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Level of knowledge of and capability for application of isolation precautions in a tertiary-level pediatric hospital

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Abstract

Objective: *To assess the level of knowledge of and capability for application of isolation precautions.* **Materials and Methods:** *A cross-sectional study was conducted at a tertiary-level pediatric hospital, and a questionnaire including structured questions and clinical scenarios was applied to healthcare personnel. Descriptive and inferential statistics were performed with the chi-squared test and odds ratios were obtained.* **Results:** *A total of 131 healthcare workers participated in the study, including 34 (26%) attending physicians, 47 (36%) medical residents, 48 (37%) nurses, and 2 (1%) physicians who were heads of the department. According to our definition, 99 (75%) had poor, 22 (17%) had fair, and 10 (8%), good knowledge. With regard to the capability for application of isolation precautions, 66 (51%), 33 (25%), and 32 (24%) possessed poor, fair, and good levels, respectively. Association with poor knowledge was exhibited as follows: physicians, OR: 0.17 (0.005-0.54), p = 0.001; undergraduate degree in medicine, OR: 0.37 (0.16-0.83), p = 0.01; seniority < 5 years, OR: 0.35 (0.14-0.86), p = 0.019, and training during previous year, OR: 0.09 (0.03-0.24), p = 0.005, while association with poor capability was the following; physician, OR: 0.25 (0.12-0.55), p = 0.005; undergraduate degree in medicine, OR: 0.38 (0.18-0.80), p = 0.009; seniority < 5 years, OR: 0.90 (0.45-1.81), p = 0.78, and training during previous year, OR: 0.23 (0.10-0.51), p = 0.005.* **Conclusions:** *Being a physician, having an undergraduate degree in medicine, < 5 years working at the hospital, and having received training in the previous year were positively associated with knowledge and application of isolation precautions.* (Gac Med Mex. 2015;151:530-7)

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Introduction

Healthcare-associated infections are those originating in a medical unit; currently, they are increasingly better assessed and monitored due to their severity and the threat they represent to safety, sustainability and productivity of hospitals[1]. In the past few years, multiple surveillance and control strategies for hospital-acquired infections have been developed, which have bee shown to be efficacious and cost-effective in the reduction of infections[2].

Several institutions have undertaken the task of finding an informative means that involves the majority of the population with the least time and personnel possible, since most hospitals have limited human, economical and material resources[3].

Knowledge acquired during continued education, training, updating and other teaching means should be reinforced with relevant evaluation and supervision.

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"Data shadow", sentinel and survey-based studies on what the personnel knows, what attitudes and skills they have, and how they apply them help to detect areas of opportunity or renewal of human and material resources for their optimization[4].

In Mexico, studies have been conducted assessing the levels of knowledge and implementation of standard or universal precaution measures in some healthcare workers[4,5]; however, no studies have been conducted in our country focused on knowledge and implementation of precautions based on transmission mechanisms. Hence, the purpose of our research was to assess the degree of knowledge on isolation precautions and skills for their application by healthcare personnel in a tertiary care pediatric hospital.

Methodology

Study design

Transversal, analytical study conducted at the High-Specialty Medical Unit (UMAE) Pediatrics Hospital of the Centro Médico Nacional de Occidente of the Instituto Mexicano del Seguro Social in Guadalajara, México.

Selection criteria

Healtcare personnel assigned to the hospital of the following categories were included: physician (non-general practicioner), nursing assistant, registered nurse, specialized nurse, head nurse and medical residents of any specialty.

Study development (Table 1)

- A questionnaire was developed to assess the level of knowledge on isolation precautions for the control nosocomial infections.
- This questionnaire was based on international guidelines and on Mexican and institutional regulations, as well as those of the UMAE Pediatrics Hospital[5-10].
- A preliminary assessment was performed, as well as the corresponding reviews and/or corrections; a pilot test was run for its development.
- The questionnaire was applied to healthare workers who met the inclusion criteria.
- The questionnaires were anonymously and randomly administered with a homogeneous distribution between the different working shifts.
- A group of 2nd to 4th year pediatrics residents of different pediatric sub-specialties was randomly selected.
- The academic day and the research seminar of the intern personnel were used to attain the minimally required study population.
- A group of workers of all different categories were randomly selected before the start of their shift (for the evening, night and cumulative shifts) or at the end of their shift (for the morning shift) and were applied the questionnaire in groups of 5 to 10 persons in a selected area.
- The questionnaire was always administered in the presence of previously trained personnel on its application in order to watch that every individual answered on their own and to solve doubts that might arise during the procedure.
- After data collection, a database was filled with the obtained information for further analysis.
- Skills were defined as the capability to use and integrate the knowledge on isolation precautions.

Evaluation instrument

The questionnaire had 35 items divided in three sections; the first section had 10 items related to personal, academic and work-associated data; the second section is divided in two domains, the first domain, with 20 items, intended to assess the knowledge on isolation precautions, and the second domain, with 5 items in form of case reports, intended evaluate the skills for integration and implementation of the individual's knowledge on the subject.

Knowledge was graded according to the result obtained for each domain out of a probable total of 100 points (5 points per item) as adequate (80-100 points), fair (60-79 points) and poor (0-59 points). Skills were assessed according to the score obtained in this domain out of a probable total of 100 points (20 points per item) as adequate (80-100 points), fair (60-79 points) and poor (0-59 points).

Validation of the document

The questionnaire underwent a preliminary assessment by a group of experts in the infectology specialty, as well as 3 pediatric infectology residents and from other specialties (3 epidemiology and 3 pediatrics residents); additionally, 3 individuals were selected from the different nursing categories.

Table 1. Isolation precautions questionnaire

Associate the conditions with the required type of isolation. (Can be repeated)

a. Airborne b. Droplet c. Contact d. Standard e. None f. Don't know

1.	Meningitis due to *S. pneumoniae*	( )
2.	Decompensated diabetes mellitus	( )
3.	Cavitating pulmonary tuberculosis	( )
4.	Rotavirus-associated acute diarrhea	( )
5.	Disseminated herpes zoster	( )
6.	Measles	( )
7.	Pertussis-like syndrome or pertussis	( )
8.	Methicillin-resistant *S. aureus* wound infection	( )
9.	Hepatitis A	( )
10.	Active varicella	( )

Write the correct letter in the color code you consider specific to identify the isolation precaution.

11.	Blue	( )	a) Airborne
12.	Red	( )	b) Droplet
13.	Yellow	( )	c) Contact
14.	Green	( )	d) Standard
15.	Grey	( )	e) None

Correlate the necessary components for each isolation precaution.

a. Airborne b. Droplet c. Contact d. Standard e. None f. Don't know

16.	Person in individual room or grouping of patients with same microorganism. Maintain at least 1-meter separation between patients and visitors. Use mask if you are within a radius of 1 meter from the patient.	( )
17.	Hand hygiene. Use of gloves. Use mask, eye and/or face protectors.	( )
18.	Person in individual room or grouping of patientes with same microorganism. Gloves at all time. Handwashing before and after the use of gloves. Use of gown if personal clothes are to be in contact with the patient or his/her surroundings.	( )
19.	Use personal protection garment ONLY if the patient is diagnosed with infection. Perform HIV/AIDS screening in every patient who is to undergo surgery. Use of gloves between patients with the same disease.	( )
20.	Person in individual room or grouping of patientes with same microorganism. Use negative pressure ventilation (6 to 12 air changes per hour). Inside the patient's room, use airway-protection device (H95 mask). Use of gown within the room.	( )

(Continues)

Methodology

The descriptive analysis of qualitative variables was described using frequencies and percentages. Categorical variables were compared with the chi-square test or Fisher's exact test. Odds ratios (OR) were calculated to determine the weight or impact of certain variables considered to be more important when the information was analyzed. Version 21.0 of the SPSS statistical package for Windows was used. Statistically significant difference was considered with a p-value < 0.05.

Sample size

The sample was calculated with the Epi 6 software and it was estimated for an expected prevalence of 50%, with worst result of 20% and a 99% level of confidence,

Table 1. Isolation precautions questionnaire *(continued)*

The following section presents 5 (five) brief clinical cases, CIRCLE the most important precaution for each case (only one correct answer per case).

CASE 1. 15-month-old infant with 2-day-evolution condition with fever, 4 gastric content vomiting events in 24 h**, diarrhea with mucus, blood and pus, 12 stools in 24 hours**. On PE: 7.900 kg weight, 73 cm length, HR of 160 x', RR 48 x', hyperpneic, marble skin, limb hypothermia, capillary refilling of 6 seconds.
Type of recommended precaution:

a) Standard b) Contact c) Droplet d) Airborne e) None f) Don't know

Case 2. 3-year-old pre-school child with manifestations of asthenia, adynamia, 38.5 ºC fever, **vomiting, choluria and acholia of 5-day-evolution**. On PE: 12 kg weight. 91 cm height, HR 120 x', RR 30 x', 39 ºC temperature, **jaundice coloration** is observed, irritable, with periods of somnolence, liver edge at 3-3-2 cm, increased osteotendinous reflexes, has a stool with melena.
Type of recommended precaution:

a) Standard b) Contact c) Droplet d) Airborne e) None f) Don't know

Case 3. Male 8-year-old schoolchild, with a 5-day history of **vesicle-type disseminated rash with some lesions in the scaly phase**, 38.3 ºC **fever** since 3 days ago and since last 24 h he has general condition deterioration, somnolence. On PE he has HR 140 x', RR 45 x', BP 90/40, capollary refilling of 3 seconds, lesions at different stages, a **swollen zone** is observed at the **elbow dorsum**, with limited and painful mobility, negative meningeal signs.
Type of recommended precaution:

a) Standard b) Contact c) Droplet d) Airborne e) None f) Don't know

Case 4. Male 9-month-old infant with prior history of upper respiratory infection 10 days ago, treated with oral ampicillin and acetaminophen. Since 2 days ago he has been **irritable and with fever**, cough and vomiting 4-5 times per day, with generalized tonic-clonic convulsions added within the last 24 h. He has a 4-year-old healthy sibling. On PE: 9 kg weight, 72 cm height, head circumference of 46 cm, HR 120 x', RR 18 x', Glasgow of 10, **uncertain meningeal signs**. Chest without exudative phenomena, protuberant abdomen with decreased peristalsis, some zones with ecchymosis, absent osteotendinous movements and reflexes on left side of body.
CSF study with 10 mg/dl glycorrhachia, gycemia of 60, pleocytosis of 850 with 90% polymorphonuclear and 10% mononuclear cells, protein 200 mg/dl, **Gram staining with Gram-positive cocci, *S. pneumoniae*-positive coagglutination in CSF.**
Type of recommended precaution:

a) Standard b) Contact c) Droplet d) Airborne e) None f) Don't know

Case 5. Female 12-year-old patient diagnosed with **type-1 diabetes mellitus** attending the emergency department due to headache and mild abdominal pain with 1-day-evolution; she denies vomiting, nausea and diarrhea; she denies cough or dyspnea. PE with 38 kg weight, 140 cm height, HR 110 x', RR 28 x', Glasgow 15, semi-moist oral mucose, only slight pain on epigastrium with intermediate depth palpation. Capillary refill 2 seconds. No infectious focus was identified. Capillary glycemia of 300. She was admitted for surveillance and central glycemia determination, hydration and glycemic control.
Type of recommended precaution:

a) Standard b) Contact c) Droplet d) Airborne e) None f) Don't know

based on results of previous publications[5,11-13]. A minimal sample of 80 individuals was obtained for statistical significance, out of which, through a cluster sampling, 26 non-GP physicians, 29 nurses and 25 residents were selected according to the population distribution and categories.

Ethical considerations

According to the general statute of health the study was considered free of risk; however, informed consent was requested to apply the questionnaires. The proposed procedures are in agreement with ethical standards, with the General Statute of Health Regulations for health research and with the Declaration of Helsinki of 1975, as well as with current Good Research Practice international standards. The work was approved by the hospital local research committee with registration number R-2012-1302-46.

Results

One hundred and thirty-five surveys were administered in different departments of the medical unit. Population characteristics are described in table 2. Predominance of the male gender was obseved, 2 to 1,

Table 2. Profile of work-associated characteristics of the personnel studied for knowledge and skills on precaution measures

Characteristics	Study population No. (%)
Gender	
Male	89 (68)
Female	42 (32)
Age in years, median (range)	33(20-57)
Work experience in years, median (range)	6 (1-35)
Seniority in years, median (range)	3 (0-27)
Personnel category	
Medical	83 (63)
Nursing	48 (37)
Academic degree	
Technician	18 (14)
College degree	50 (38)
Specialty	59 (45)
Post-degree	4 (3)
Working shift	
Mobile	53 (40)
Morning	38 (29)
Evening	23 (18)
Night	17 (13)
Personnel with training on prevention measures	46 (36)

No.: number; %: percentage. Total: 131

Table 3. Healthcare personnel results on the assessment of knowledge on and skills for isolation precautions application

Characteristics	Knowledge No. (%)	Skills No. (%)
Poor, 0-59 correct answers	99 (75)	66 (51)
Fair, 60-79 correct answers	22 (17)	33 (25)
Adequate, 80-100 correct answers	10 (8)	32 (24)

No.: number; %: percentage. Total: 131

young adults with enough working experience as to have knowledge on the subject; medical area population was predominant, with specialty, and variable shifts.

Table 3 presents broadly the degree of knowledge and general skills for isolation precautions application. Most part of the sample showed poor knowledge and skills.

With regard to work category, nursing personnel had the lowest level and the medical staff the highest level of knowledge on the subject. As to education level, the best assessments were for personnel with college degree and specialty, with the lowest for technical level and post-degree. Most personnel with no training within the previous year showed poor knowledge. This is shown in table 4.

Table 5 shows the assessment values in the area of skills for precautions implementation. We observed the highest skills to be found in the medical personnel, staff physicians and interns, and in a lower proportion, nursing personnel, especially nursing asistants. Education level showed higher levels in the post-degree and college degree categories. Most part of the personnel with poor level had not taken the course recently.

Table 6 shows the degree of association of some values with less knowledge on isolation precautions. We observed a significant association with belonging to the medical staff (OR: 0.17, 0.005-0.54), seniority lower than 5 years (OR: 0.35, 0.14-0.86) and training within the previous year on nosocomial infection prevention measures (OR: 0.09, 0.03-0.24).

These same association levels are shown for skills in table 7, where association of poor skills is observed with medical staff (OR: 0.25, 0.12-0.55), seniority of less than 5 years (OR: 0.90, 0.45-1.81) and training within the year prior to the study on precaution measures (OR: 0.23, 0.10-0.51).

Discussion

Given that nosocomial infections are a public health and safety problem in hospitals, the NOM-045-SSA2-2005 standard establishes that the hospital unit shall inforce specific actions for nosocomial infections prevention and control, through training programs for the personnel and the user population[14]. These actions include precaution measures, which are intended to prevent and/or interrupt the pathogenic microorganisms' transmission chain.

During the monthly rotation through the Infectology Department, second-year pediatrics and epidemiology residents review the subject of nosocomial infection and all different precautions, through bibliographic sessions and workshops on case reports; in addition, there is the policy to write down in the emergency and admission departments indications the type of precaution required for each patient, as well as to place the corresponding color card on the bed headbord by

Table 4. Degree of knowledge on precautions according to working category, education level and history of training

Level of knowledge	Poor No. (%)	Fair No. (%)	Adequate No. (%)	Total
Category				
Non-GP physician	29 (85)	3 (9)	2 (6)	34
Nursing assistant	11 (100)	0	0	11
Registered nurse	14 (100)	0	0	14
Specialist nurse	11 (85)	2 (15)	0	13
Head nurse	8 (80)	2 (20)	0	10
Medical resident	24 (51)	15 (32)	8 (17)	47
Other	2 (100)	0	0	2
Education level				
Technical career	18 (100)	0	0	18
College degree	32 (64)	13 (26)	5 (10)	50
Specialty	26 (70)	8 (22)	3 (8)	37
Sub-specialty	19 (86)	1 (5)	2 (9)	22
Masters degree	3 (100)	0	0	3
PhD	1 (100)	0	0	1
Training within previous year				
Yes	22 (48)	15 (33)	9 (19)	46
No	77 (91)	7 (8)	1 (1)	85

No.: number: %: percentage.

Table 5. Frequency of results by category, education, history of training and scores in the area of skills for precautions implementation

Level of knowledge	Poor No. (%)	Fair No. (%)	Adequate No. (%)	Total
Category				
Non-GP physician	17 (50)	9 (27)	8 (23)	34
Nursing assistant	9 (82)	1 (9)	1 (9)	11
Registered nurse	10 (71)	3 (22)	1 (7)	14
Specialist nurse	10 (77)	3 (23)	0	13
Head nurse	5 (50)	4 (40)	1 (10)	10
Medical resident	14 (30)	12 (25)	21 (45)	47
Other	1 (50)	1 (50)	0	2
Education level				
Technical career	13 (72)	4 (22)	1 (6)	18
College degree	18 (36)	13 (26)	19 (38)	50
Specialty	21 (57)	11 (30)	5 (13)	37
Sub-specialty	12 (54)	5 (23)	5 (23)	22
Post-degree	2 (67)	0	2(66)	4
Training within previous year				
Yes	13 (28)	13 (28)	20 (44)	46
No	53 (62)	20 (24)	12 (14)	85

No.: number: %: percentage.

the nursing personnel, as with the fall risk. Consequently, the pediatrics medical trainees clearly obtained better results than the rest of the personnel, perhaps owing to more recent participation on training areas.

A low percentage of knowledge on isolation precautions was reported in the studied population, since only a fourth part had knowledge between fair and adequate, with the rest of the studied sample (76%) obtaining a

Table 6. Factors associated with less knowledge (poor knowledge) on isolation precautions by category, work seniority and training history

Variable	OR (95% CI)	p
Category		
Medical personnel (NGP)	0.17 (0.05-0.54)	0.001*
Resident	0.12 (0.05-0.30)	< 0.005*
Nursing (combined categories)	5.6 (1.82-17.16)	0.001*
Education		
College degree	0.37 (0.16-0.83)	0.01*
Specialty	0.62 (0.21-1.79)	0.37
Sub-specialty	1.62 (0.55-4.62)	0.37
Seniority in pediatrics hospital		
Less than 5 years	0.35 (0.14-0.86)	0.019*
5 years or more	2.82 (1.15-6.88)	0.019*
Training within previous year		
Yes	0.09 (0.03-0.24)	< 0.005*
No	10.5 (4.14-26.6)	< 0.005*

OR: odds ratio; 95% CI: 95% confidence interval; NGP: non-general practicioner.
*Significant.

Table 7. Factors associated with less skills (poor skills) for isolation precautions implementation by category, work seniority and history of training

Variable	OR (95% CI)	p
Category		
Medical personnel (NGP)	0.25 (0.12-0.55)	< 0.005*
Resident	0.37 (0.16-0.83)	0.014*
Nursing (combined categories)	3.87 (1.80-8.30)	< 0.005*
Education		
College degree	0.38 (0.18-0.80)	0.009*
Specialty	0.78 (0.32-1.89)	0.59
Sub-specialty	1.26 (0.52-3.04)	0.59
Seniority in pediatrics hospital		
Less than 5 years	0.90 (0.45-1.81)	0.78
5 years or more	1.1 (0.56-2.2)	0.78
Training within previous year		
Yes	0.23 (0.10-0.51)	< 0.005*
No	4.2 (1.93-9.14)	< 0.005*

OR: odds ratio; 95% CI: 95% confidence interval; NGP: non-general practicioner.
*Significant.

score lower than 60 points. This information differs from results at the national[4,5] and international[11,13,15,16] levels, since from 60[11] to 75%[5] of good knowledge is documented in their studied samples. This difference can be explained because the referred publications declare that the way to survey their populations is personally and anonymously and, therefore, truthfulness of the obtained information cannot be warranted, which is a situation that differs in the present work, since at all time we verified that the participants would not receive some type of information or support from other people.

Association was found of the medical resident category with better skills for isolation precautions implementation; conversely, in the nursing category, the poorest result was obtained when the type of precaution required for each case was identified. This information reveals that it is important for the institution to have not only regulations and information with regard

to isolation precautions available, but the way should be sought for this information to reach all personal involved with patient care, as well as for measures to ensure the implementation of the acquired knowledge to be enforced.

Some limitations in the present work should be taken into account: the assessment instrument was approved only by a group of experts on the subject and was administered to a pilot group where some modifications were made for better clarity in the evaluation; the instrument was agreed by a group of experts on the subject, but it was not validated, and even when a statistically significant sample was calculated, the obtained results may not reflect the current reality of the assessed institution.

The obtained information offers a general view on the situation of the level of knowledge on isolation precautions and suggests which areas of opportunity should be priorized to improve patient care, as well as to reduce the frequency of healthcare-associated infections.

Conclusions

- The level of knowledge on and skills for isolation precautions implementation by healthcare personnel of the unit was low.
- The medical staff, particularly pediatrics residents, showed better knowledge, as well better skills. In contrast, a poorer result was documented in the nursing personnel.
- Being a physician, having a college degree, seniority lower than five years and having received training within the previous year were positively associated with knowledge on precautions and their implementation.
- Other educational intervention strategies should be assessed, by means of workshops on precautions for healthcare personnel, with pre- and post-evaluation; shadow data studies on implementation and adequate observance of precautions should be conducted, an allow for the results to be directly assessed personnel and patients.

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Conflicts of interest

There are no conflicts of interest.

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