

Natural Rubber Latex: A Matter of Concern for Nurses

ING-MARIE BUNDESEN, MSc, RN, RNT, CNOR

During the past 20 years, glove use in health care settings has become indispensable for protecting patients from health care-acquired infections and protecting staff members from infectious agents and chemicals.¹ The gloves used in health care are made from a variety of materials, including natural rubber latex (NRL), synthetic rubber of various types, and plastic.²

Natural rubber latex is a product extracted from the *Hevea brasiliensis* tree. In its original form, it is a milky white liquid that is 60% water and 35% rubber; the remaining 5% consists of various organic substances.³ About 250 different proteins are found in NRL. Accelerators, antioxidants, emulsifiers, dyes, and stiffeners are added during the manufacturing process. Most chemicals are destroyed during this process, but a few remain and can cause dermatological problems. Gloves manufactured of NRL provide better barrier protection for health care workers and have properties such as better strength and increased flexibility and elasticity, and, therefore, they are more commonly used than gloves made of other materials.^{2,4,5}

From 1988 to 1992, health care workers in the United States used approximately 11.8 billion pairs of nonsterile examination gloves and 1.8 billion pairs of sterile surgical gloves made of NRL. From 1998 to 1999, 18 million pairs of nonsterile examination gloves were used annually by health care facilities in the Stockholm County Council. During the same period, 1 million pairs of sterile surgical gloves made of NRL were used.⁶ The use of protective gloves increased following the HIV outbreak in

the 1980s. Guidelines implemented in the United States in 1987 resulted in an estimated 20-fold increase in glove use in health care settings up to and including the year 2004.³

The first reported allergic reaction to NRL occurred in Germany in 1927 when a woman developed general urticaria after being exposed to dental materials made of NRL.⁷ As the use of NRL gloves has increased worldwide, the number of people who have developed allergies to NRL also has increased. During glove use, latex protein can be spread in the air via the cornstarch powder used in NRL products. Powder is used in gloves to counteract the sticky surface that would otherwise be present.²

Because the number of people with latex allergy is growing around the world, it is important for medical personnel who work in areas in which NRL products are used to know what

ABSTRACT

DURING THE PAST 20 YEARS, the use of protective gloves in health care has increased, as have hypersensitivity reactions to the natural rubber latex (NRL) used in glove manufacture.

A STUDY WAS CONDUCTED to determine what nurses who work in environments in which NRL is commonly used know about NRL, including their education about and experience with NRL-related allergies.

NURSES REPLIED TO A QUESTIONNAIRE with 20 statements pertaining to NRL and NRL-related allergies. The results showed that the nurses had inadequate knowledge about NRL, but nurses in a specialty training program scored significantly higher than professionally active nurses. *AORN J* 88 (August 2008) 197-210. © AORN, Inc, 2008.

is involved with NRL allergy, which risk factors are associated with the allergy, and what preventive measures health care workers can practice.

BACKGROUND

In 2001, the World Health Organization (WHO) adopted the Health 21—Health for All policy framework to promote and maintain health for all people throughout their lives.⁸ The policy's purpose was to reduce the incidence of the most commonly occurring diseases and personal injuries and to alleviate the suffering they cause. The eighth target aims to reduce noncommunicable and chronic diseases, including allergies. The 10th target provides guidelines to ensure a healthy and safe physical environment.⁸

In the "Public Health Objective Bill—2002/03:35," the Swedish Ministry of Health and Social Affairs specifies 11 public health objectives.⁹ Objective 5 refers to environments and products with regard to allergies.⁹ The incidence of allergy problems in Sweden has doubled during the past 30 years. A total of 2.7 million Swedes believe they have allergies, which means that 40% of the population between the ages of 16 and 84 years is affected.¹⁰ Many factors are involved in this increase in allergy problems, and environmental factors are specified as a large element. In adult life, these factors can mainly be found in the work environment. The Swedish National Institute of Public Health works with preventive environmental initiatives at both the local and regional levels.⁹⁻¹¹

In the developed world, allergies are common and the incidence continues to rise.¹² The interplay between heredity and environment is of significance in relation to the prevalence of allergies. People in developing countries are afflicted by allergies to a greater extent as their lifestyles increasingly resemble those of people in the developed world.¹⁰⁻¹²

ALLERGY TYPES. The word allergy comes from the two Greek words: *allos*, which means different or changed, and *ergos*, which means work or activity.^{13(p21)} Hypersensitivity refers to a reaction to stimuli that usually are tolerated by healthy individuals. Hypersensitivity may be

nonallergic or allergic (ie, of immunologic origin). According to classic nomenclature, allergic reactions are divided into types I to IV.¹⁴

Type I, immediate hypersensitivity, is a serious form of allergy that also is referred to as atopic allergy. Onset is rapid, from several minutes to several hours. A foreign substance, or antigen, that causes an immunologic allergic reaction is called an allergen. When organisms are exposed to an allergen, antibodies known as immunoglobulin E (IgE) are formed. This occurs at the first exposure to the allergen.

An increased tendency to form antibodies is called atopy.¹⁴ The IgE molecule, when combined with the allergen, affects the mast cells in connective tissue and the basophil cells in the bloodstream that release chemical mediators, such as histamines. These mediators affect the organism through constriction of smooth musculature, vasodilation, increased vascular permeability, and increased mucous production. Type I allergies may affect the skin, airways, gastrointestinal tract, and central nervous system and present a risk of anaphylaxis.¹⁵

Types II and III, which are immediate hypersensitivity reactions, are not relevant to exposure to NRL products. A type II reaction can occur with incompatible blood transfusions. A type III reaction can be seen in autoimmune medical conditions such as rheumatoid arthritis.

A type IV reaction is a delayed hypersensitivity reaction, which does not occur until 12 to 48 hours after exposure and causes allergic contact dermatitis. This reaction occurs after exposure to nickel, chromium, rubber chemicals, perfumes, and preservatives. The reaction involves various cells, such as T-cells, but does not affect antibody formation to any significant extent. In glove use, chemical residues typically trigger this form of reaction, and it is therefore the same for all different glove materials. Both type I and type IV reactions are preceded by an earlier exposure to the substance to which the body reacts (Figure 1).^{2,3,15}

Allergic reactions that occur during contact with NRL products are either type I reactions triggered by the proteins found in NRL or type IV reactions triggered by the chemicals that remain after production. Severity of reactions varies in different individuals.^{2,3,6} Between 1988

and 1992, more than 1,000 cases of type I reaction to NRL were reported to the US Food and Drug Administration (FDA); 15 of these cases were lethal.¹⁶ In 1997, 1,200 cases of type I reaction and 13 deaths were reported.¹⁷ Studies show that the incidence of allergy to NRL in the general population varies between 0.8% and 6.5%.^{2,16} Prevalence among health care workers ranges from 3% to 17%.^{3,11,17}

Of the approximately 250 different proteins found in NRL, 57 are allergenic, and 11 of these have been mapped. Natural rubber latex is used in a number of different applications, including protective gloves, catheters, dental materials, condoms, balloons, toys, and pacifiers. When using gloves, the most common reaction is nonallergic contact dermatitis. This reaction can be difficult to distinguish from a type IV reaction because the dermatologic manifestations are similar. A type IV allergic reaction manifests as pruritus, erythema, papules, vesicles, and scaling and is limited to the area of the skin that was exposed to chemicals.

The most serious reaction seen in contact with NRL is a type I reaction, which usually occurs when the mucous membranes, airways, or bloodstream are directly exposed to NRL. The effect is seen as pruritus, erythema, urticaria, rhinitis, conjunctivitis, asthmatic reactions, and anaphylactic shock. In health care, such contact may occur in conjunction with a number of different examinations, treatments, and surgical procedures or during dental treatments. Sensitive people also react to the airborne allergens from NRL that come from powdered gloves.^{2,3,6}

The risk of developing allergies to NRL is greater in people

- with a history of atopy,¹⁸

- who have concurrent allergy to certain fruits and *Ficus benjamina* trees,¹⁹⁻²¹
- with congenital spina bifida and related diseases,^{22,23}
- who are exposed to repeated procedures or urogenital diseases,^{24,25} and
- who are exposed to NRL through occupational uses.²⁶⁻²⁹

In health care settings, measures have been taken to reduce the incidence of latex allergens and glove-related hypersensitivity problems. The Stockholm County Council's purchasers strive to purchase powder-free gloves with low levels of latex allergens and chemical residues.^{30,31}

Nurses need basic knowledge of NRL allergies in order to offer a safe care environment

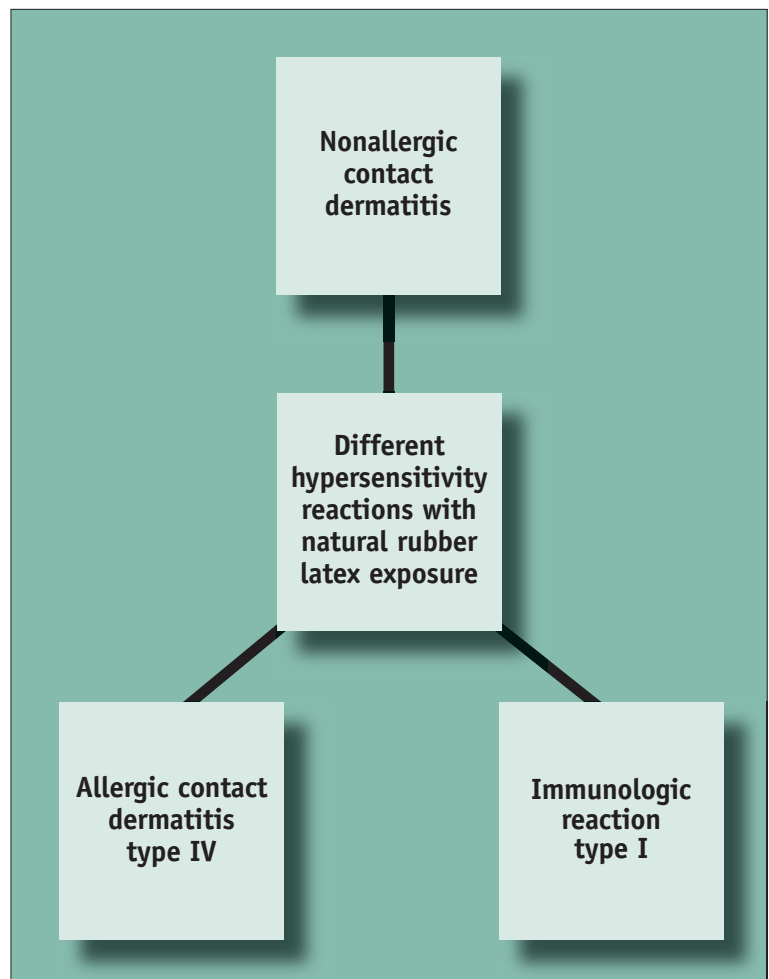


Figure 1 • Reactions caused by exposure to natural rubber latex products.

for patients and colleagues. A study conducted with 89 nurses who worked in environments in which NRL is frequently used found that both education and experience were significantly correlated with knowledge of NRL allergies. Those nurses who had completed training programs or who had cared for patients with allergies demonstrated more knowledge than those who had not. The study found that nurses who were allergic to NRL had less knowledge, although the finding was not significant. The results showed a lack of knowledge about caring for people with NRL allergy that could result in a patient's anaphylaxis and death.³²

Another study showed that nurses who worked in a setting that had an established latex allergy protocol scored better on an NRL knowledge questionnaire than those working in a setting that did not have a protocol, and perioperative nurses with CNOR certification had better knowledge scores than nurses who were not CNOR certified. In a second phase of the same study, a group of perioperative nurses had better scores and less variance in scores on a post-test compared to a pretest after they participated in a continuing education program about NRL allergy.³³

KNOWLEDGE. Knowledge is a word with many different definitions.³⁴ In the traditional sense, it may be equated to words such as *awareness*, *acquaintance*, or *familiarity*. Other definitions include "insight, proficiency, learning, and knowing."^{13(p229)} Contemporary educators often use Aristotle's logic as a basic premise to describe and explain the concept of knowledge. They have interpreted the three virtues—*episteme*, *techne*, and *fronesis*—described by Aristotle in the fourth century BC.^{34,35} *Episteme* can be interpreted as theoretical-scientific knowledge, a knowledge that can be learned but that can also be forgotten: to know. *Techne*, which was interpreted as practical and productive knowledge, is linked to having skills and the ability to accomplish something practical: to be able to. In interpersonal contacts, knowledge must be used correctly. The third form, *fronesis* or practical wisdom, is based on ethical actions and refers to good judgment and wisdom. To act wisely when dealing with others requires experience and judgment. Judgment and the

ability to assess are developed over time as a reflection on practice. The three forms are therefore interactive rather than mutually exclusive.^{34,35}

Nursing professor and author Patricia Benner, RN, PhD, FAAN, FRCN, carried out qualitative studies on which she based her theory describing the development of nurses' knowledge from novice to expert. The process is not linked to age or years in the profession; that type of experience does not automatically lead to learning. It is when knowledge is integrated with reflection that it leads to learning and personal development.³⁶ Because nurses must develop expertise, their education should include basic knowledge of hypersensitivity reactions and knowledge of NRL. In practical nursing care, knowledge develops through reflection on actions and through continuing education. This is essential to provide a safe care environment for both patients and health care workers.

METHOD

The aim of this study was to document knowledge about NRL in nurses who work in environments in which NRL is prevalent. The investigator also surveyed the nurses about the education they had received related to NRL and their own experience with allergies.

SETTING AND SAMPLE. All 130 nurses on three wards within an intensive care and emergency department at a hospital in southern Sweden were asked to participate in the study. Inclusion criteria were employment as a nurse in the involved department with a focus on emergency medical services, anesthesiology, intensive care, or surgery. The group included nurses with and without specialist training. The professionally active nurses had graduated from nursing programs between 1966 and 2005. In the pilot study, included within this study, 36 nurses who were in specialist training programs to become emergency department nurses were asked to participate. The nurses undergoing a specialist training program had completed their nursing education between 1991 and 2005 (Figure 2).

DATA COLLECTION. This is a replication study of a study carried out in 1998 in the United States.³³ For the current study, the investigator used a

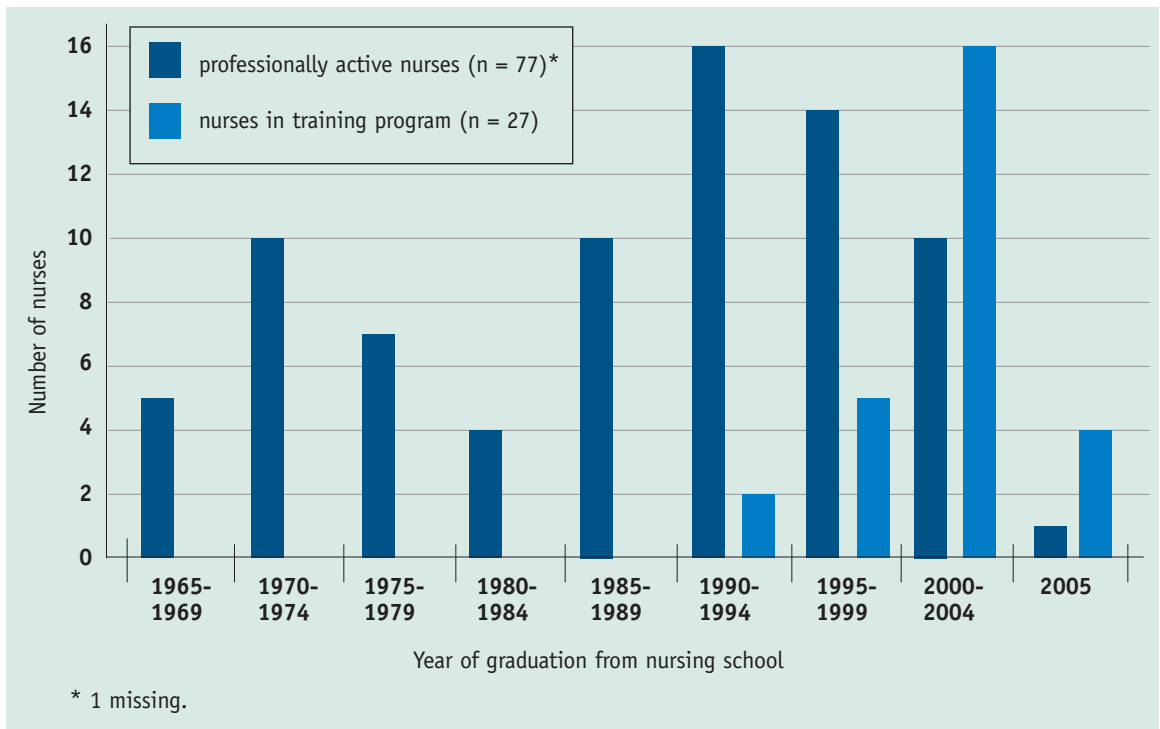


Figure 2 • Year survey participants graduated from nursing school.

survey design with an e-mailed questionnaire. The questionnaire contained 20 statements about NRL and several background questions to assess nurses' knowledge of allergy to NRL. Permission to use the questionnaire was obtained from AORN, which owns the copyright.

The questionnaire was tested for validity and reliability in the original study. The original questionnaire was designed based on a literature review of the topic. Ten experienced nurses were asked to participate in the pilot test to complete a 40-item questionnaire about latex allergy reactions and recommended precautions. Next, three national experts in latex allergy ranked the statements based on relevance, after which they were compared with the literature. Some items were revised or deleted.

In the first phase of the original study, the questionnaire was completed by 158 perioperative nurses. In the next phase, 72 perioperative nurses completed the questionnaire before and after a two-hour NRL training program. The pretest reliability (ie, Cronbach's alpha) was 0.57 and the post-test reliability was 0.80.³³

For the current study, the instrument had to

be translated into Swedish in order to be used in Sweden. The translation was done by a native English speaker living in Sweden and working as an assistant in the hospital's accident and emergency department. A bilingual person whose native language was English then reviewed the translation and performed a back-translation from Swedish to English to check on the accuracy of the translation. A nurse who works with NRL products in Sweden reviewed the factual content as well as the language both before and after the translation.

A pilot study to test the Swedish version of the instrument was carried out during 2005. The pilot test of the Swedish version proved satisfactory and no further modifications were made to the questionnaire. Nurses in specialist training programs in emergency care with a focus on prehospital emergency care, anesthesiology, intensive care, or surgery participated. Licensed nurses take part in a one year university training program to prepare them for practice in a new specialty area. The training program curriculum includes education about NRL.

The local ethical review group at the School

of Social and Health Sciences, Halmstad University, Halmstad, Sweden, reviewed the research design of the study. The clinical administrator of the involved department and the ward administrators gave their permission to carry out the survey. Participation in the study was voluntary and responses were anonymous.

The questionnaire was distributed by e-mail to the nurses in the workplace, and oral and written information was provided on the wards. Several questionnaires also were available on the wards. The nurses were encouraged to participate at workplace meetings and through contact persons on the wards who were specially selected for the study.

DATA PROCESSING. The questionnaire was processed according to the instructions described in the original article, meaning that the four-point scale collapsed into an incorrect or correct measure, where a higher score represents more knowledge.³³ The Statistical Package for the Social Sciences (SPSS), version 9, was used during processing.³⁷ The assessment scale with the four alternatives: "agree completely," "agree partially," "disagree partially," and "disagree completely" was converted to numerical values from 1 to 4.³³ Table 1 presents the 20 statements with the rating scale.

The next step involved recoding the eight false statements. The higher the numerical value of the statement, the more correct the response. The 4s and 3s were changed to 1s, and the 2s and 1s were changed to zeros. The internal non-response rate was treated as a zero. This process followed the protocol of the original study.

The highest score that the instrument could yield was 20 points.³³ Descriptive statistics with frequency, average, median, percent, and standard deviation were calculated for all 20 statements in both the group in the training program ($n = 27$) and the professionally active nurse group ($n = 78$) and for the two groups combined ($N = 105$). Kruskal-Wallis tests were used to test for differences in mean scores between the two groups.³⁷

RESULTS

Of the 130 professionally active nurses, 78 completed the questionnaire (60%). These nurses worked on three different wards in the

department. The group included nurses with and without specialist training. To be able to compare the results of nurses undergoing education in NRL with a group of nurses with a different educational background, the pilot study data were included with this study's results. The pilot group of 36 nurses who were in specialist training programs to become emergency room nurses were asked to participate, and 27 of these nurses completed the questionnaire (75%). Previous educational experience about NRL allergy among the respondents varied (Table 2). The questionnaire asked about their personal and family history of allergies. The nurses in the training program also were asked whether they had previous experience of caring for patients with allergies to NRL (Table 3).

The results of the 20 statements in the questionnaire showed a combined average of 12.88 for the two groups ($N = 105$). The results for the professionally active nurses ($n = 78$) averaged 11.99. The nurses in the training program ($n = 27$) achieved an average of 15.44 (Table 4, Figures 3 and 4). The Cronbach's alpha reliability estimate for this use of the instrument was 0.53. This represents moderate reliability.

The results showed that the statements for which all respondents ($N = 105$) showed the most knowledge and in which the correct alternative was chosen by more than 75% of respondents were statements 7, 10, 12, 17, 19, and 20. The incorrect statements are marked with an asterisk:

- Serious reactions have been reported in connection with inhalation of latex protein (83.8%).
- The ideal in health care is gloves that are powder-free, and with a low level of latex protein (80%).
- People at increased risk of allergic reaction to NRL include those with cardiac disease* (79%).
- Symptoms of allergy to NRL may include shortness of breath (81%).
- Planned surgery on patients with known allergy to NRL must be carried out first thing in the morning (85.7%).
- Natural rubber latex surgical gloves must

TABLE 1
Natural Rubber Latex Questionnaire

	Disagree completely	Disagree partially	Agree partially	Agree completely
1. Skin testing with allergen extract is the most sensitive indicator for demonstrating allergies to natural rubber latex.	1	2	3	4
2. Natural rubber latex products that are "dipped" during production, such as gloves, condoms, and catheters, have a higher latex protein content than those products that are "molded," such as syringes, etc.	1	2	3	4
3. Type IV reactions to latex are T-cell mediated and are localized to the exposure site.	1	2	3	4
4. Even though they are unpleasant, natural rubber latex reactions that are IgE mediated (type I) are not life-threatening.*	1	2	3	4
5. Redness and swelling of the hands after taking off gloves indicates an allergy to natural rubber latex.*	1	2	3	4
6. Using powder-free gloves results in a low or negligible level of latex protein in the air.	1	2	3	4
7. Serious reactions have been reported in connection with inhalation of latex protein.	1	2	3	4
8. People who are allergic to fruit (eg, bananas) should avoid contact with natural rubber latex.	1	2	3	4
9. Synthetic rubber poses a great danger for latex-sensitive individuals.*	1	2	3	4
10. The ideal in health care is gloves that are powder-free, and with a low level of latex protein.	1	2	3	4
11. People at increased risk of allergic reaction to natural rubber latex include those with myelomeningoceles.	1	2	3	4
12. People at increased risk of allergic reaction to natural rubber latex include those with cardiac disease.*	1	2	3	4
13. People at increased risk of allergic reaction to natural rubber latex are those with congenital birth defects within the urogenital tract.	1	2	3	4
14. People with increased risk of allergic reactions to natural rubber latex are those who are exposed to synthetic latex paints.*	1	2	3	4
15. People at increased risk of allergic reaction to natural rubber latex include those with rheumatoid arthritis.*	1	2	3	4
16. All patients should be tested for allergy to natural rubber latex prior to any surgical procedure.*	1	2	3	4
17. Symptoms of allergy to natural rubber latex may include shortness of breath.	1	2	3	4
18. Symptoms of allergy to natural rubber latex may include heartburn.*	1	2	3	4
19. Planned surgery on patients with known allergy to natural rubber latex must be carried out first thing in the morning.	1	2	3	4
20. Natural rubber latex surgical gloves must be removed from the operating room or placed in a tightly sealed box before bringing patients with known allergies to natural rubber latex into the room.	1	2	3	4

* = indicates reverse coding

Adapted from Kleinbeck SVM, English NL, Sherley MA, Howes J. A criterion-referenced measure of latex allergy knowledge. AORN J. 1998;68(3):388 with permission from AORN, Inc, Denver, CO. Translation provided by Lesley Marshall, assistant, Accident and Emergency Department, Halmstad County Hospital, Halmstad, Sweden. AORN assumes no responsibility for translation accuracy or content of the Swedish version.

TABLE 2
Educational Experience on the Subject of
Natural Rubber Latex and Allergy

	All nurses (N = 105)	Professionally active nurses (n = 78)	Nurses in training program (n = 27)
Education during nursing school	10 (9.5%)	7 (9%)	3 (11.1%)
Education during specialist training	47 (44.8%)	20 (25.6%)	27 (100%)
Education on the job	26 (24.8%)	23 (29.5%)	3 (11.1%)

TABLE 3
Experience of Allergy Problems

	All nurses (N = 105)	Professionally active nurses (n = 78)	Nurses in training program (n = 27)
Personal history of allergy	37 (35.2%)	27 (34.6%)	10 (37%)
Family history of allergy	54 (51.4%)	37 (47.4%)	17 (63%)
Have cared for a patient with an allergy to natural rubber latex	58 (55.2%)	55 (70.5%)	3 (11.1%)

TABLE 4
Comparison of Knowledge Scores*

	All nurses (N = 105)	Professionally active nurses (n = 78)	Nurses in training program (n = 27)	H
Knowledge score minimum	0	0	12	
Knowledge score maximum	19	19	18	
Mean	12.88	11.99	15.44	18.79**
Median	14	13	16	
Standard deviation	4.134	4.341	1.826	

* Maximum 20 points
** Kruskal-Wallis test, df = 1, P < .001

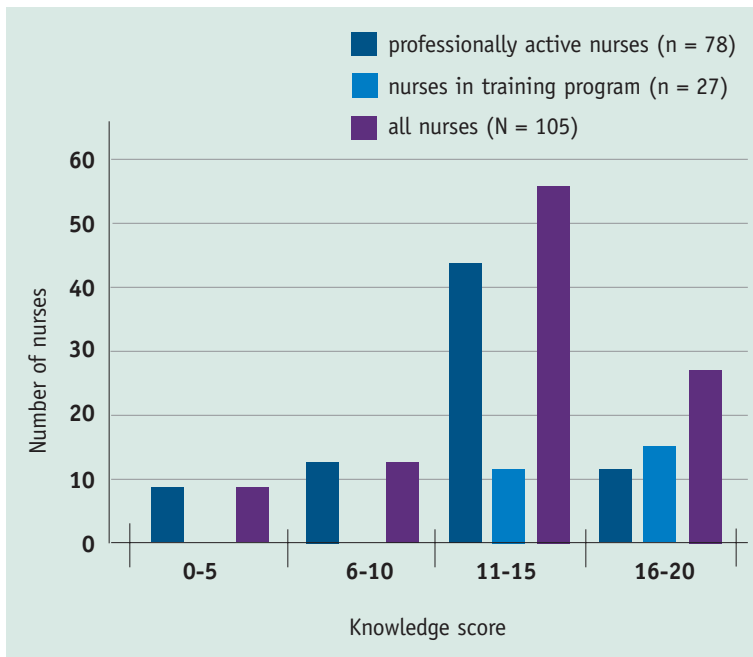


Figure 3 • Knowledge score distributed by group.

be removed from the OR or placed in a tightly sealed box before bringing patients with known allergies to NRL into the room (87.6%).

The statement for which all respondents (N = 105) showed the least knowledge and where the correct alternative was chosen by less than 25% of respondents was statement 5.

- Redness and swelling of the hands after taking off gloves indicates an allergy to natural rubber latex* (21%).

The group of professionally active nurses (n = 78) were most knowledgeable about statements 7, 10, 12, 19, and 20; in other words, more than 75% responded correctly. The statement about which they showed the least knowledge was statement 5 (ie, less than 25% responded correctly). The respondents from the training program had the most knowledge about statements 1, 4, 7, 8, 9, 11, 12, 13, 17, 18, 19, 20; in other words, more than 75% responded correctly to these statements. The statement about which they showed the least knowledge was statement 5 (ie, less than 25% responded correctly).

A comparison of mean knowledge scores between the two groups demonstrated significant

differences for statements 4, 8, 9, 11, 13, 17, and 19 ($P < .01$) (Table 5). In these statements, nurses who had completed training programs achieved significantly better results.

- Even though they are unpleasant, NRL reactions that are IgE mediated (type I) are not life-threatening.*
- People who are allergic to fruit (eg, bananas) should avoid contact with NRL.
- Synthetic rubber poses a great danger for latex-sensitive individuals.*
- People at increased risk of allergic reaction to NRL include those with myelomeningoceles.
- People at increased risk of allergic reaction to NRL are those with congenital birth

defects within the urogenital tract.

- Symptoms of allergy to NRL may include shortness of breath.
- Planned surgery on patients with known allergy to NRL must be carried out first thing in the morning.

DISCUSSION OF RESULTS

The results show that the professionally active nurses had little knowledge of NRL, NRL allergy, or its associated risk factors. According to the earlier study, a score of more than 17 is recommended to indicate that nurses have an acceptable level of knowledge to care for a patient with an NRL allergy.³³ This score was determined when the questionnaire was used as an assessment after a two-hour training course. In the current study, the combined average for the two groups was 12.88. The professionally active nurses' average was 11.99, which must be considered low. The score for the nurses in training was 15.44, which does not reach the recommended level that is considered acceptable but is significantly better than the knowledge of the professionally active nurses ($H = 18.79$, $P < .001$).

Lewis et al described how nurses who have

experience in caring for patients who are allergic to NRL and those who have training in the field demonstrate the most knowledge about this subject.³² Among the 27 nurses in the training program, only three had cared for patients who were allergic to NRL, but all had completed education programs on NRL, most on more than one occasion. The professionally active nurses ($n = 78$) had to a much greater extent cared for patients who were allergic to NRL but had not been educated to the same extent. When both experience and knowledge are integrated, a higher score can probably be achieved on the questionnaire.

This discussion can be compared to the knowledge base that Aristotle described and that contemporary educators have interpreted as practical wisdom.³⁴⁻³⁶ The development from novice to expert mainly takes place when theoretical knowledge and experience are combined with reflection. The ability and opportunity to integrate this content with the individual personality is essential for expertise to arise and for the novice to develop into an expert.³⁶

The answers to statement 5 in the questionnaire indicate that all of the nurses had inadequate knowledge of dermatological problems related to NRL gloves, which can be interpreted to mean that knowledge of the mechanism underlying hypersensitivity reactions is inadequate. This may be related to confusion regarding concepts described in the literature about different hypersensitivity reactions.¹⁴ Most professionally active nurses are well aware of the importance of choice of materials as well as the practicalities of caring for patients with NRL allergies. This may be because most nurses have encountered this group of patients in their work and have practical experience in the field.

The nurses in the training program were significantly more knowledgeable about the majority of statements, both theoretical and practical. This could be interpreted to mean that theoretical knowledge is important for being able to care for patients with NRL allergies. Even if this is not the complete explanation, this assessment showed a clear difference in the two groups; Kruskal-Wallis tests suggested a significantly higher score for the nurses in the training program ($H = 18.79, P < .001$). The questions that show significant differ-

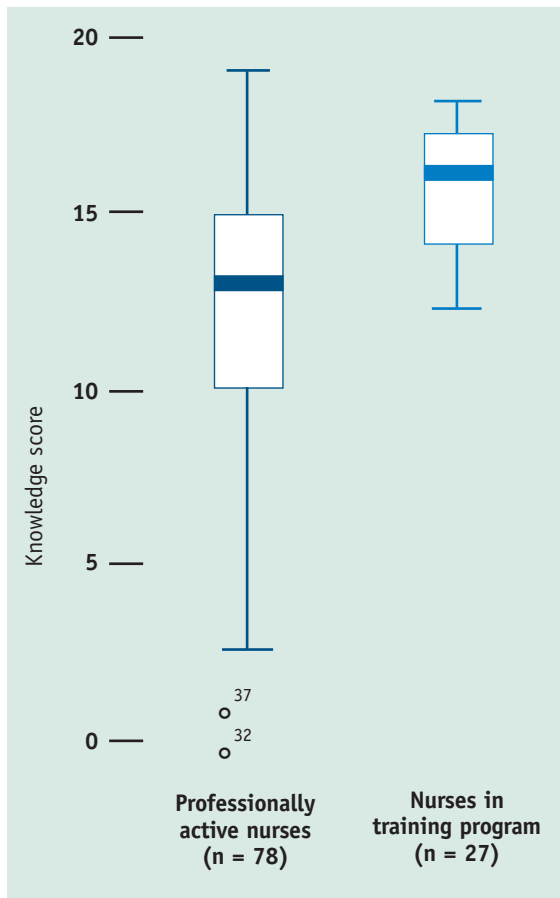


Figure 4 • Boxplot for comparison of the two groups.

ences mainly stem from theoretical knowledge.

Lewis et al found that nurses with experience in caring for patients with NRL allergies demonstrated better knowledge,³² which is not supported by this study. The same study also showed that nurses who have NRL allergies themselves are not necessarily more knowledgeable, which the investigator was also unable to confirm in this study.³² This study did show significant scores suggesting that nurses who have new theoretical knowledge in the field also achieve higher scores on the questionnaire, however. These findings are in line with the findings presented by Kleinbeck et al.³³

DISCUSSION OF METHODS

Using an existing instrument has both advantages and disadvantages. The instrument has undergone several critical reviews,

TABLE 5
Knowledge Items Answered Correctly More Frequently by Nurses in the Training Program than by the Professionally Active Nurses

Statement	X ²	df	P
4. Even though they are unpleasant, natural rubber latex (NRL) reactions that are IgE mediated (type I) are not life-threatening.*	20.51	1	.000
8. People who are allergic to fruit (eg, bananas) should avoid contact with NRL.	19.95	1	.000
9. Synthetic rubber poses a great danger for latex-sensitive individuals.*	8.35	1	.004
11. People at increased risk of allergic reaction to NRL include those with myelomeningoceles.	19.91	1	.000
13. People at increased risk of allergic reaction to NRL are those with congenital birth defects within the urogenital tract.	13.25	1	.000
17. Symptoms of allergy to NRL may include shortness of breath.	8.55	1	.003
19. Planned surgery on patients with known allergy to NRL must be carried out first thing in the morning.	6.06	1	.014

and there are not many other ways to ask the same questions.³⁸ One of the disadvantages of using an available instrument is the limitation of not being able to ask additional questions. Another disadvantage is that the choice of words could be limited or even become outdated. There is also a risk that the instrument changes in content after the translation.³⁸ To counteract this effect, it was essential to have a bilingual person review the translation, in addition to a review of the content by someone who was familiar with the field. Both the original version and the translated version were available during the review.

Several of the nurses commented that they wanted the option to respond to the questions with “don’t know.” As a result, a few nurses designed their own alternative answers, which had to be treated as an internal nonresponse. After conversion to numerical values, however, the response assumes a value of zero and therefore only had the effect of lowering the score. The probability of guessing at least 17 correct answers on the form is less than one in 1,000, assuming that the answers

are binominally divided ($P = .001$).

Comparing a group of nurses with recently completed theoretical training in the subject with a group that has mixed experience provides an opportunity to evaluate the extent to which instruction in the subject raises the nurses’ level of knowledge. All participating nurses had the same opportunity to participate in the study, which means that selection was nonrandom.³⁹ There is, however, no assurance that the sample is representative of the population because of the self-selected participation. The response rate of 75% for nurses in the training program can, of course, be due in part to the fact that they had time to complete the questionnaire in the training program and in part because they felt familiar with the subject. Among the professionally active nurses, the response rate was 60%, despite repeated requests that they complete the questionnaire. Lack of time was clearly a determining factor. The nurses also expressed concern that their knowledge gaps would become apparent. This may have meant that those who completed the questionnaire were the nurses who

were confident about the subject. If everyone who was invited to participate in the study had completed the questionnaire this may have resulted in an even lower score.

CONCLUSION

It is essential for nurses to provide good and safe care for patients, themselves, and other health care workers in environments in which NRL is commonly found. Instruction should be included in the nurses' undergraduate education curriculum as well as on the job and through continuing education. All nurses should know about the risk factors for developing hypersensitivity reactions from exposure to NRL products that are known from previous research. The nurses' job description includes keeping up with scientific developments and developments in clinical practice. It is crucial to monitor developments in the field both about choice of materials and about caring for people with hypersensitivity reactions. The health care system should formulate guidelines that are clear and readily available to be able to offer a safe and secure environment for both patients and health care workers. — **AORN** —

Acknowledgment: The author thanks Mölnlycke Healthcare AB, Göteborg, Sweden, for the grant that made this work possible; her supervisor AnneCharlotte Berggren, RN, RMT, MNsc, PhD, senior lecturer, School of Social and Health Sciences, Halmstad University, Sweden, for her excellent guidance; her colleagues Irene Mårtensson, RN, RNIC, MNsc, lecturer, School of Social and Health Sciences, Halmstad University, and Marie Sandh, RN, RNAN, RNT, MNsc, lecturer, School of Social and Health Sciences, Halmstad University, for advice, support, and assistance; Mats Gunnarsson, teacher of mathematics and statistics, lecturer, School of Information Science, Computer and Electrical Engineering, Halmstad University, for help with processing the statistics; and AORN for use of the research instrument.

REFERENCES

1. Att Förebygga Infektioner i Vården II: Ett Kunskapsunderlag [To Prevent Health Care-Related Infections II: A Basis of Knowledge] [SoS-rapport 1998:12]. Stockholm, Sweden: Nordstedts tryckeri AB; 1998.

2. Hammarsten R; Jörbeck H, Hammarsten J. *Handskrekommendation Inom Hälso—Och Sjukvården [Glove Usage Guideline in Healthcare]*. Lund, Sweden: Studentlitteratur; 2002.

3. AORN latex guideline. In: *Perioperative Standards and Recommended Practices*. Denver, CO: AORN, Inc; 2008:87-102.

4. Korniewicz DM, Garzon L, Seltzer J, Feinleib M. Failure rates in nonlatex surgical gloves. *Am J Infect Control*. 2004;32(5):268-273.

5. Kerr LN, Chaput MP, Cash LD, et al. Assessment of the durability of medical examination gloves. *J Occup Environ Hyg*. 2004;1(9):607-612.

6. Folkhälsoinstitutet 2001:03. *Naturgummilatel i Sjukvården [Natural Rubber Latex in Health Care]*. Stockholm, Sweden: Folkhälsoinstitutets distributionstjänst; 2001. <http://www.fhi.se/upload/PDF/2004/rapporter/latex.pdf>. Accessed June 23, 2008.

7. Stern G. Überempfindlichkeit gegen kautschuk als ursache von urticaria und quinckeschem ödem [Hypersensitivity to natural rubber as a cause of urticaria and Quincke's edema]. *Klin Wochenschr*. 1927;23:1096-1097.

8. Världshälsoorganisationen [World Health Organization]. *Hälsa 21—Hälsa för Alla på 2000-Talet [Health 21—Health for All in the 21st Century]*. Stockholm, Sweden: Folkhälsoinstitutet, 1999. <http://www.fhi.se/upload/PDF/2004/övrigtmtl/h21.pdf>. Accessed July 8, 2008. <http://www.euro.who.int/document/EHFA5-E.pdf>. Accessed July 8, 2008.

9. Socialdepartementet 2002/03:35. *Mål för Folkhälsan [Goal for Public Health]*. Stockholm, Sweden: Regeringskansliet, 2002. <http://www.regeringen.se/content/1/c4/12/59/ce6a4da9.pdf>. Accessed July 8, 2008.

10. Socialstyrelsen. *Folkhälsorapport 2001*. [Swedish Public Health Report 2001]. Stockholm, Sweden; Modins-Tryck; 2001. <http://www.socialstyrelsen.se/NR/rdonlyres/D022AC8D-FAA5-497C-82B1-6224504F6688/1523/omslag.pdf>. Accessed June 23, 2008.

11. Svensson Å. *Omfattningen av Allergi och Annan Överkänslighet i Huden—Symptom, Omfattning, Orsaker [The Scope of Allergy and Hypersensitivity in Skin—Symptoms, Scope, Causes]*. Stockholm, Sweden: Folkhälsoinstitutets distributionstjänst, 2001. http://www.fhi.se/shop/material_pdf/OmfattningHud.pdf. Accessed July 8, 2008.

12. Socialstyrelsen. *Folkhälsorapport 2005* [Swedish Public Health Report 2005]. <http://www.socialstyrelsen.se/Publicerat/2005/8707/Sammanfattning.htm>. Accessed June 23, 2008.

13. *Nationalencyklopedin Ordbok [Dictionary]*. Höganäs, Sweden: Bokförlaget Bra Böcker AB; 1989.

14. Johansson SG, Cardell LO, Foucard T, et al. Entydiga termer skapar klarhet och undanröjer missförstånd [Revised global nomenclature for allergy. Unambiguous terms create clarity and prevent misunderstandings]. *Lakartidningen*. 2006;103(6):379-383.

15. Burton GRW, Engelkirk PG. *Microbiology for the*

Health Sciences. 7th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2004.

16. Buhr V. Screening patients for latex allergies. *J Am Acad Nurse Pract*. 2000;12(9):380-383.
17. Meade BJ, Weissman DN, Beezhold DH. Latex allergy: past and present. *Int Immunopharmacol*. 2002;2(2-3):225-238.
18. Meglio P, Arabito E, Plantamura M, Businco L. Prevalence of latex allergy and evaluation of some risk factors in a population of atopic children. *J Investig Allergol Clin Immunol*. 2002;12(4):250-256.
19. Ebo DG, Bridts CH, Hagendorens LS, De Clerck LS, Stevens WJ. The prevalence and diagnostic value of specific IgE antibodies to inhalant, animal and plant food, and ficus allergens in patients with natural rubber latex allergy. *Acta Clin Belg*. 2003; 58(3):183-189.
20. Blanco C. Latex-fruit syndrome. *Curr Allergy Asthma Rep*. 2003;3(1):47-53.
21. Hemmer W, Focke M, Götz M, Jarisch R. Sensitization to *Ficus benjamina*: relationship to natural rubber latex allergy and identification of foods implicated in the Ficus-fruit syndrome. *Clin Exp Allergy*. 2004;34(8):1251-1258.
22. Sutherland RW, Gonzales ET. Current management of the infant with myelomeningocele. *Curr Opin Urol*. 1999;9(6):527-531.
23. Kattan H, Harfi HA, Tipirneni P. Latex allergy in Saudi children with spina bifida. *Allergy*. 1999;54(1):70-73.
24. Dehlink E, Prandstetter C, Eiwegger T, Putschögl B, Urbanek R, Szépfalusi Z. Increased prevalence of latex-sensitization among children with chronic renal failure. *Allergy*. 2004;59(7):734-748.
25. Ricci G, Gentili A, Di Lorenzo F, et al. Latex allergy in subjects who had undergone multiple surgical procedures for bladder exstrophy: relationship with clinical intervention and atopic diseases. *BJU Int*. 1999;84(9):1058-1062.
26. Sutherland MF, Suphioglu C, Rolland JM, O'Hehir RE. Latex allergy: towards immunotherapy for health care workers. *Clin Exp Allergy*. 2002;32(5): 667-673.
27. Holter G, Irgens Å, Nyfors A, et al. Self-reported skin and respiratory symptoms related to latex exposure among 5,087 hospital employees in Norway. *Dermatology*. 2002;205(1):28-31.
28. Edelstam G, Arvanis L, Karlsson G. Glove powder in the hospital environment—consequences for healthcare workers. *Int Arch Occup Environ Health*. 2002;75(4):267-271. Epub January 30, 2002.
29. Jones KP, Rolf S, Stingl C, Edmunds D, Davies BH. Longitudinal study of sensitization to natural rubber latex among dental school students using powder-free gloves. *Ann Occup Hyg*. 2004;48(5):455-457.
30. AFS 2001:03. *Användning av Personlig Skyddsutrustning [Use of Personal Protective Equipment]*. Solna, Sweden: Arbetsmiljöverket; 2001. <http://www.av.se/dokument/inenglish/legislations/eng0103.pdf>. Accessed July 8, 2008.
31. SS/EN 455-3. *Medicinska Engångshandskar—Del 3: Krav och Provningsmetoder för Biologisk Utvärdering [Medical Gloves for Single Use—Part 3: Requirements for Testing and Biological Evaluation]*. Stockholm, Sweden: SIS; 2000.
32. Lewis LC, Norgan G, Reilly M. Are nurses knowledgeable in regards to latex allergy? *Semin Periop Nurs*. 1998;7(4):239-253.
33. Kleinbeck SV, English NL, Sherley MA, Howes J. A criterion-referenced measure of latex allergy knowledge. *AORN J*. 1998;68(3):384-392.
34. Gustavsson B. *Kunskapsfilosofi: Tre Kunskapsformer i Historisk Belysning [Philosophy of Knowledge: Three Knowledge's Shapes in Historical Illustration]*. Stockholm, Sweden: Wahlström & Widstrand; 2000.
35. Gustavsson B. Vad är kunskap? En diskussion om praktisk och teoretisk kunskap [What is knowledge? A discussion about practical and theoretical knowledge]. Skolverket. <http://www.skolverket.se/publikationer?id=1108>. Accessed June 18, 2008.
36. Benner PE. *From Novice to Expert: Excellence and Power in Clinical Nursing Practice*. Menlo Park, CA: Addison-Wesley Pub Co, Nursing Division; 1984.
37. Aronsson Å. *SPSS: En Introduktion till Basmodulen* [version 9 for Windows 95/98/NT]. Lund, Sweden: Studentlitteratur; 1999.
38. Streiner DL, Norman GR. *Health Measurement Scales: A Practical Guide to Their Development and Use*. Oxford, England: Oxford University Press; 1995.
39. Gunnarson R. *Forskningsmetodik kvantitativa (statistika) och kvalitativa ansatser [Research method quantitative (statistics) and qualitative onset]*. Department of Primary Health Care, Göteborg University. <http://infovoice.se/fou>. Accessed June 23, 2008.

Ing-Marie Bundesen, MNSc, RN, RNT, CNOR, is a lecturer at the School of Social and Health Sciences, Halmstad University, Halmstad, Sweden.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.