Journal of Hospital Infection (2001) **47**: 131–137
doi:10.1053/jhin.2000.0854, available online at http://www.idealibrary.com on IDEAL®

Better compliance and better tolerance in relation to a well-conducted introduction to rub-in hand disinfection

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Summary: The aim of the study was to demonstrate that the introduction of rub-in hand disinfection (RHD) in hospital units, with the implementation of suitable equipment, drafting of specific protocols, and training users, improved compliance of hand disinfection and tolerance of user's hands. In four hospital units not previously using RHD an external investigator conducted two identical studies in order to measure the rate of compliance with, and the quality of, disinfection practices, [rate of adapted (i.e., appropriate) procedures, rate of correct (i.e., properly performed) procedures, rate of adapted and correct procedures carried out] and to assess the state of hands (clinical scores of dryness and irritation, measuring hydration with a corneometer). Between the two studies, the units were equipped with dispensers for RHD products and staff were trained. Compliance improved from 62.2 to 66.5%, quality was improved (rate of adapted procedures from 66.8% to 84.3%, $P<10^{-6}$, rate of correct procedures from 11.1% to 28.9%, $P<10^{-6}$, rate of adapted and correct procedures from 6.0 to 17.8%, $P<10^{-8}$). The tolerance was improved significantly ($P<10^{-2}$) for clinical dryness and irritation scores, although not significantly for measurements using a corneometer. This study shows the benefit of introducing RHD with a technical and educational accompaniment.

Keywords: Hand-disinfection; tolerance; compliance.

Received 23 February 2000; revised manuscript accepted 13 September 2000.
Most of the data presented in the following paper by Dr Girard *et al*. have already appeared in HygièneS, the publication of the Société Française d'Hygiène Hospitalière. This Journal is not indexed in the major databases of medical literature and is published in French. Editorial Advisers of the Journal of Hospital Infection felt the work was of sufficient interest that it would benefit from a wider readership than it was likely to receive where first published. We have therefore agreed to publish the following as a loose translation of the original work and much of the data presented can also be found in the original publication. Girard R, Amazian K, Fabry J. Allez-y: ça marche! L'introduction organisée du traitement hygiénique par friction permet d'améliorer l'observance et la tolérance. *HygieneS* 1999; **VII**:364–366.
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Introduction

Hand disinfection is considered one of the most important measures for preventing hospital-acquired infections.[1,2] However its implementation remain incomplete due to resource difficulties and workload, with many variations between professional groups and clinical specialities.[3–8]

Hand hygiene procedures recommended in France[9,10] are either washing (simple, hygienic or surgical) or hand rubbing with aqueous alcohol solutions (hygienic or surgical rubbing). For each level of exposure risk (limited, intermediate or high) two adapted procedures are recommended (washing or rubbing). Despite these recommendations, hand disinfection is still often synonymous merely with washing; rub-in hand disinfection (RHD) has not been adopted on a large scale.

0195-6701/01/020131+07 $35.00

RHD was introduced into some hospitals 10 years ago. In many places, it was introduced progressively on the basis of published data,[11–14] and to respond to difficulties with hand washing. Initially, RHD was reserved for emergencies, and only later as a regular procedure with specific protocols, which makes it impossible to evaluate its true benefit in these hospitals. In order to determine whether RHD resulted in greater compliance and improved state of hands, we therefore carried out a better prepared introduction in non-user care units.

The introduction of RHD in treatment units in this study was associated with a campaign for adequate equipment and promoting hand hygiene. Therefore the benefit measured is that of the complete programme.

Materials and methods

Population

The study was carried out in four hospital units not previously using RHD at the E. Herriot Hospital (University Hospital Centre) in Lyon: a rheumatology unit, a urology unit, a paediatric unit and a paediatric intensive care unit.

All members of staff of all professional categories were observed: nurses, nursing auxiliaries, ancillary staff, paediatric nursing auxiliaries, physiotherapists and doctors.

Products

The study was carried out using an antiseptic solution for hands already in use in Lyon: Sterillium® (mecetronium etisulfate, propanol-1 and propanol-2; Bode Chemie Gmbh and Co., Hamburg, Germany).

Development of the study

Survey phase 1, before the introduction of RHD (18 November 1998 to 3 February 1999)
This initial phase was carried out without making any change to usual hand washing methods in the units. It included a compliance study and an assessment of the state of hands.

Introduction of RHD (4 February to 17 February 1999)
Each of the four units was equipped to make the use of RHD instinctive. Dispensers for the hand wash agents were installed, close to strategic points wherever possible: in treatment rooms, food stores, medical offices. These areas were provided with incentive stickers.

An informative meeting was organized in each of the four units to answer questions from nursing and medical staff and to define conditions for using RHD based on local and national recommendations.[9,10]

Survey phase 2, after introduction RHD (3 March to 8 April 1999)
This phase began at least two weeks after introducing the new procedure in order to give the staff enough time to get used to the product. This phase was carried out by the same investigator in exactly the same way as the first phase.

Observance study

Hand hygiene procedure definitions
A procedure was classed as 'adapted' if it was appropriate for the clinical situation. It was classed as 'correct' if performed properly, irrespective of its appropriateness to the clinical situation.

Data collection

All observations were made by the same external investigator using identical methods for both periods. Each member of nursing staff was observed for 1.5 h and for a series of successive activities during each period. The data gathered for each act included: the type of activity, the immunocompetence of the patient concerned, the possible infection by the patient concerned, the type of hand hygiene procedure carried out (if any), its adapted and correct nature, and the type of error for an incorrect procedure. All data were recorded anonymously.

Main judgement criteria

Rate (%) of compliance
The rate of compliance for disinfecting hands was defined as the number of hand hygiene procedures carried out (washing or antisepsis) compared with the number of situations where this procedure was considered necessary.

Secondary judgement criteria

Rate (%) of adapted procedures
This rate enables the suitability of the chosen hand hygiene procedure to be assessed, i.e., relationship

Table I *Quality criteria for hand disinfecting procedures related to local recommendations*

Simple wash	Antiseptic wash	Hygienic disinfection by friction
Application: hands and wrists	Application: hands and wrists	Clean and dry hands
Soaping time > 10 s	Soaping time > 60 s	Application: hands and wrists
Rinsing time > washing time	Rinsing time > washing time	Nails and spaces between fingers
Drying without rubbing	Drying without rubbing	Rubbing until dry
Without subsequent contamination	Without subsequent contamination	

of the microbiological efficiency of the procedure chosen to the level of risk incurred, in relation with local recommendations. This is defined as the number of adapted procedures compared to the number of procedures carried out.

Rate (%) of correct hand hygiene procedures

This rate gives the proportion of procedures performed correctly. A procedure is considered correct if it is carried out according to the protocol set and complies with the key points specified in Table I. The rate is defined as the number of correct procedures compared to the number of procedures carried out. Incorrect procedures were classed in one of three categories:

(1) risk of infection – for errors which induced a risk of infection (e.g., insufficient contact time);
(2) risk of causing cutaneous intolerance (e.g., excessively short rinsing);
(3) double risk in cases of both the above errors.

Rate (%) of adapted and correct procedures carried out

This rate is the combination of the criteria used above for adapted and correct procedures. It is defined as the number of adapted and correct procedures carried out, compared with the number of procedures expected.

For each rate, a gross rate was calculated for the 'before' and 'after' periods, then specific rates for units, professional categories and levels of risk.

Tolerance study

This study was carried out using two different approaches: a clinical method and a para-clinical method.

Judgement criteria for the clinical method

Two judgement criteria were used, a dryness score and an irritation score.

These are validated scores previously used by our team[15,16] and initially adapted from articles by Larson *et al.*[17–19] The dryness score is calculated by adding points quantifying the dryness (Table II). The irritation score is calculated by adding points quantifying the irritation (Table III).

Table II *Marking of the dryness score*

Observation	Points attributed
Supple and elastic skin	0
Supple skin, dry on surface extensively	1
Dry skin, rough or thickened extensively	2
Desquamation	1
Breaks	1
Peri-ungual dryness	
Localized	0.5
Extensively	1
Score obtained for dryness	Sum of points

Table III *Marking of the irritation score*

Observation	Points attributed
No sign of irritation	0
Redness	
Moderate and localized	1
High and localized or moderate and extensive	2
High and extensive	3
Abrasions	1
Phlyctena	1
Oedema	1
Score obtained for dryness	Sum of points

The clinical assessment of the cutaneous state of hands was carried out by the investigator at the same time as the observation, i.e., once for each period.

Judgement criterion for the para-clinical method

The judgement criterion used was the average value of 10 measurements of the hand's cutaneous hydration. Cutaneous hydration was measured using a CM825® corneometer (Courage and Khazala Electronic, Monte Carlo, France) which measures the skin's electrical capacity, on a scale from 0 to 100. Values lower than 35 indicate very dry skin,

35–50 indicate dry skin and greater than 50 normally hydrated skin.

For the first period all measurements were made in January (the apparatus was not available at the beginning of the study). For the second period, measurements were taken at the same time as the clinical assessments. The measurements were taken using a probe strapped on to the back of the hand at least 5 min after washing or antisepsis.

Tolerance data were marked on a sheet with the subject's name. Separate sheets were used for each period to avoid bias.

Analysis methods

Data were entered using Epi Info version 6[20] and the SPSS version 8[21] software. Qualitative judgement criteria were compared between the two periods (before and after) using Mantel Haenzel's Chi-square test with a significance threshold of 5% ($P<0.05$).

The before/after comparison of variables assessing tolerance was carried out using Student's *t*-test for matched series.

Results

Observance

For the first period, 87 subjects were observed for a total of 105 h 45 min. There were 614 occurrences of patient contact, (i.e., 5.8/h) warranting hand hygiene. For the second period 77 subjects were observed for a total of 82 h 10 min. There were 421 occurrences (i.e., 5.1/h).

The gross rate of compliance was 62.2% during the first period and 66.5% during the second period (non-significant difference), in only unit 1 was there a significant difference ($P=0.03$). No relationship was shown between the number of occurrences per hour and compliance. The overall results and the results for each unit are given in Table IV.

The rate of adapted procedures increased from 66.8% during the first period to 84.3% during the second period ($P<10^{-5}$). The rate of correct procedures was 11.1% during the first period and 28.9% during the second ($P<10^{-6}$). The quality of hand hygiene procedures improved significantly during the second period in all units except unit 1.

The rate of adapted and correct procedures increased from 6.0% during the first period to 17.8% during the second ($P<10^{-8}$). This difference was also highly significant in all units except unit 1. Details are given in Table V.

Table IV *Gross compliance according to units and periods*

Unit	Before carried out/expected	After carried out/expected	*P**
1	30/57 52.6%	45/63 71.4%	0.03
2	86/122 70.5%	61/89 68.5%	0.76 (NS)
3	118/177 66.7%	81/106 76.4%	0.08 (NS)
4	148/258 57.4%	93/163 57.1%	0.95 (NS)
Total	382/614 62.2%	280/421 66.5%	0.15 (NS)

*Mantel Haenzel χ^2 test.

Table V *Adaptation and quality of procedures by period*

Criteria	Before nb (%)	After nb (%)	*P**
Procedures carried out	382	280	
Adapted procedures	255 (66.8%)	236 (84.3%)	$<10^{-5}$
Correct procedures	42 (11.1%)	81 (28.9%)	$<10^{-6}$
Expected procedures	614	421	
Adapted and correct procedures	37 (6.0%)	75 (17.8%)	$<10^{-8}$

*Mantel Haenzel χ^2 test.

Observance and level of risk

Analysis of compliance rates according to levels of risk showed an improvement for both intermediate and limited exposure levels of risk. This improvement was not significant but was greater for intermediate (58.2–69.3%) than for limited risk (63.4–65%); no high exposure risk activities were observed. Analysing the procedure according to the level of risk also showed improved compliance. This improvement was significant for both intermediate (70.7–92.3%, $P<10^{-2}$) and for limited risk (65.7–82.5%, $P<10^{-3}$).

Observance and professional categories

Nurses showed a significant improvement in compliance (60.8–68.4%, $P<0.05$). Improvement was not statistically significant for nursing auxiliaries or

paediatric auxiliaries. For doctors and ancillary staff rates of compliance were lower during the second period but this is based on a small number of observations for these two categories.

The rates of adapted procedures and correct procedures showed a significant improvement with nurses, paediatric auxiliaries and ancillary staff. For each rate the values measured for nurses were greater than for other professional groups.

Procedures

During the second period RHD was used in 43.0% of cases for limited risk and in 36.5% of cases for intermediate risk.

Errors

Simple washing was more correctly carried out during the second period: 36.2% vs. 15.0%, $P<10^{-4}$. The quality of antiseptic washes remained practically unchanged. There was a decrease in the number of errors associated with a tolerance risk (insufficient rinsing for example) but not a large reduction in the number of errors which could have led to the procedure's inefficiency and therefore a risk of infection (contact time too short).

Tolerance study

For the clinical method, 86 subjects were seen during the first period and 80 during the second period. Seventy-seven were seen during both periods. For the para-clinical method 84 subjects were seen during the first period, 80 during the second period, and 76 during both periods.

Development of clinical tolerance: dryness

The average dryness score was 1.08 during the first period and 0.66 during the second period. The scores of individuals lost during the second period did not differ from the scores of others. There was an overall decrease in dryness of hands after RHD was introduced. This was significant in units 1 and 3 (Table VI). Lower dryness scores after RHD was introduced were found in all professional groups.

Clinical tolerance: irritation

The average irritation score was 0.85 during the first period and 0.24 during the second. The scores of individuals lost during the second period did not differ from the scores of others. Irritation scores were reduced significantly after RHD was introduced, particularly in units 3 and 4 (Table VII) and applied to all professional categories.

Table VI *Development of dryness by unit and by period*

Unit	Average score before*	Average score after*	Average difference†	P‡
1	0.90	0.50	−0.50	0.05
2	1.10	1.12	−0.04	0.91 (NS)
3	1.07	0.57	−0.50	0.01
4	1.13	0.58	−0.39	0.11 (NS)
Total	1.08	0.66	−0.38	0.002

*For all subjects observed.
†For the 77 subjects observed both before and after.
‡Student's *t*-test for matched series.

Table VII *Development of irritation by unit and by period*

Unit	Average score before*	Average score after*	Average difference†	P‡
1	0.55	0.20	−0.40	0.10 (NS)
2	0.53	0.39	−0.15	0.43 (NS)
3	1.24	0.15	−1.04	$<10^{-5}$
4	0.74	0.27	−0.33	0.03
Total	0.85	0.24	−0.56	$<10^{-5}$

*For all subjects observed.
†For the 77 subjects observed both before and after.
‡Student's *t*-test for matched series.

Para-clinical tolerance

Average cutaneous hydration was 36.0 in the first period and 38.9 in the second. The results for individuals lost in the second period did not differ from the results of other individuals. As shown in Table VIII, there was a non-significant improvement. Analysis of development of cutaneous hydration scores for hands accordingly rank showed lower irritation scores after RHD was introduced for nurses, paediatric auxiliaries and ancillary staff. Because of the low number of subjects according to rank, no statistical test was carried out.

Clinical dryness scores and corneometer measurements were significantly related (in linear regression $R^2=0.210$, $P<10^{-3}$). No significant relationship was found between the clinical irritation score and hydration measurements on the corneometer.

Table VIII *Cutaneous hydration scores for hands according to units and according to periods*

Unit	Average before*	Average after*	Average difference†	*P*‡
1	37.6	38.9	1.3	0.71 (NS)
2	35.2	28.3	−7.0	0.005
3	35.7	38.0	2.0	0.42 (NS)
4	36.2	44.2	5.0	0.08 (NS)
Total	36.0	38.9	1.6	0.3 (NS)

*For all subjects observed.
† For the 76 subjects observed both before and after.
‡ Student's *t*-test for matched series.

Discussion

Compliance with hand disinfection in our study was relatively high in comparison with others.[3–8] However, it is comparable with the results of our study carried out in 1998 at the CHLS[22] and those of other studies[23] from outside France.

The compliance varied between units and was no better where risks were greater, contrary to other studies. The lowest rate of compliance was recorded in the intensive care unit and was accompanied by a greater workload in the first period but not in the second. Thus workload does not appear to be an explanatory factor.

Observance differed between professional categories and was lower for doctors and physiotherapists, as in other studies.[3] These two groups were hardly affected by the campaign: only two doctors attended the informative meetings. The rate of adapted procedures as well as the rate of correct procedures collected in our study are similar to the rates given in the literature.[5]

The low rate of correct adapted procedures carried out represents an alarming figure, indicating that the daily practice of disinfecting hands falls far short of the recommendations.

The introduction of RHD led to a greater number of procedures carried out and particularly to improved quality, associated with a greater cutaneous tolerance. This result is similar to studies already published which also show a greater effect, compared with a simple programme for promoting the hygiene of hands.[24,25]

Improved compliance was significantly more pronounced in unit 1, which benefited from adapted equipment and complete information since all of the nursing staff were present at the informative meeting. This highlights the importance of preparing the introduction of RHD.

In the other units compliance was improved non-significantly (unit 3) or remained unchanged (units 2 and 4), but the quality of procedures carried out was significantly greater after the introduction of RHD, which is perhaps linked to the simpler nature of RHD compared to washing. The rate of adapted correct procedures carried out is a judgement criterion rarely used in the literature, but it gives a good overall picture of the practice of disinfecting hands. It tripled after the introduction of RHD (from 6.0 to 17.8%), demonstrating the value of the programme.

The tolerance analysis showed a clear improvement in the state of the hands of nursing staff in the second study period. This improvement was very significant with the method using clinical results, both for the type of dryness and the type of irritation. The difference in dates may explain this, but meteorological conditions showed no difference between the two periods. The improvement in the state of hands therefore seems due mainly to RHD, as demonstrated by others.[14,16] The presence of additives in the solutions helps provide better protection for the state of hands.[11,12] This improvement could also be explained by the improved quality of disinfection technique in the second period. The errors associated with a tolerance risk almost disappeared in the second period.

Although time savings were not measured in this study, it should be noted that simply washing hands requires approximately 1.5 min, excluding time to reach a sink, an antiseptic wash needs 2.5 min and RHD less than 1 min. Since RHD was used in almost 40% of cases during the second period, a considerable amount of time most have been saved, which is likely to favour better compliance.

Results obtained with the corneometer correlated well with those of the clinical dryness assessments and the two thus seem to measure the same characteristic. The corneometer appeared less discriminatory than the clinical assessment, perhaps because measurement is carried out on a single point, on the back of the hand. Dryness on the back of hands often only appears following dryness on nails and fingers. However, the corneometer was often better perceived than the clinical method, which the nursing staff considered subjective. Future studies might explore more discriminatory methods, such as measuring the loss of transepidermal water[14] or increasing the number of points measured.

Although alcohol-based products are suspected to be more irritant than soap, our work showed the opposite. However such a test was too short to provide a reliable measurement of the different irritant effects in chronic use.

In conclusion, our work has demonstrated a variety of benefits from the introduction of a well-tolerated hand disinfection programme using RHD. The study emphasizes the importance of making appropriate equipment available and the need to make particular efforts to include medical staff in educational efforts.

Acknowledgments

We thank the hygiene team at the Edouard Herriot Hospital (Annick Gandin, Geneviève Perrin, Christine Chemorin, Michel Perraud and Françoise Tissot Guerraz) for their help as well as RIVADIS and Bode Chemie Gmbh and Co., who sponsored the study.

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