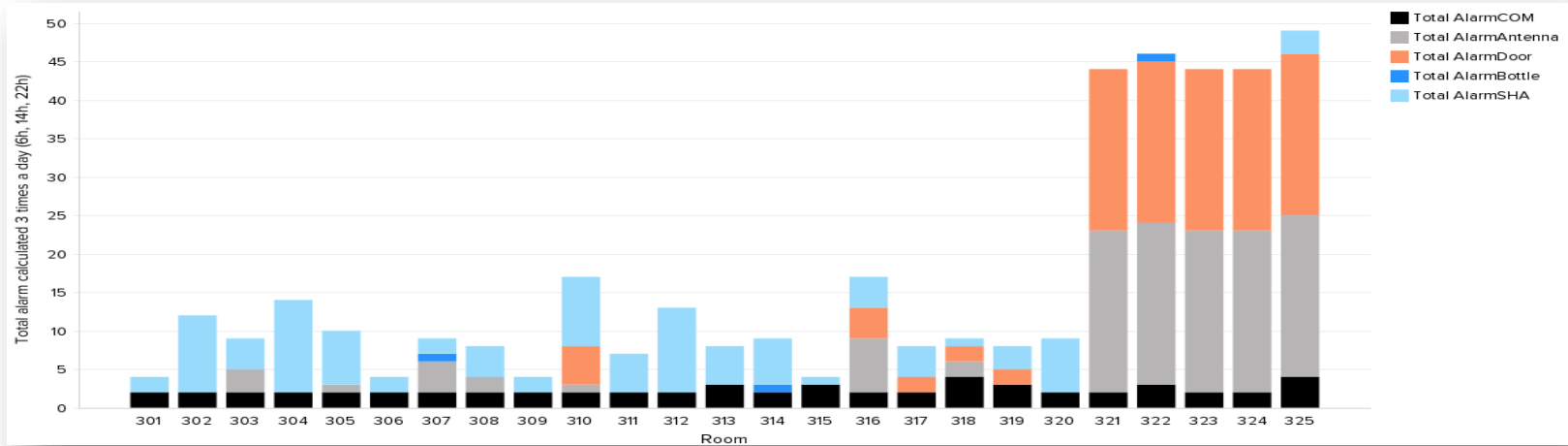
Compliance:
Number of good entry and good exit on the
total number of entry and exit



Care pathway with good entry for one HWC last 24 hours



System surveillance and maintenance



Plan

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What automated HH monitoring highlighted ?

Measuring the Hawthorne effect

RTLS HH monitoring records twice more when auditors are visible

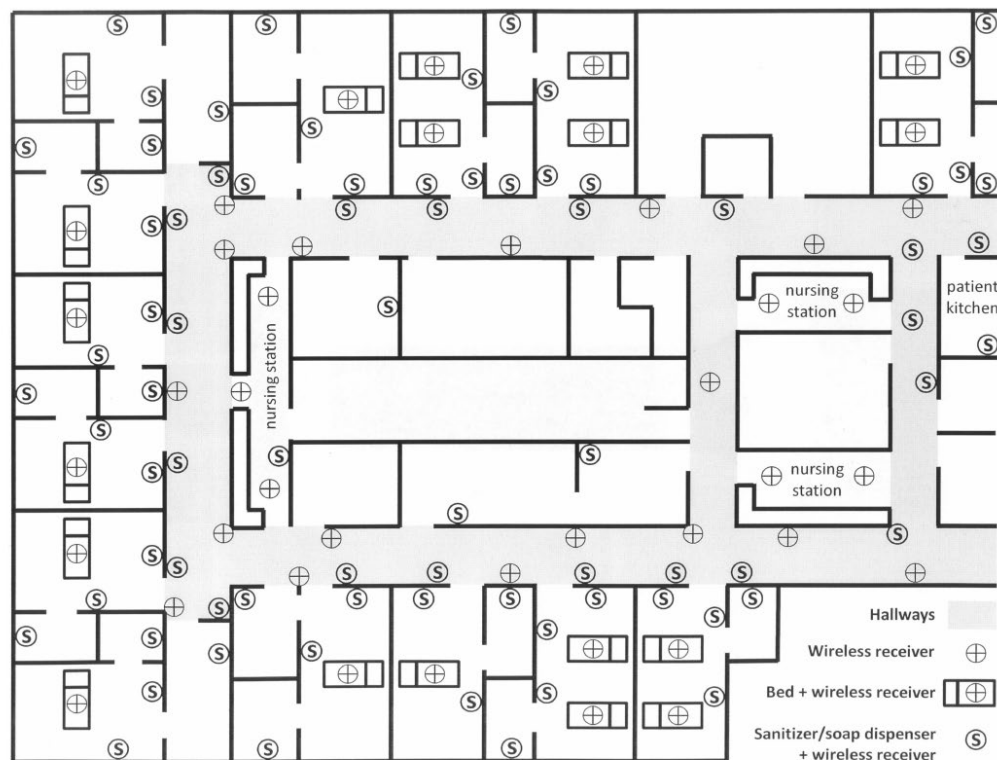


Figure 1 Unit floor plan and location of real-time location system components.

Quantification of the Hawthorne effect in hand hygiene compliance monitoring using an electronic monitoring system: a retrospective cohort study

Jocelyn A Srigley,^{1,2} Colin D Furness,^{3,4} G Ross Baker,¹ Michael Gardam^{5,6}

Results The hand hygiene event rate in dispensers visible to auditors (3.75/dispenser/h) was significantly higher than in dispensers not visible to the auditors at the same time (1.48; $p=0.001$) and in the same dispensers during the week prior (1.07 $p<0.001$). The rate increased significantly when

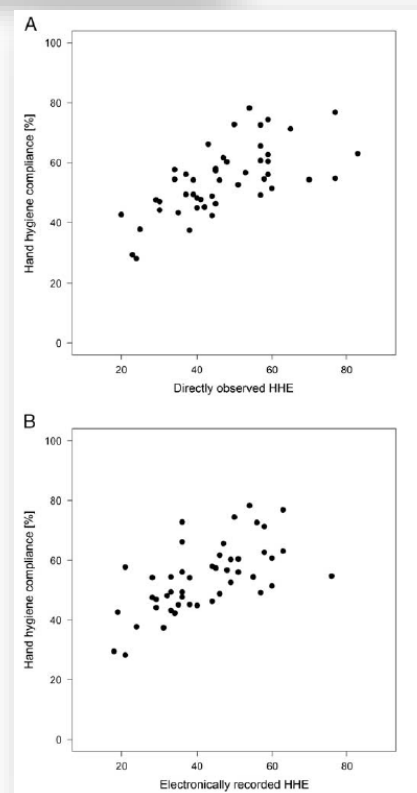
What automated HH monitoring highlighted ?

Measuring the Hawthorne effect

Quantifying the Hawthorne Effect in Hand Hygiene Compliance Through Comparing Direct Observation With Automated Hand Hygiene Monitoring

Stefan Hagel, MD;^{1,2} Jana Reischke;¹ Miriam Kesselmeier, Dipl Math;^{2,3} Johannes Winning, MD;⁴ Petra Gastmeier, MD;⁵ Frank M. Brunkhorst, MD;^{2,4,6,7} André Scherag;^{2,3} Mathias W. Pletz, MD¹

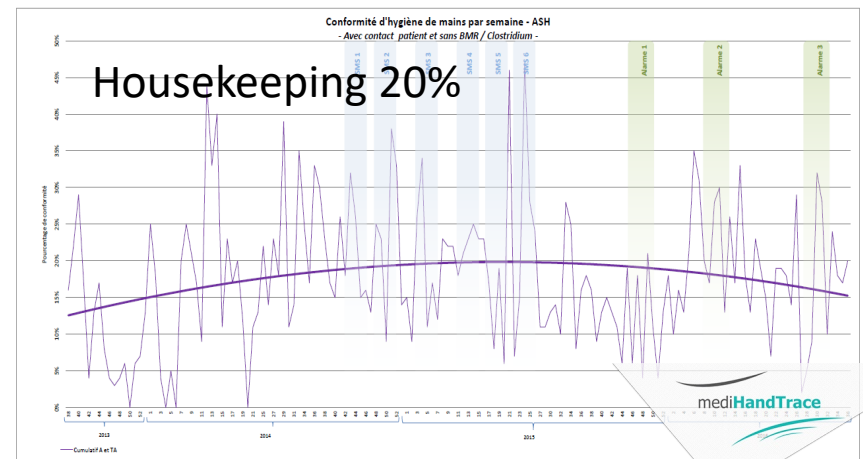
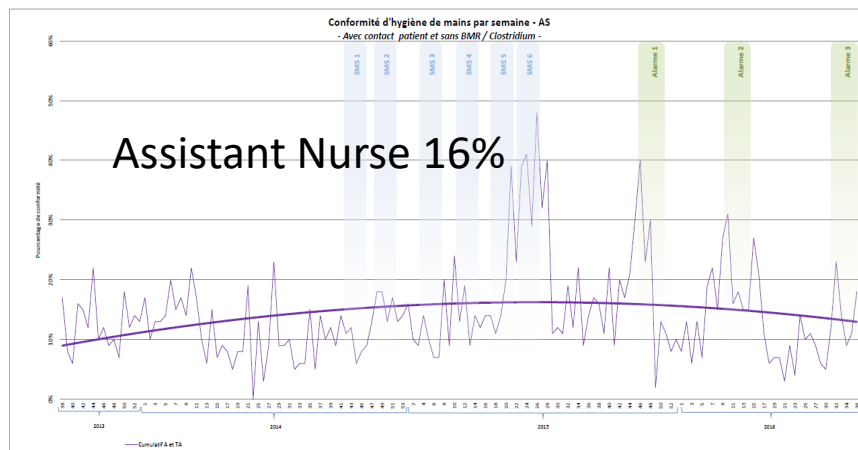
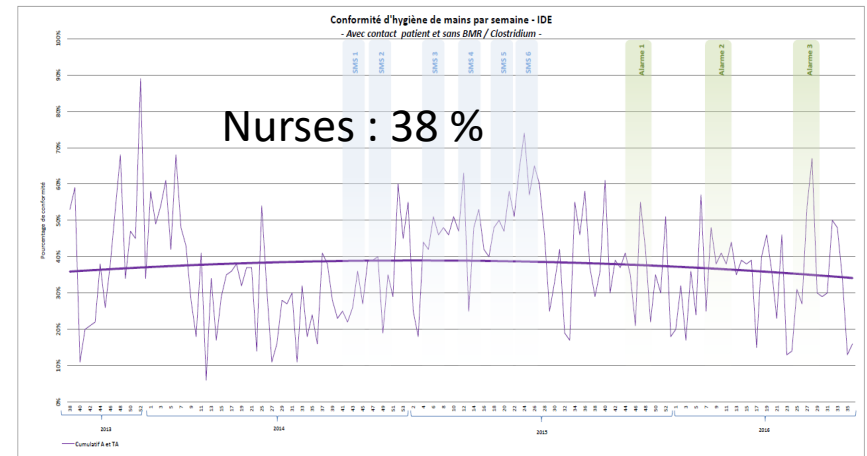
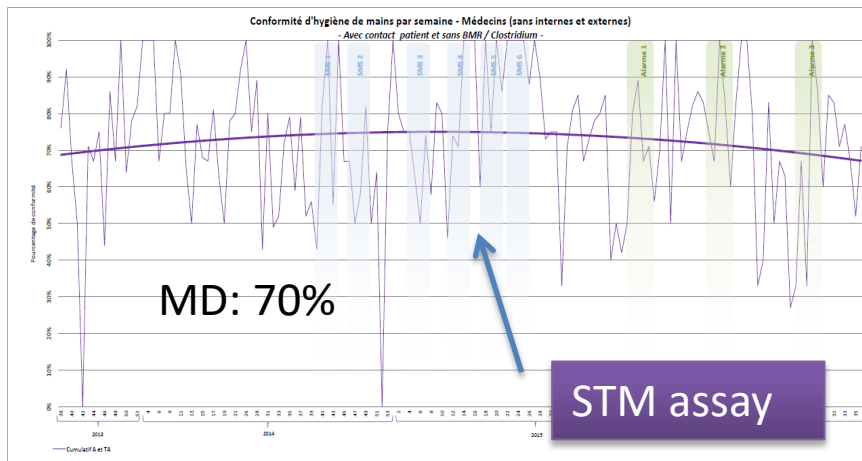
Strong positive correlation between observation and automatic hand hygiene monitoring . Observation report twice more AHR than the electronic recording system.



What automated HH monitoring highlighted?

Monitoring 24/24 7/7

3 years of RFID Real-Time Continuous monitoring before approaching the patient



What automated HH monitoring highlighted ?

Monitoring 24/24 7/7

Implementation and Impact of an Automated Group Monitoring and Feedback System to Promote Hand Hygiene Among Health Care Personnel

Laurie J. Conway, RN, MPhil, CIC; Linda Riley, RN, MEd, CIC; Lisa Saiman, MD, MPH; Bevin Cohen, MPH; Paul Alper, BA; Elaine L. Larson, RN, PhD, FAAN, CIC

Feedback via an automated system was associated with improved hand hygiene performance **in the short term.**

Hospital Hand Hygiene Compliance Trends Before and After Feedback,
January 2012–March 2013

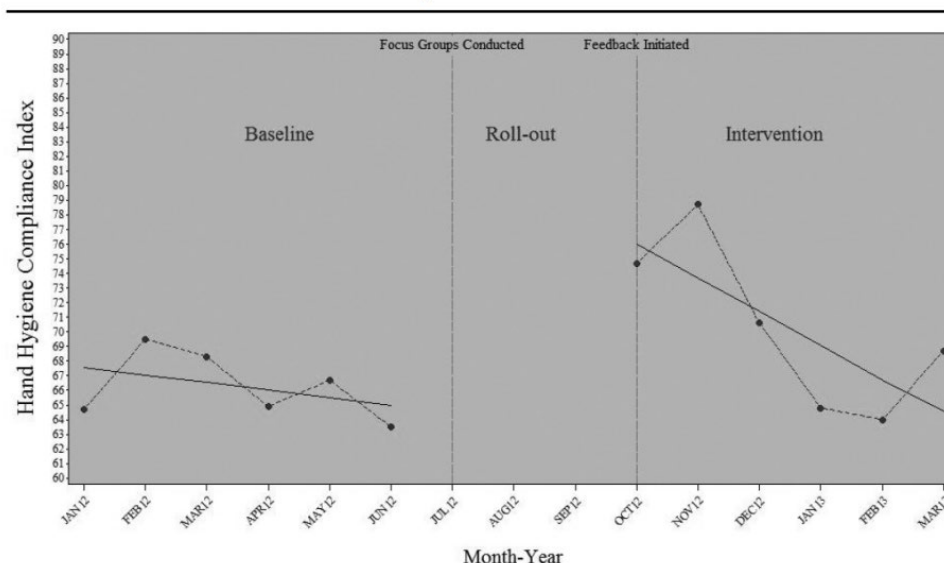


Figure 1. For 1,778,852 hand hygiene events recorded by the group monitoring system, the monthly hand hygiene compliance index ranged from 63.5 to 69.5 before the feedback and from 64.0 to 78.7 after the feedback began. Hand hygiene compliance did not change significantly from month to month during the baseline period (baseline trend, $p = .55$).

What automated HH monitoring highlighted ?

HH is an individual behavior

Evaluation of hand hygiene compliance and associated factors with a radio-frequency-identification-based real-time continuous automated monitoring system

J-C. Dufour^{a,b,*}, P. Reynier^{a,b,c}, S. Boudjema^{c,d}, A. Soto Aladro^{c,d},
R. Giorgi^{a,b}, P. Brouqui^{c,d}

Interpretation: Hand hygiene compliance at the bedside, as analysed using the continuous monitoring system, depended upon the HCW's occupation and personal behaviour, number of HCWs, time spent in the room and (potentially) dispenser location. Meal tray

Table III
Null multi-level models

	Null multi-level models			
	AHR inside use Ref = no hand disinfection		AHR outside use Ref = no hand disinfection	
	OR (95% CI)	P	OR (95% CI)	P
<i>Fixed effect</i>				
Individual adjusted OR	0.11 (0.1–0.2)	<0.0001	0.31 (0.20–0.47)	<0.0001
<i>Random effect</i>				
Interindividual variance	2.458	—	1.658	—
ICC	0.43	—	0.34	—
<i>Statistical model</i>				
AIC	1618.6	—	3497.1	—
BIC	1631.1	—	3509.9	—
-2logLik	–807.3	—	–1746.6	—
Deviance	1614.6	—	3493.1	—

AHR, alcohol-based hand rub; ICC, intraclass correlation coefficient; OR, odds ratio; CI, confidence interval.

Hand Hygiene Analyzed by Video Recording

Philippe Brouqui*, Sophia Boudjema, Pauline Reynier, Jean Charles Dufour, Olga Florea, Philippe, Patoureaux and Patrick Peretti-Watel
Institut Hospitalo-Universitaire Méditerranée Infection, 13005 Marseille, France

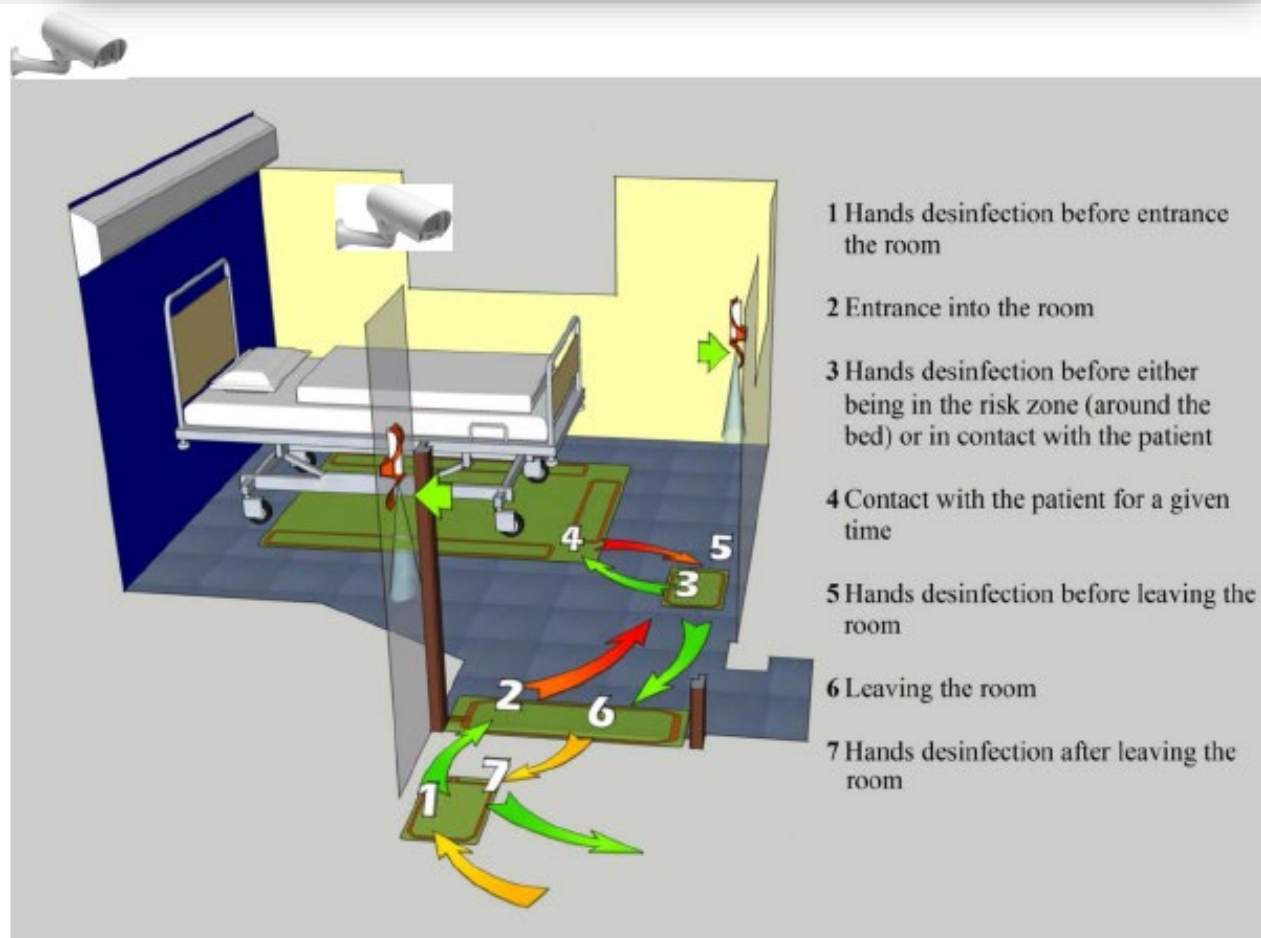


Figure 1: Schema of the experimental room with video camera and antennas from MediHandTrace®.

Hand Hygiene Analyzed by Video Recording

Philippe Brouqui*, Sophia Boudjema, Pauline Reynier, Jean Charles Dufour, Olga Florea, Philippe, Patoureaux and Patrick Peretti-Watel
Institut Hospitalo-Universitaire Méditerranée Infection, 13005 Marseille, France

Results : A total of 756 videos were captures. 249 were rejected because they were not contributive and 507 videos (811 Healthcare workers paths) were analyzed. Healthcare workers had hand disinfection at least one time in the path in 28.2%. Hand disinfection at entrance and exit of the bedroom is respected in 6.2%. The meal tray delivery is associated with a lower hand hygiene practice. The glove wearing adhesion is 51.2% in *Clostridium difficile* contact precaution, and conformity to protocol is 17.5%. Wearing gloves impairs hand disinfection especially in situation where gloves are not part of the protocol (38.7%). Adhesion to mask wearing in airborne precaution is 90.7%.

Use of hydro-alcoholic solution in the patient's room:	N (%)
At both entrance and exit	70 (8.6%)
Only at entrance	21 (2.6%)
Only at exit	72 (8.9%)
At entrance (missing data for exit)	14 (1.7%)
At exit (missing data for entrance)	52 (6.4%)
At least one time during the HCW path (either entrance or exit)	229 (28.2%)
Never	582 (71.8%)
Total	811

Table 1: Hand disinfection among HCWs in hospital setting (N=811 paths, France, 2013-2014).

Hand Hygiene Analyzed by Video Recording

Philippe Brouqui*, Sophia Boudjema, Pauline Reynier, Jean Charles Dufour, Olga Florea, Philippe, Patoureaux and Patrick Peretti-Watel
Institut Hospitalo-Universitaire Méditerranée Infection, 13005 Marseille, France

Hand Disinfection N=97					
	p^*	Before patient contact	After patient contact	Before + After patient contact	Total
Type Of Care	0.025				
non invasive		4 (7.7%)	31 (59.6%)	17 (32.7%)	52 (53.6%)
invasive		2 (6.7%)	9 (30.0%)	19 (63.3%)	30 (30.9%)
nursing		3 (20.0%)	8 (53.3%)	4 (26.7%)	15 (15.5%)
Total		9 (9.3%)	48 (49.5%)	40 (41.2%)	97 (100.0%)
*Exact Fisher test					

Table 3: Hand disinfection and type of care.

Hand Hygiene Analyzed by Video Recording

Philippe Brouqui*, Sophia Boudjema, Pauline Reynier, Jean Charles Dufour, Olga Florea, Philippe, Patoureaux and Patrick Peretti-Watel
Institut Hospitalo-Universitaire Méditerranée Infection, 13005 Marseille, France

Type of Isolation					
	p^*		C. difficile isolation N=41 (%)	Others or no isolation N=770 (%)	Total (N=811)
Wearing Gloves	0.11				
YES			21 (51.2%)	295 (38.7%)	316 (39.3%)
NO			20 (48.8%)	468 (61.3%)	488 (60.7%)
Missing data			0	7	7
Conformity For Wearing Gloves	0.37				
YES			7 (17.5%)	35 (12.4%)	42 (13.0%)
NO			33 (82.5%)	248 (87.6%)	281 (87.0%)
Missing data			1	19	20
Not affected			0	468	468

*Chi test

Table 4: Conformity for wearing gloves in *Clostridium difficile* isolation precaution.

Hand Disinfection				
	p^*	At least one time N=229	Never N=582	Total N=811
Wearing Gloves	0.037			
YES		77(24.4%)	239 (75.6%)	316 (39.3%)
NO		152 (31.1%)	336 (68.9%)	488 (60.7%)
Missing data		0	7	7
Wearing Gloves Only in no isolation	0.0064	At least one time N=217 (28.4%)	Never N=546 (71.6%)	Total N=763
YES		67 (22.7%)	228 (77.2%)	295 (38.7%)
NO		150 (32%)	318 (67.9%)	468 (61.3%)
Missing data		0	7	7
Wearing Gloves in C.D isolation		0	0	41

*Chi test

Table 5: Gloves wearing and hand disinfection.

Hand Hygiene Analyzed by Video Recording

Philippe Brouqui*, Sophia Boudjema, Pauline Reynier, Jean Charles Dufour, Olga Florea, Philippe, Patoureaux and Patrick Peretti-Watel
Institut Hospitalo-Universitaire Méditerranée Infection, 13005 Marseille, France

Type of Isolation					
	p^*	Number of HCWS	Other isolations N=423 (%)	Airborne isolation N=388 (%)	Total (N=811)
		n (% column)	n (% column) (% row)	n (% column) (% row)	
Wearing Mask	<0.0001				
YES		42	36 (8.5%) (9.3%)	353 (91.0%) (90.7%)	389 (48.0%)
NO		53	387 (91.5%) (91.7%)	35 (9.0%) (8.3%)	422 (52.0%)
*Chi test					

Table 6: Wearing mask and type of isolation.

What automated HH monitoring highlighted ?

HH is an individual behavior

Mastandrea et al. BMC Res Notes (2015) 8:426
DOI 10.1186/s13061-015-0406-0

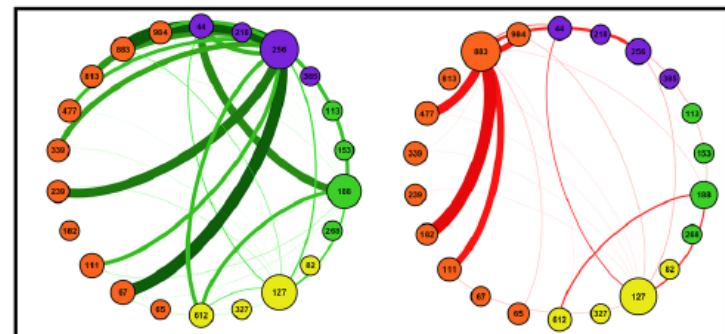
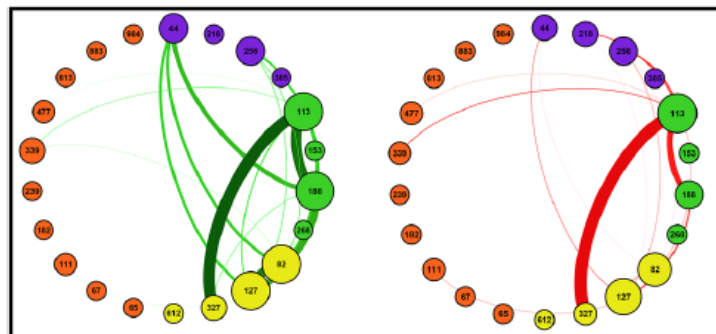
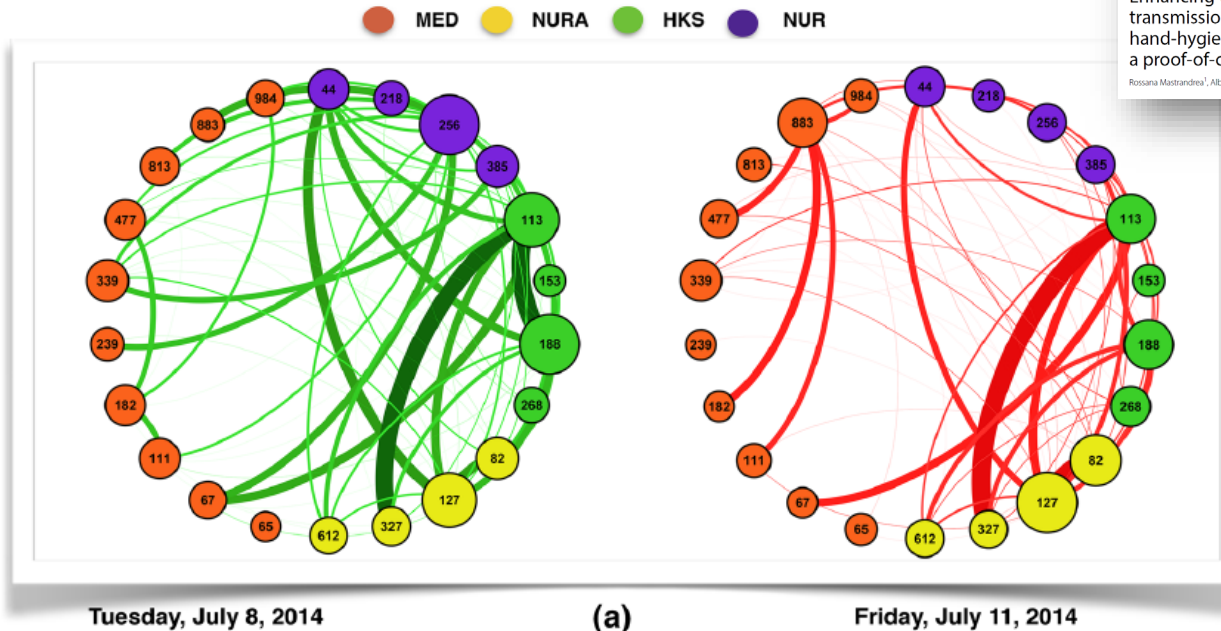
BMC
Research Notes

RESEARCH ARTICLE

Open Access

Enhancing the evaluation of pathogen transmission risk in a hospital by merging hand-hygiene compliance and contact data: a proof-of-concept study

Rossana Mastandrea¹, Alberto Soto-Aladro^{2,3}, Philippe Brouqui^{2,3} and Alain Barria^{1,4*}



What automated HH monitoring highlighted ?

Major Article

Merging video coaching and an anthropologic approach to understand health care provider behavior toward hand hygiene protocols

Sophia Boudjema ^{a,b,f}, Clément Tarantini ^{c,f}, Patrick Peretti-Watel ^{c,d,e,f},
Philippe Brouqui MD, PhD ^{a,b,f,*}

Main results

In a hospital ward specializing in contagious diseases, video records showed that HCWs frequently broke hand hygiene protocols and overused gloves. In-depth interviews indicated that they did it consciously: HCWs displayed good knowledge of the protocols, but they considered them inadequate and confusing, at least in some situations. HCWs developed hybrid practices, trying to reconcile protocols with concrete constraints (eg, needing their 2 hands to hold a meal tray) and competing goals (avoiding bare hand contact with potentially contaminated surfaces and preserving a patient's comfort). HCWs were also well aware of the risk of contamination, which is both invisible and uncertain, and several expressed reassuring beliefs regarding their own immunity.

What automated HH monitoring highlighted ?

Alcohol hand rub consumption objectives in European hospitals need to be revisited

P. Brouqui and A. Soto Aladro

Institut Hospitalo Universitaire Méditerranée Infection, Aix-Marseille

Université, Unité de Recherche sur les Maladies Infectieuses et Tropicales

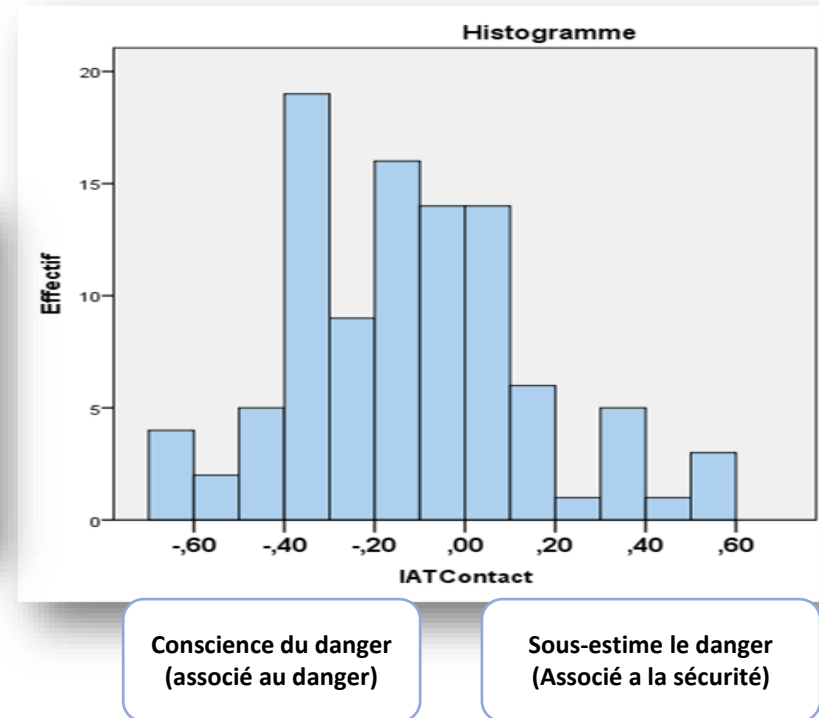
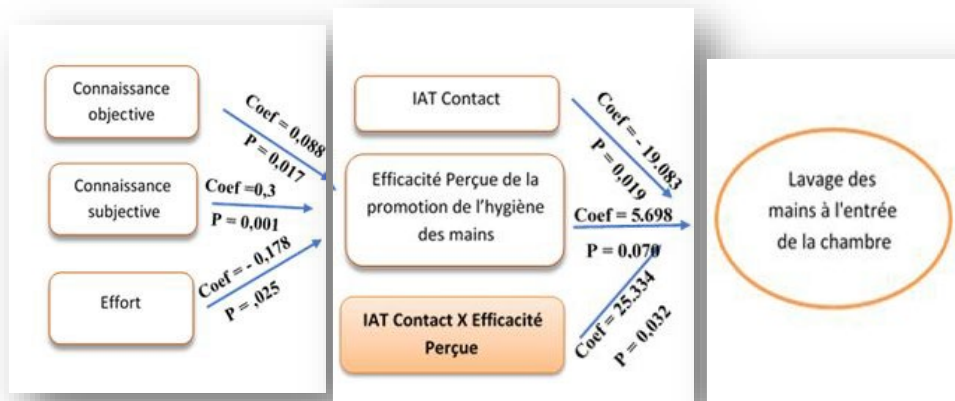
Emergentes, Marseille, France

contact with the patient. These results suggest that the mean reported AHR consumption in Europe reflects very low AHR compliance rates, far from the WHO objectives. In fact, our system registered a mean of 30 healthcare worker entry/exit events per patient-day [5], which indicates that the objectives of AHR consumption on the medical ward should be at least three times higher than that currently recommended. Alcohol hand rub solution consumption (orders) objectives need to be quickly revisited to a more ambitious goal.

What automated HH monitoring highlighted ?

HH behavior of HCW studies and understanding

- Explicit and implicit measures of risk perception to categorized HWC behavioral attitudes toward hand hygiene. *A Djire, C Magnin, S Boudjema, P Brouqui and I Regner . 2018.*



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 - HH behavior of HCP studies and understanding
- **Is automated HH monitoring enhancing HH disinfection ?**
 - **SMS , Reminder, feedback , conclusion**
- Is automated HH monitoring reduce HAI ?
- How automated HH monitoring perceived by HCW ?
- The future of HH monitoring
 - Risk assessment
 - Guidelines and regulations

Is automated HH monitoring enhancing HH disinfection ?

Review 2015

Hand hygiene monitoring technology: a systematic review of efficacy

J.A. Srigley^{a,*}, M. Gardam^b, G. Fernie^c, D. Lightfoot^d, G. Lebovic^e, M.P. Muller^f

- 7 studies 2015
 - Most study are of poor quality
 - Studies at lower bias showed only a small **increase** of HH compliance
 - Studies a moderate risk of bias showed **rapid and sustained increase** of HH compliance
 - One RCT showed a **6.8 % increase** in HH compliance

Automated Measures of Hand Hygiene Compliance among Healthcare Workers Using Ultrasound: Validation and a Randomized Controlled Trial

Dale A. Fisher, FRACP;^{1,2} Theresa Seetoh, MSc;^{1,3} Helen Oh May-Lin, FRCP;⁴ Sivakumar Viswanathan, PhD;⁵ Yanling Toh, BEng;⁶ Wong Chiang Yin, MMed(PH);⁶ Loh Siw Eng;⁴ Tan Shire Yang;¹ Steve Schiefen, MBA;⁷ Minkyu Je, PhD;⁸ Ruey Feng Peh, BEng;⁶ Fiona Wei Ling Loke, MS;⁶ Michael Dempsey, BSEE⁹

Overall compliance in the intervention arm was 6.8% (2.5%–11.1%; *P*.002) *higher than in the control arm.*

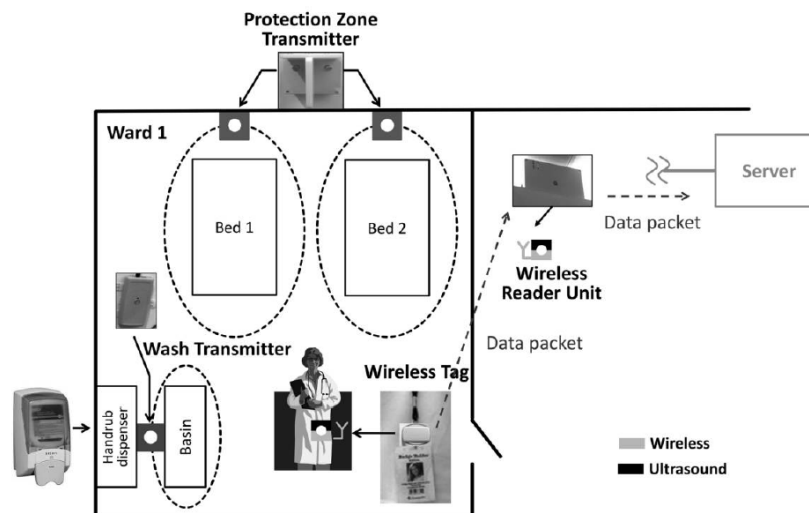


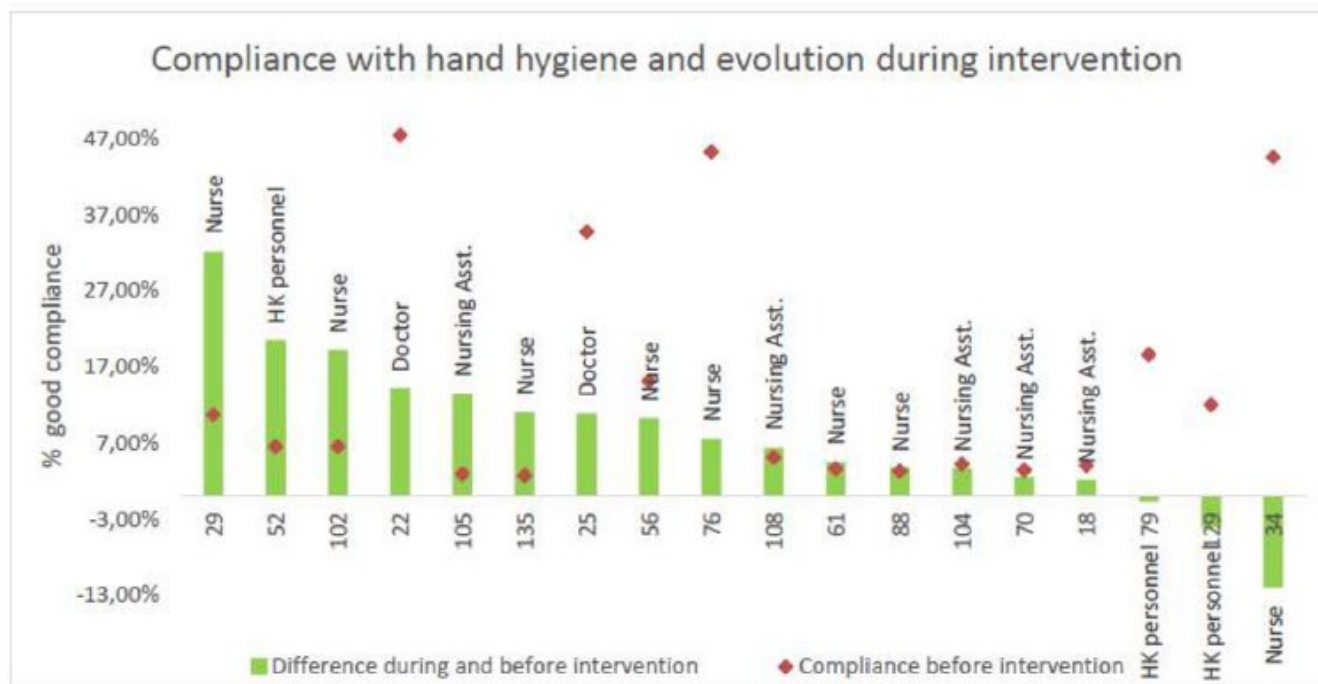
FIGURE 1. Wireless hand hygiene monitoring system.

Is automated HH monitoring enhancing HH disinfection ?

Feedback

Smartphone text message service to foster hand hygiene compliance in health care workers

Jad Kerbaj MD ^a, Youssoupha Toure MS ^b, Alberto Soto Aladro MS ^{b,c},
Sophia Boudjema MS ^{a,b,c}, Roch Giorgi MD, PhD ^{b,d,e}, Jean Charles Dufour MD, PhD ^{b,d,e},
Philippe Brouqui MD, PhD ^{a,b,c,*}



Hand hygiene is an individual behavior and evaluation can't be that of a group , an hospital or a nation....

Is automated HH monitoring enhancing HH disinfection ?

Nudges as an actor to change behaviors

How a smiley protects health: A pilot intervention to improve hand hygiene in hospitals by activating injunctive norms through emoticons

Susanne Gaube^{1*}, Dimitrios Tsivrikos², Daniel Dollinger³, Eva Lerner^{1,4}

¹ Department of Experimental Psychology, University of Regensburg, Regensburg, Germany, ² Division of Psychology and Language Sciences, University College London, London, United Kingdom, ³ Institute of Flight System Dynamics, Technical University of Munich, Garching bei München, Germany, ⁴ FOM University of Applied Sciences, Munich, Germany

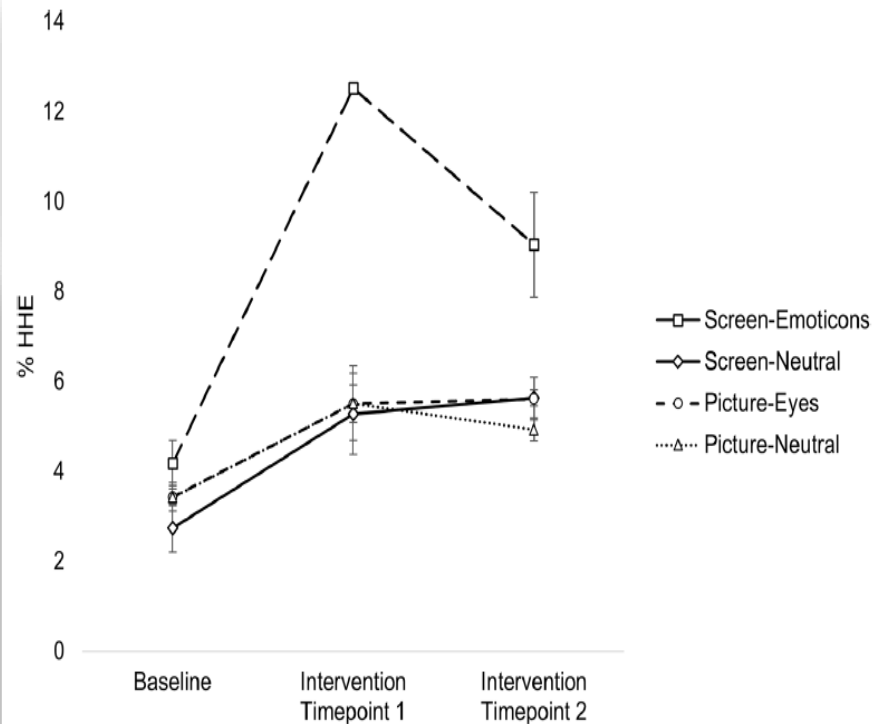
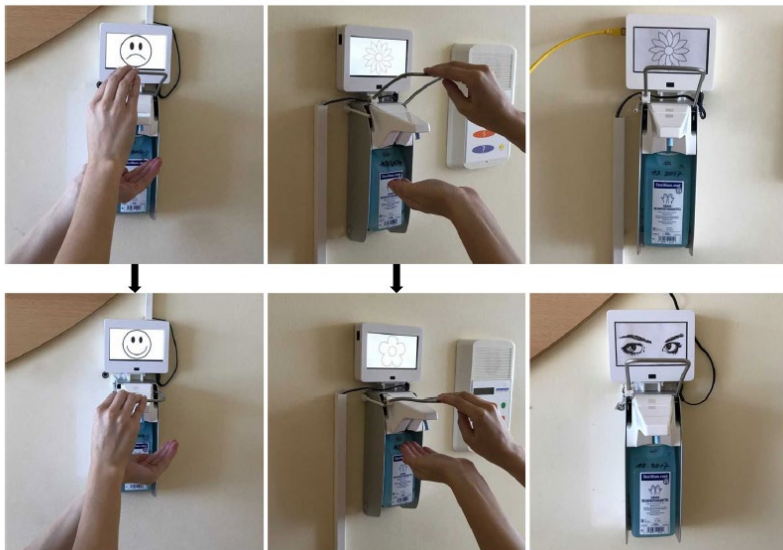


Fig 3. Hand hygiene event ratio data. Mean HHE ratio during baseline phase, intervention phase at intervention timepoint 1 and intervention timepoint 2 for each condition: Screen-Emoticons, Screen-Neutral, Picture-Eyes and Picture-Neutral. Standard errors are presented as error bars.

Activating injunctive norms may be a promising approach

Is automated HH monitoring enhancing HH disinfection ?

Nudges as an actor to change behaviors

Nudging to improve hand hygiene

M.G. Caris^{a,b,*}, H.A. Labuschagne^a, M. Dekker^b, M.H.H. Kramer^a,
M.A. van Agtmael^a, C.M.J.E. Vandenbroucke-Grauls^b

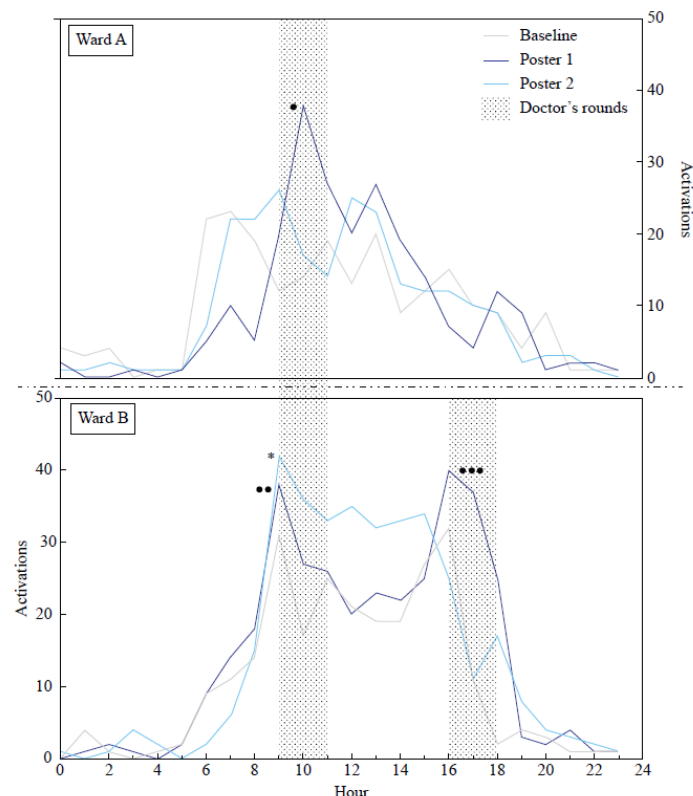
^a Department of Internal Medicine, VU University Medical Center, Amsterdam, The Netherlands

^b Department of Medical Microbiology & Infection Control, VU University Medical Center, Amsterdam, The Netherlands



- Nudges based on cognitive biases that play a role in hand hygiene, and displayed as posters, could provide an easy, inexpensive measure to increase use of alcohol based hand rub.
- When applying nudges to change behavior, **it is important to identify the right nudge for the right audience.**

M.G. Caris et al. / Journal of Hospital Infection 98 (2018) 352–358



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Is automated HH monitoring reduce HAI ?

Reduction in ventilator associated pneumonia in a mixed intensive care unit after initiation of a novel hand hygiene program ☆

Matthew D. Koff MD^{a,*}, Howard L. Corwin MD^a, Michael L. Beach MD, PhD^b, Steven D. Surgenor MD^a, Randy W. Loftus MD^a



Table 1 Patient demographics

	Study period	Control period	P
Age (mean ± SD)	61 ± 18	61 ± 17	.92
APACHE (mean ± SD)	17.7 ± 7.9	17.4 ± 7.8	.38
Male (%)	56	56	.98
Medicine (%)	45	48	.18
Surgery (%)	41	37	.10
Trauma (%)	14	15	.73

APACHE indicates Acute Physiology and Chronic Health Evaluation.

Table 2 Outcomes study period vs control period

	Study period	Control period	P
LOS ^a d (mean ± SD)	5.9 ± 7.8	5.8 ± 8.6	.79
Mortality (%)	296/1330 (22.3)	299/1262 (23.7)	.38
VAP number (number per 1000 vent days)	22 (3.7)	43 (6.9)	<.01
Eligible VAP patients (>2 days mechanically ventilated)	887	716	.01
CRBSI number (number per 10000 catheter days)	9 (1.5)	17 (2.6)	.09

^a ICU length of stay.

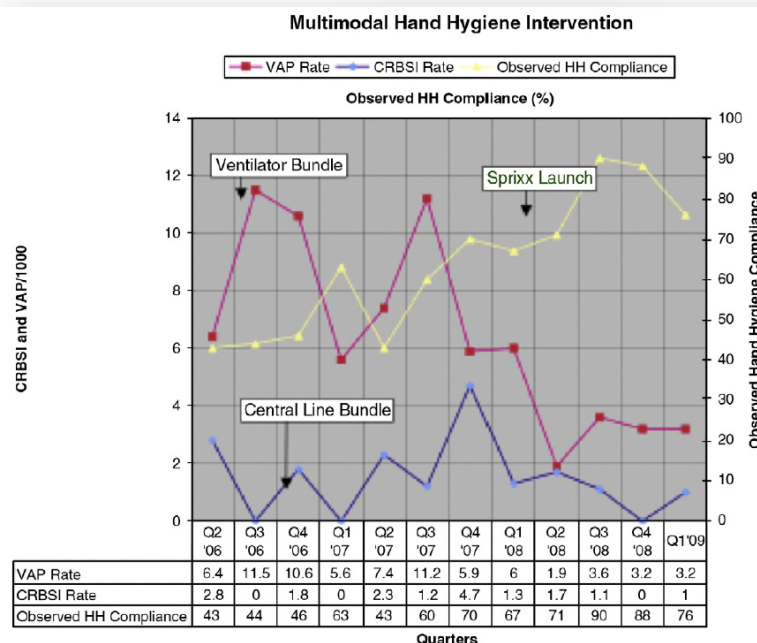


Fig. 2 Hand hygiene and infection rates.

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How automated HH monitoring perceived by HCW ?

Healthcare Personnel Perceptions of Hand Hygiene Monitoring Technology

Katherine Ellingson, PhD;¹ Philip M. Polgreen, MD;^{2,3} Amy Schneider, MPH;¹ Laura Shinkunas;³
Lauris C. Kaldjian, MD, PhD;³ Donald Wright, MD;⁴ Geb W. Thomas, PhD;^{2,5} Alberto M. Segre, PhD;^{2,6}
Ted Herman, PhD;^{2,6} L. Clifford McDonald, MD;¹ Ronda Sinkowitz-Cochran, MPH¹

HCWs Perceptions and Attitudes toward a Hand Hygiene Monitoring Technology in a Medical
Ward.

Clément Tarantini¹⁻², Philippe Brouqui³, Philippe Patouraux⁴, Karolina Griffiths³, Patrick Peretti-
Watel^{1*}

Recommendations for effective
implementation of A HH
monitoring:

Addressing accuracy issues before
implementation and **transparent
communication with frontline HCP
about the intended use of the
data.**

Innovative technologies should be
developed to address HCWs' perceptions.

It is crucial **to highlight much information
from HCWs about the nature of
technologies** although some criticisms about
monitoring system depend on more
structural causes.

Healthcare workers' attitudes towards hand-hygiene monitoring technology

C. Tarantini^{a,b}, P. Brouqui^c, R. Wilson^a, K. Griffiths^c, P. Patouraux^d,
P. Peretti-Watel^{a,*}

“-So honestly the screen, I'm not even paying attention to it. I don't even look at it anyway, so... he can show me that I made 70% or 20%, anyway, for me it doesn't matter. Because anyway, I think it was wrong...

[CT] Do you perceive it as something rather negative, positive? -
[Noelle] No, it's positive. And on the contrary, it pushes us to... -[CT] Is it stimulating? -[Noelle] It's stimulating, yes

I think it's good, because at least we know who does what, who washes his hands or are not washed... At first, what was good is that we had shown us the true path. After we do not do it anymore because we have not the time, but that's good, because it serves. It's good to know.”

“-We wear tags and there are antenna tags at ground level; we walk on the floor and everything... So, we thought: could this be carcinogenic?”

[PP] And do you understand how it works, you understand the logic of this screen?-[Julia] Yes, it was well explained to us. How I perceive it... it's a beautiful wallpaper!”

-It's spending a lot of public money ... Personally I think that instead of that, they would have done better to add staff, it would have been perhaps more useful ! Because it costs, right, that crap...”

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The future of automated HH monitoring

- Impact on HAI
 - Needs large multicenter RCT studies but much more easily achievable than using observation
- Risk assessment
 - Action target to high risk transmission
 - Identification
 - Development of interactive tools
 - MHT/PSR
- Guidelines and regulations
 - Universal tool to monitor hand disinfection at bedside / compliance
 - Need to be recommended by scientific societies and public health authorities

Disinfection of gloved hands during routine care

A. Vogel, P. Brouqui and S. Boudjema

Aix-Marseille Université, IRD, MEPHI, IHU-Méditerranée Infection, Marseille, France

- Prélèvements : lors des toilettes, sur 18 aides-soignants et 22 infirmiers

- 1- Directement sur les mains, à l'entrée du soignant dans la chambre
- 2- Sur les gants après 10 minutes de soins
- 3- Sur les gants après désinfection à l'alcool
- 4- Sur les gants après 20 minutes de soins (si soins excédant 20 minutes)

- Identification par MALDI-TOF

Valeur	Description	Symboles	Couleur
2.00 – 3.00	Identification avec une haute confiance	(+++)	vert
1.70 – 1.99	Identification avec une faible confiance	(++)	jaune
0.00 – 1.69	Aucune identification possible	(+)	rouge

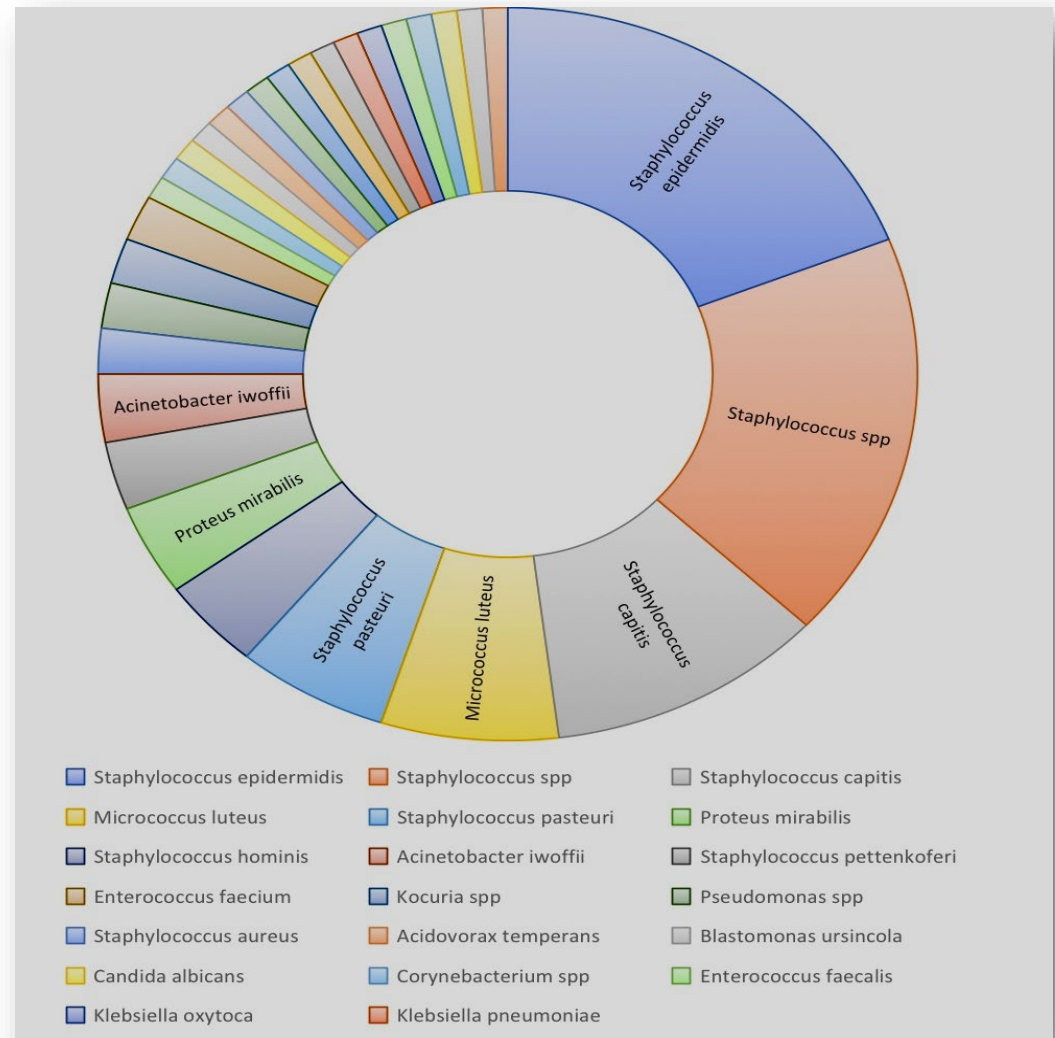
- Extraction de l'ADN et identification des *C.difficile* par PCR



Une diversité de micro-organismes sur les mains et les gants des soignants

- 100 micro-organismes identifiés sur les mains et les gants des soignants
- 92% des micro-organismes identifiés sont pathogènes
- Principalement des staphylocoques coagulase négative = bactéries commensales de la peau

Diagramme représentant les micro-organismes identifiés sur les mains et les gants des soignants selon leur incidence



Les gants sont contaminés par les germes des patients ou de leur environnement

Dans 14 cas :

Les mains des soignants sont stériles avant l'entrée dans la chambre

Les gants sont contaminés après 10 minutes de soins

Les gants sont contaminés par les germes du patient ou de son environnement

Les gants sont stériles après désinfection à l'alcool

N° :	AS/ID E	Mains gauche et droite	Après 10 min de soin - gant droit	Après 10 min de soin - gant gauche	Après désinfection des gants - gants gauche et droite
10	AS	Stérile	<i>Blastomonas ursincola</i>	<i>Acidovorax temperans</i>	Stérile
12	AS	Stérile	N/A	N/A	Stérile
17	IDE	Stérile	<i>S.pettenkoferi</i>	Stérile	Stérile
19	IDE	Stérile	Stérile	<i>Pseudomonas spp</i>	Stérile
27	IDE	Stérile	Stérile	<i>Staphylococcus</i>	Stérile
28	IDE	Stérile	<i>Staphylococcus spp</i>	<i>Staphylococcus pettenkoferi</i> <i>Staphylococcus capitis</i> <i>Roseomonas mucosa</i>	Stérile
33	AS	Stérile	<i>Proteus mirabilis</i>	<i>Proteus mirabilis</i>	Stérile
34	AS	Stérile	<i>Staphylococcus capitis</i>	<i>Staphylococcus spp</i> <i>Staphylococcus capitis</i>	Stérile
35	IDE	Stérile	<i>Pantoea septica</i> <i>Staphylococcus spp</i>	<i>Pantoea agglomerans</i> <i>Staphylococcus hominis</i> <i>Staphylococcus haemolyticus</i>	Stérile
38	AS	Stérile	<i>Candida albicans</i>	Stérile	Stérile
39	AS	Stérile	<i>Enterococcus faecium</i>	Stérile	Stérile
44	IDE	Stérile	<i>Staphylococcus spp</i>	<i>Staphylococcus spp</i> <i>Pantoea spp</i>	Stérile
48	IDE	Stérile	<i>Staphylococcus epidermidis</i>	<i>Staphylococcus epidermidis</i>	Stérile
47	IDE	Stérile	<i>Staphylococcus pasteurii</i>	<i>Staphylococcus spp</i> <i>Staphylococcus epidermidis</i> <i>Corynebacterium spp</i>	Stérile

Tableau représentant l'état de contamination des gants lorsque les mains et les gants après désinfection sont stériles

Les mains des soignants sont contaminées

Dans 9 cas :

- Les mains et les gants sont contaminés
- Les bactéries identifiées correspondent à la flore commensale de la peau

N°	AS/IDE	Main droite	Main gauche	Après 10min de soins - gant droit	Après 10min de soins - gant gauche	Après désinfection - gants gauche et droit
18	IDE	<i>Pseudomonas</i> spp <i>S.capitis</i> <i>M.luteus</i>	<i>Acinetobacter</i> spp	<i>Moraxella</i> spp	<i>M.luteus</i>	Stérile
24	AS	<i>Kocuria</i> spp	Stérile	<i>S.epidermidis</i>	<i>S.epidermidis</i> <i>Staphylococcus</i>	Stérile
31	AS	Stérile	<i>S.pasteuri</i>	<i>S.pettenkoferi</i>	<i>S.epidermidis</i> <i>S.pasteuri</i>	Stérile
32	AS	<i>S.epidermidis</i>	<i>S.epidermidis</i>	<i>Staphylococcus</i> spp <i>S.epidermidis</i>	<i>Staphylococcus</i> spp	Stérile
36	AS	<i>Rothia</i> <i>dentocariosa</i> <i>Streptococcus</i> <i>parasanguinis</i>	Stérile	<i>Klebsiella</i> <i>oxytoca</i> <i>S.epidermidis</i>	<i>S.capitis</i> <i>S.epidermidis</i>	Stérile
37	AS	Stérile	<i>Staphylococcus</i> spp <i>Proteus</i> <i>mirabilis</i>	<i>S.epidermidis</i>	<i>S.epidermidis</i>	Stérile
42	AS	Stérile	<i>M.luteus</i>	<i>Klebsiella</i> <i>pneumoniae</i>	Stérile	Stérile
48	AS	Stérile	<i>S.pasteuri</i>	<i>Staphylococcus</i>	<i>S.hominis</i>	Stérile
49	AS	<i>Staphylococcus</i> spp	<i>Staphylococcus</i> spp	<i>S.epidermidis</i> <i>S.aureus</i>	<i>S.aureus</i>	Stérile

Tableau représentant l'état de contamination des mains et des gants lorsque les gants après désinfection étaient stériles

Les mains des soignants sont contaminées

Dans 9 cas :

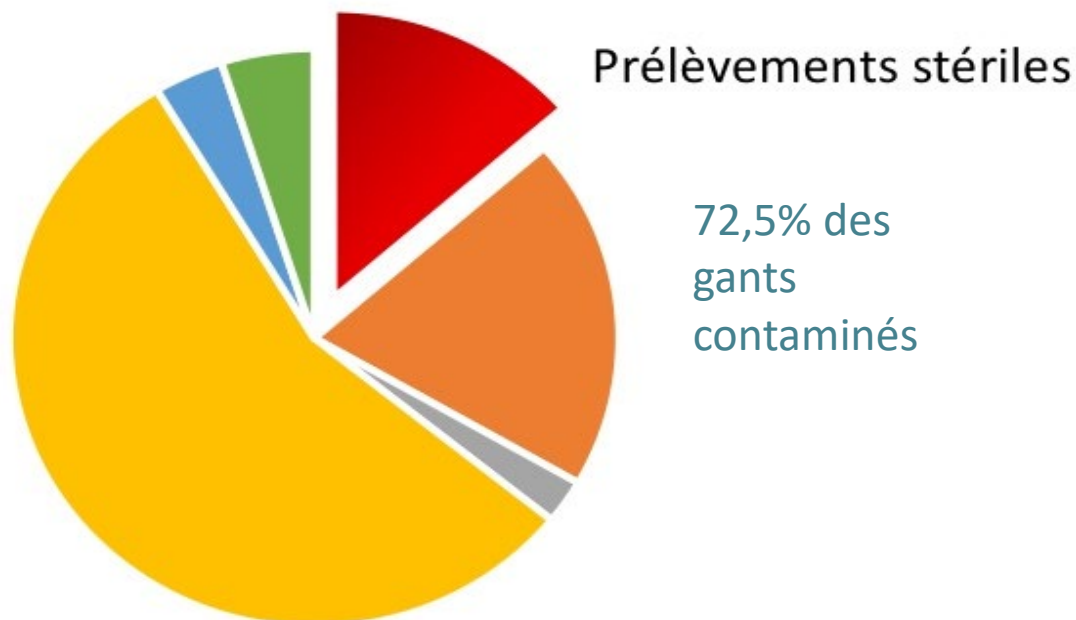
- Les mains et les gants sont contaminés
- Les bactéries identifiées correspondent à la flore commensale de la peau
- Des bactéries similaires sont identifiées sur les mains et sur les gants

Les soignants ont pu contaminer leurs gants eux-mêmes

Tableau représentant l'état de contamination des mains et des gants lorsque les gants après désinfection étaient stériles

N°	AS/IDE	Main droite	Main gauche	Après 10min de soins - gant droit	Après 10min de soins - gant gauche	Après désinfection - gants gauche et droit
18	IDE	<i>Pseudomonas</i> spp <i>S.capitis</i> <i>M.luteus</i>	<i>Acinetobacter</i> spp	<i>Moraxella</i> spp	<i>M.luteus</i>	Stérile
24	AS	<i>Kocuria</i> spp	Stérile	<i>S.epidermidis</i>	<i>S.epidermidis</i> <i>Staphylococcus</i>	Stérile
31	AS	Stérile	<i>S.pasteuri</i>	<i>S.pettenkoferi</i>	<i>S.epidermidis</i> <i>S.pasteuri</i>	Stérile
32	AS	<i>S.epidermidis</i>	<i>S.epidermidis</i>	<i>Staphylococcus</i> spp <i>S.epidermidis</i>	<i>Staphylococcus</i> spp	Stérile
36	AS	<i>Rothia dentocariosa</i> <i>Streptococcus parasanguinis</i>	Stérile	<i>Klebsiella oxytoca</i> <i>S.epidermidis</i>	<i>S.capitis</i> <i>S.epidermidis</i>	Stérile
37	AS	Stérile	<i>Staphylococcus</i> spp <i>Proteus mirabilis</i>	<i>S.epidermidis</i>	<i>S.epidermidis</i>	Stérile
42	AS	Stérile	<i>M.luteus</i>	<i>Klebsiella pneumoniae</i>	Stérile	Stérile
48	AS	Stérile	<i>S.pasteuri</i>	<i>Staphylococcus</i>	<i>S.hominis</i>	Stérile
49	AS	<i>Staphylococcus</i> spp	<i>Staphylococcus</i> spp	<i>S.epidermidis</i> <i>S.aureus</i>	<i>S.aureus</i>	Stérile

Les gants sont contaminés lors des soins



■ Stérile ■ Autres ■ S.aureus
■ Staphylococcus ■ Enterococcus ■ Enterobactéries

-Après 10 minutes de soins, 72,5%
des gants sont contaminés

-80% des ces gants ont été
efficacement désinfectés à l'alcool

-La désinfection à l'alcool, une
alternative au changement de
gants ?

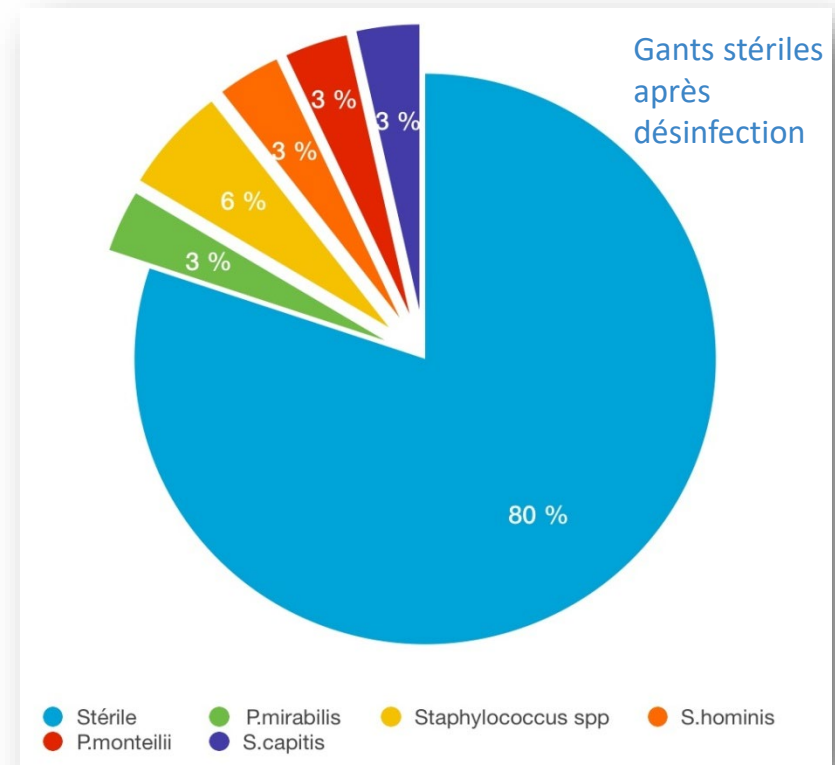


Diagramme représentant l'état de contamination des gants après désinfection à l'alcool. En bleu, les gants stériles.



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Three-year hand hygiene monitoring and impact of real-time reminders on compliance

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^b AP-HM, IHU-Méditerranée Infection, Marseille, France

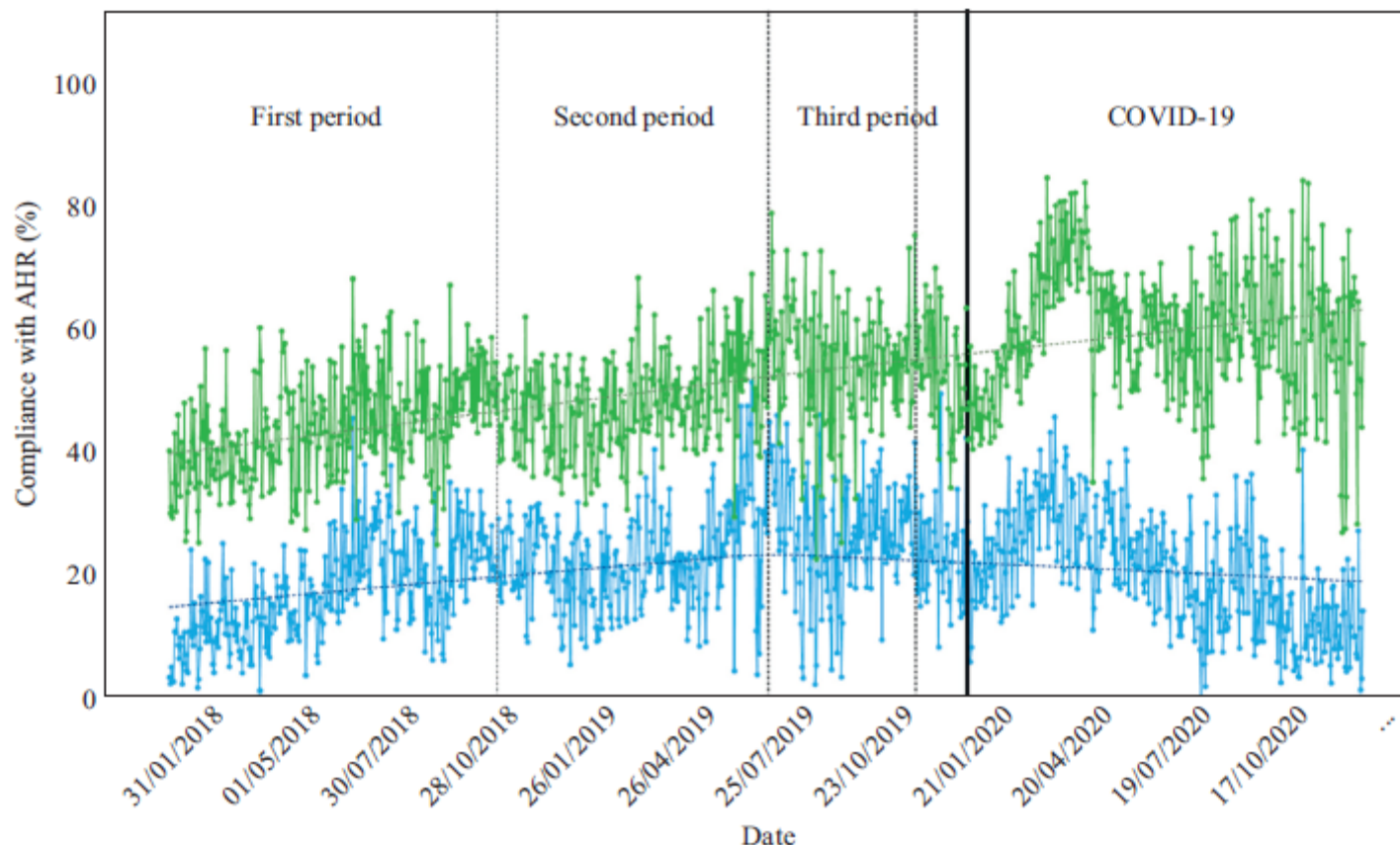
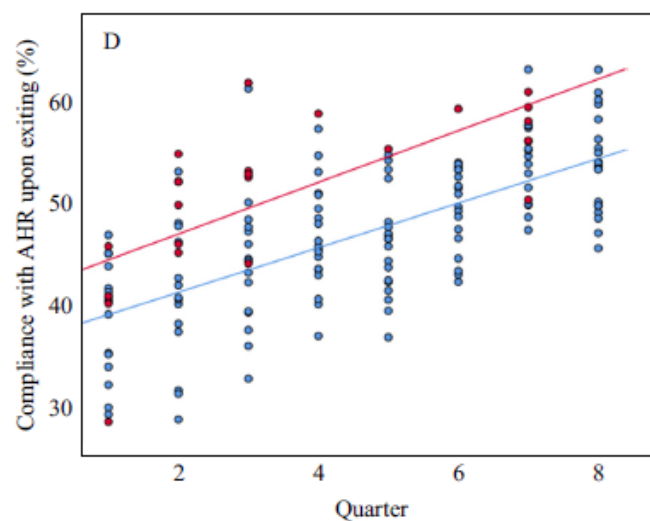
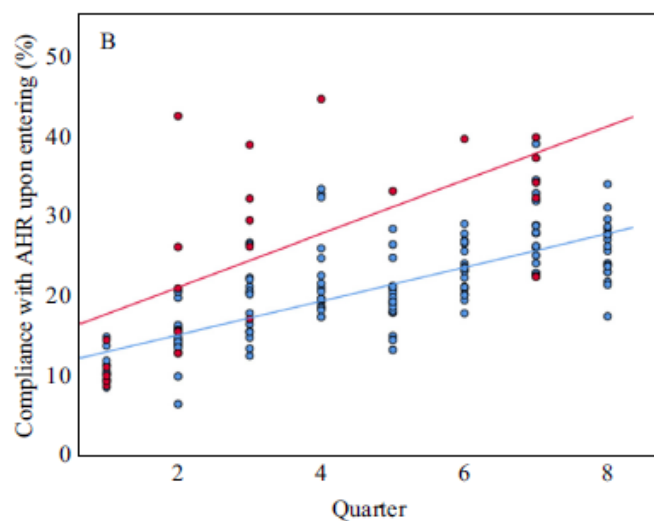
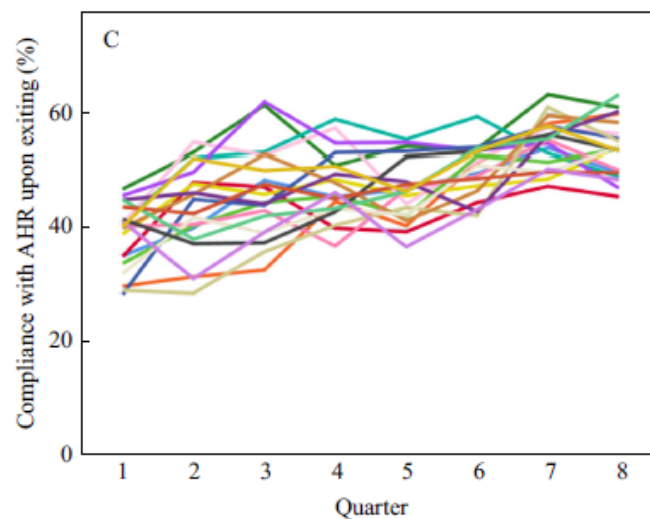
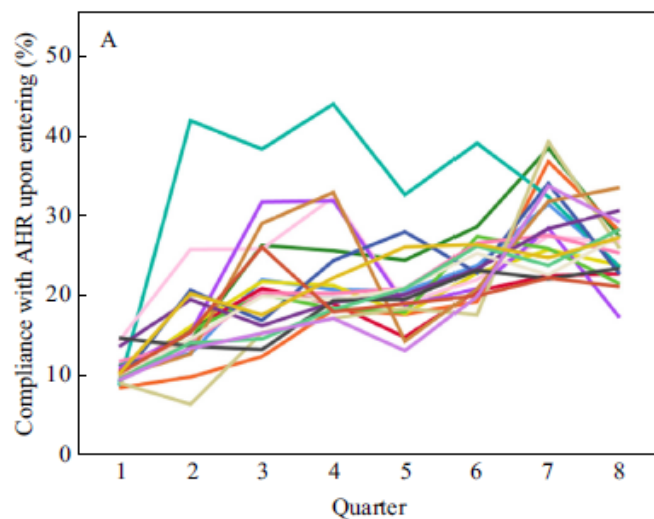


Figure 1. Evolution of daily compliance with using alcohol-based hand rub (AHR) and the three periods of real-time reminder interventions. The green line represents compliance upon exiting the room and the blue line represents compliance upon entering the room. The first period shows five randomly selected rooms with activated reminders (45 s buzzer). In the second period, one of the first five rooms had a 15 s buzzer. In the third period, there were five randomly selected rooms with activated reminders (15 s buzzer).



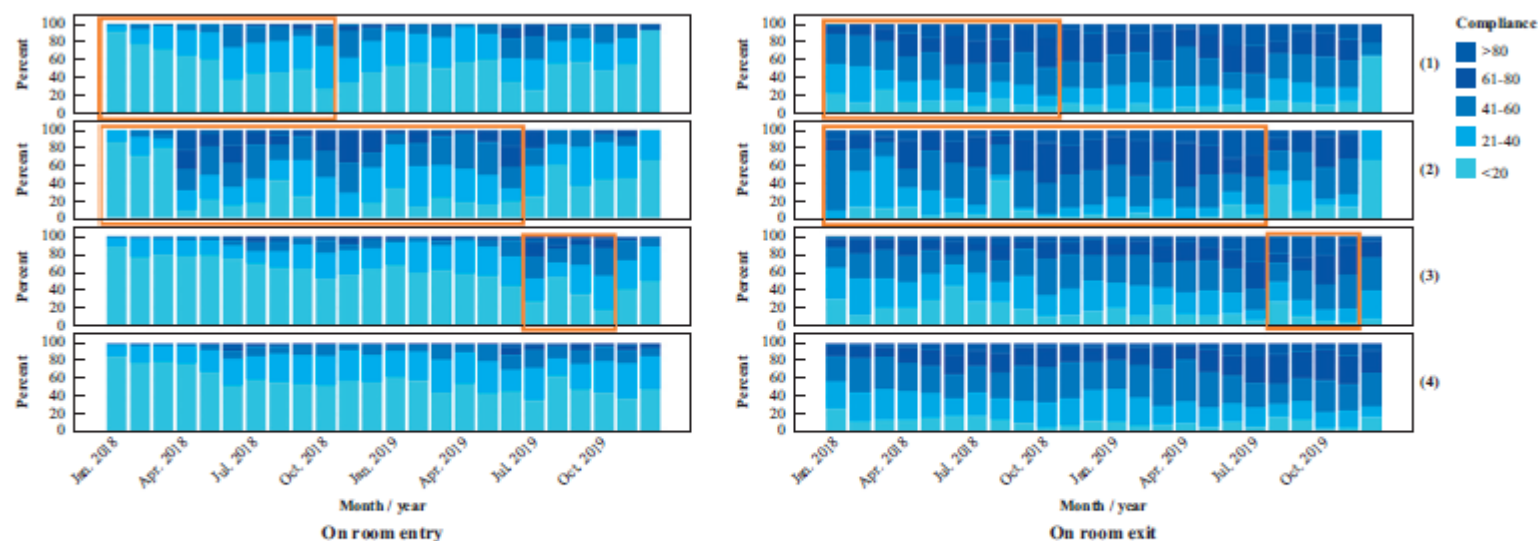


Figure 3. The percentage of monthly compliance on room entry and exit over two years: (1) the first five rooms which had a 45 s buzzer activated reminder; (2) the one room which had a 15 s buzzer activated reminder; (3) another five rooms which had 15 s buzzer activated reminders; (4) the rooms which never had an activated reminder. The orange line indicates the activated reminder period.

Internet of Things to Explore Moment 2 of “WHO My Five Moments” for Hand Hygiene

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Results: From the merged database over the 2-year study period, 30,164 nursing tasks were identified for analysis, 25,633 were classified as standard task procedures, and 4,531 were classified as aseptic task procedures for nursing care. Hand disinfection with an alcohol-based solution was not detected with our system in 42.5% of all the recorded tasks, 37% of all the aseptic task procedures, and 47.1% of all the standard task procedures for nursing ($p = 0.0362$), indicating that WHO moment 2 was not respected in 37% of mandatory situations.

Conclusion: Using a combination of different technologies, we were able to assess hand hygiene performance in the riskiest circumstances.

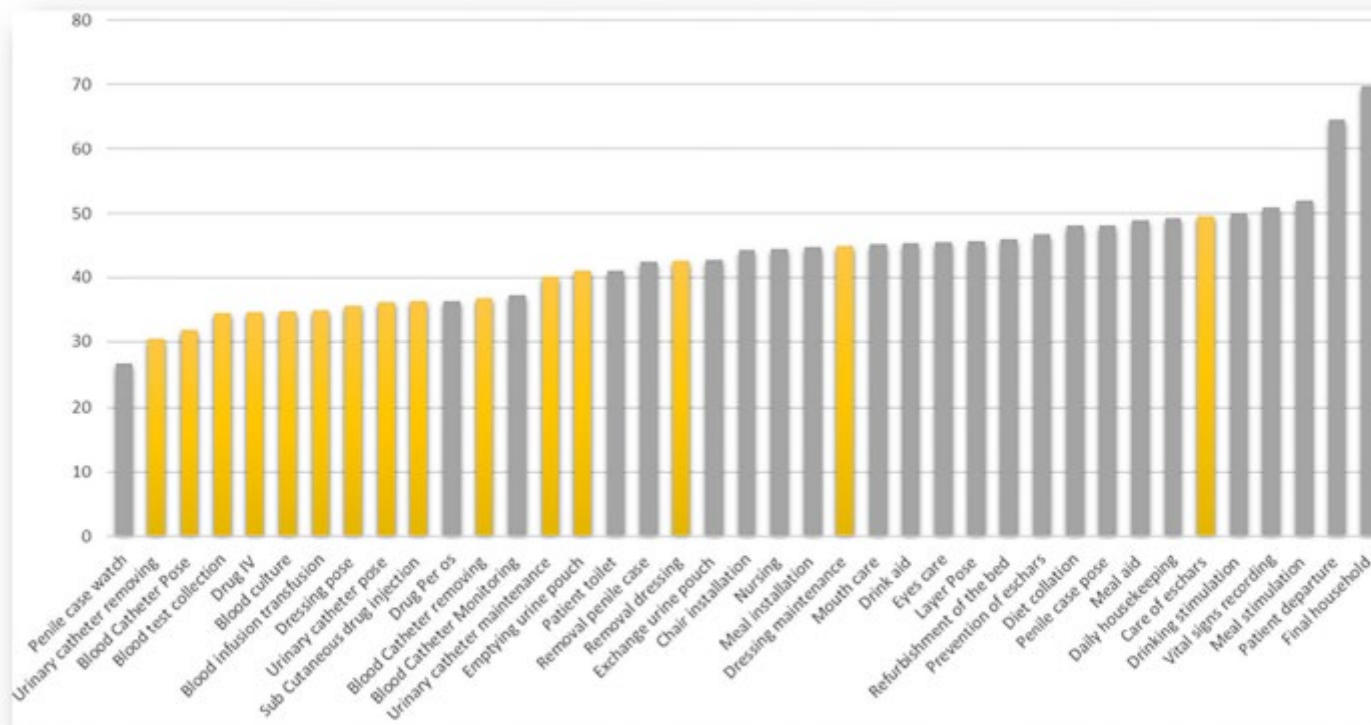


FIGURE 1 | Distribution of lack of compliance (%) to hand hygiene in aseptic task procedure (WHO Moment 2) vs. standard task procedure nursing. Hand hygiene is better performed when the nursing is in the category aseptic task (yellow) compare to standard precaution (gray) that were 1,678 (37%)/12,070 (47.1%) $p < 2.2 \text{ E-}16$.

IMPLICIT ASSOCIATION TEST PREDICTS PHYSICIANS' HAND HYGIENE BEHAVIOR: MERGING
COGNITIVE PSYCHOLOGY AND ELECTRONIC MONITORING
RUNNING TITLE: IMPLICIT ATTITUDES AND HYGIENE COMPLIANCE

FANYU HUANG, MARCO BRESSAN, MARJORIE
ARMANDO, STÉPHANE DUFAU, PHILIPPE
BROUQUI, ISABELLE RÉGNER

Direction :
Pr. PHILIPPE BROUQUI
Pr. ISABELLE RÉGNER

COMMENT LE TEST
D'ASSOCIATIONS
IMPLICITE (TAI) ENTRE
EN JEU DANS NOTRE
ÉTUDE ?

- Les gens n'expriment pas toujours le 'fond de leurs pensées' lorsqu'ils sont questionnés ouvertement sur leurs opinions :
 - Soit leurs réponses sont influencées par un biais de désirabilité sociale
 - Soit ils ne sont pas en mesure de le faire
- Le test d'Associations Implicite (testant la mémoire sémantique) démontre des divergences entre pensées conscientes et non-conscientes de manière plus convaincante que les méthodes explicites (questionnaires)

Le test d'association implicite (TAI) a été fait pour mettre en évidence l'association entre des idées automatiques.

Ex : Le premier TAI a été créé pour mesurer l'association entre le sexe d'un individu et sa prédisposition pour les lettres ou les sciences.



HOMMES

-

SCIENCES

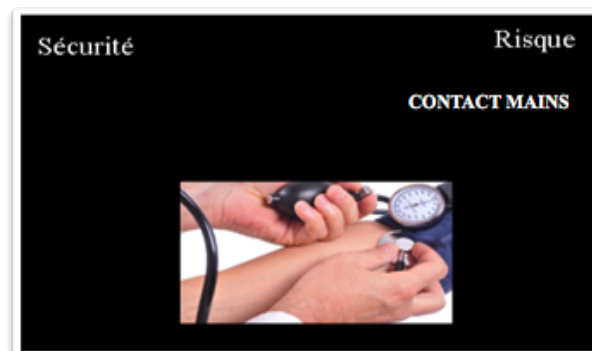
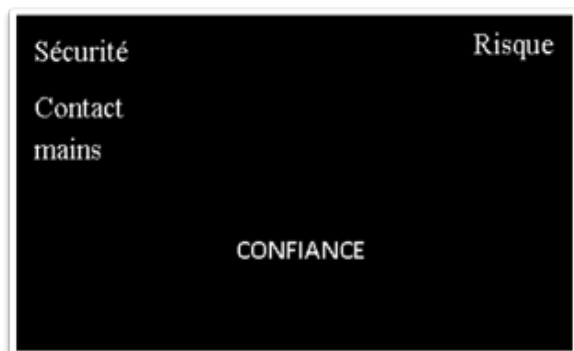


FEMMES

-

LETTRES

Un écran avec un mot ou une image au centre qu'il faut associer à des termes
situer en haut de l'écran



Objectif Principal

- Evaluer chez les soignants la **perception individuelle du risque de transmission** croisée des agents pathogènes hospitaliers

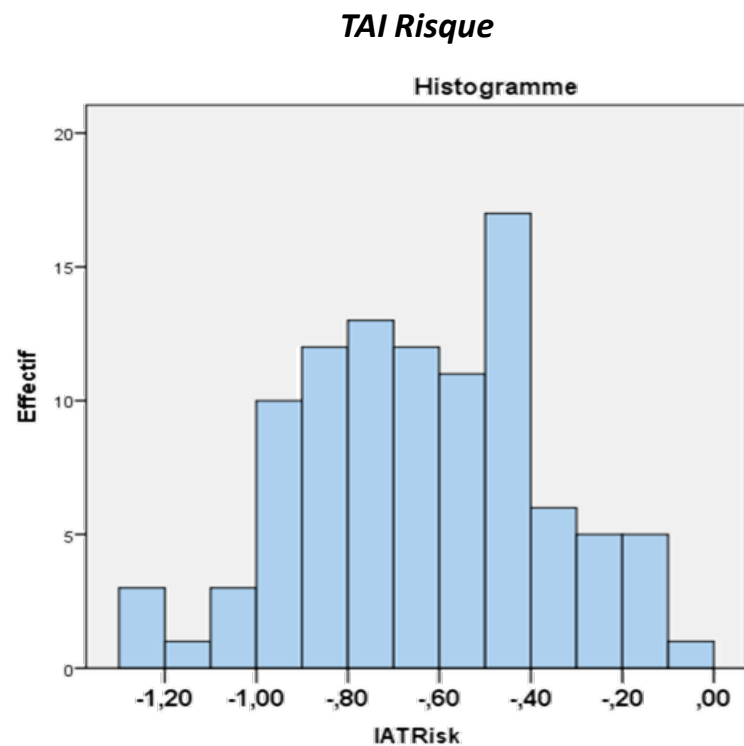
Objectifs Spécifiques

- Explorer les intentions comportementales des soignants vis-à-vis de l'hygiène des mains à travers le **TAI** (Test Association Implicite)
- Comparer les résultats du **TAI** à un questionnaire d'hygiène des mains
- Etudier la corrélation des résultats du **TAI** avec la déclaration par les soignants et la mesure automatisée de la compliance de l'hygiène des mains.

2. Analyse des TAI (mesures implicites)

- **TAI Risque**

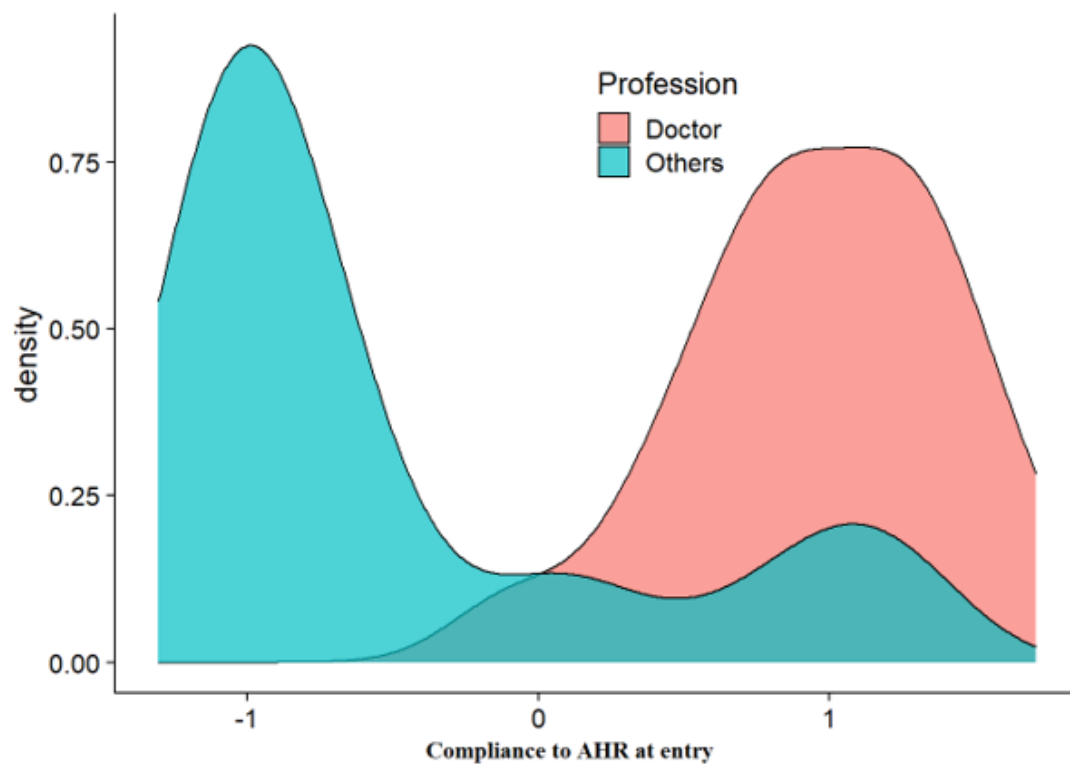
- **Evalue la prise de risque, « négatif ça veut dire que tous les soignants sont prudents »**
- **D-score (score final), moyenne globale -0.64 (-1.25 ; - 0.01) ET : 0.27**



Sécurité
(préférence pour sécurité)

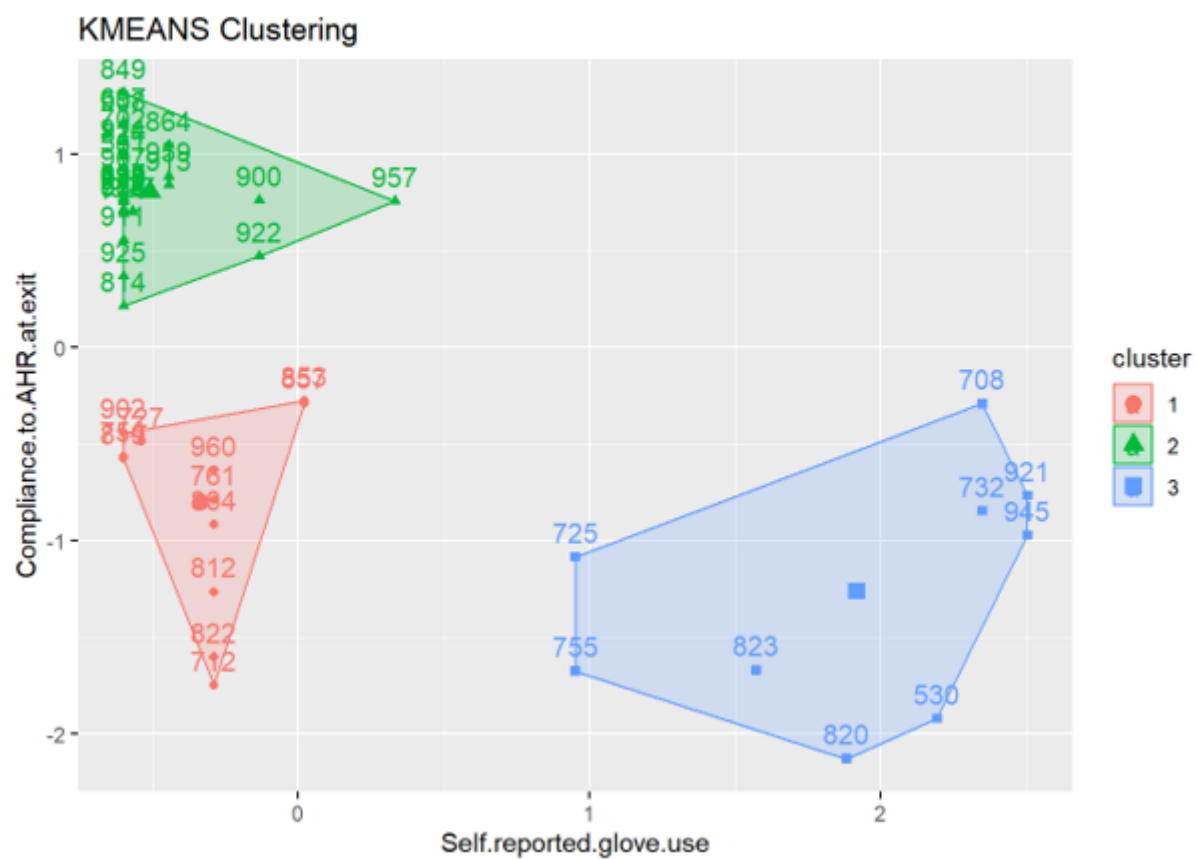
Supplementary figure 2

Density plot shows the bimodal distribution of compliance to AHR at entry. The green part represents the population of other professionals, and the red part represents the population of doctors.



Compliance to AHR upon exit

Supplementary figure 3



Findings: Actual compliance was higher among physicians than other HCWs. Self-reported objective and subjective knowledge were opposite predictors of compliance. Most importantly, higher compliance was observed among physicians with stronger automatic associations between themselves and hand hygiene ($\beta = 0.37$, $p < 0.001$) and stronger automatic associations between risk and hand contact ($\beta = -0.27$, $p = 0.001$).

Conclusion: Our findings revealed the importance of identifying automatic attitudes to achieve a deeper understanding of hand hygiene behaviours.



Thank you for attention