

# Do surgeons use double gloves during surgery? Results of a survey

## Czy chirurdzy podczas zabiegów operacyjnych stosują podwójne rękawiczki? Wyniki badania ankietowego

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A – Study Design  
B – Data Collection  
C – Statistical Analysis  
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### ABSTRACT:

**Introduction:** The perforation of gloves during surgical procedures is quite common. A cheap and quite effective method of reducing the risk of blood-borne infections is wearing two pairs of gloves. Unfortunately, some surgeons are reluctant to it, and they report decreased dexterity and sensation. The aim of the study was to evaluate surgeons' double-gloving practices to determine the factors related to compliance.

**Material and methods:** An anonymous, 21-question survey in Polish was sent by post to 41 surgical departments. The questions concerned: demographic data, type of surgical gloves used, allergy to latex, number of surgeries performed, frequency of using double gloves and negative impressions from using them and finally, the frequency of needlestick injuries during surgical procedures.

**Results:** We received 179 questionnaires back. More than 62% of the surgeons believe that double gloves provide better protection than a single pair, 24% do not believe in this, and 14% have no opinion. Only 0.6% of respondents always use double gloves during surgery, 19% double glove in at least 25% of cases and 68% do it occasionally. 13% of the surgeons declared that they had never worn double gloves. During high-risk procedures, 86% of respondents wear double gloves. About half of respondents (50.3%) report discomfort while wearing double gloves; 45% – decreased dexterity; about 30% complain of numbness and tingling; and 64% – decreased sensation.

**Conclusion:** Due to the high number of surgical glove perforations and relatively high prevalence of needlestick injuries, it is necessary to use methods that reduce the risk of transmission of pathogens. The habit of using a double pair of gloves should be implemented especially among young surgeons starting to train in their specialities. Consequently, the period of initial discomfort will be combined with the acquisition of surgical skills, which will allow for gradual acclimatization.

### KEYWORDS:

needlestick injuries, surgical gloves, surveys and questionnaires

### STRESZCZENIE:

**Wstęp:** Perforacja rękawiczek podczas zabiegów operacyjnych stanowi dość powszechne zjawisko. Uzasadnioną ekonomicznie i dość efektywną metodą zmniejszającą ryzyko krwiopochodnych infekcji jest stosowanie podwójnych par rękawiczek. Niestety część środowiska chirurgicznego przejawia niechęć do tego typu rozwiązania, argumentując to subiektywnym obniżeniem zręczności oraz czułości dotyku.

**Cel:** Celem badania była ocena praktyki chirurgów dotyczącej zakładania podwójnych rękawiczek oraz określenie czynników wpływających na ich stosowanie.

**Materiał i metody:** Anonimową ankietę złożoną z 21 pytań w języku polskim wysłano pocztą do 41 oddziałów chirurgicznych. Pytania dotyczyły: danych demograficznych, rodzaju używanych rękawiczek, alergii na lateks, liczby przeprowadzonych operacji, częstotliwości używania podwójnych rękawiczek i negatywnych odczuć związanych z ich używaniem, a także częstotliwości zranień podczas zabiegów chirurgicznych.

**Wyniki:** Otrzymaliśmy zwrot 179 ankiet. Przeszło 62% badanych uważa, że podwójne rękawiczki zapewniają większą ochronę niż pojedyncza para, 24% nie wierzy w ten efekt, zaś 14% nie ma zdania. Jedyne 0,6% badanych zawsze stosuje podwójne rękawiczki podczas zabiegów operacyjnych, 19% używa ich regularnie, to znaczy co najmniej w 25% zabiegów, zaś 68% okazjonalnie. 13% przebadanych chirurgów deklaruje, że nigdy nie zakłada podwójnych rękawiczek. Podczas zabiegów podwyższonego ryzyka podwójne rękawiczki nosi 86% respondentów. Wśród przebadanych osób ok. połowa (50,3%) odczuwa dyskomfort, 45% – pogorszenie sprawności manualnej, około 30% skarży się na mrowienie, a 64% na pogorszenie dotyku.

**Wnioski:** W związku z dużym odsetkiem uszkodzeń rękawiczek chirurgicznych, koniecznym wydaje się stosowanie metod zmniejszających ryzyko transmisji patogenów. Nawyk używania podwójnej pary rękawiczek powinien być wdrażany zwłaszcza

wśród młodych lekarzy zaczynających specjalizację, tak aby okres początkowego dyskomfortu i stopniowego przyzwyczajania się dłoni był połączony z nabywaniem umiejętności chirurgicznych.

**SŁOWA KLUCZOWE:** ankiety i kwestionariusze, rękawiczki chirurgiczne, zranienia igłą

*This is the first work evaluating the frequency of double gloving by Polish surgeons, as well as trying to determine the factors related with their use.*

## INTRODUCTION

Surgical gloves are intended to be a protective barrier against blood-borne pathogens. According to studies, the perforation of gloves during surgical procedures is quite common, and rates could be as high as several dozen percent of operations. Most cases remain unrecognized by the surgeon or scrub nurse.

A cheap and quite effective method of reducing the risk of blood-borne infections is wearing two pairs of gloves [1, 2]. In a study by Spanish authors, a protective barrier was retained by the inner pair in four out of five cases where the outer glove had been perforated [3]. What's more, when a suture needle passes through two glove layers, the volume of blood that comes into contact with the skin is reduced by 95%, thereby also significantly reducing the viral load delivered by a contaminated percutaneous injury [4].

Numerous authors suggest that using double gloves has become an absolute standard [2–7]. Unfortunately, some surgeons are reluctant to do it, and they report decreased dexterity and sensation [8]. In one study performed at two teaching hospitals in Ontario, Canada, less than half of the surgeons and residents wore double gloves routinely in their daily practice [9].

Because only a few studies have explored surgeons' double-gloving practice, we sought to evaluate it in a province in central Poland and determine the factors related to compliance.

## MATERIAL AND METHOD

An anonymous, 21-question survey in Polish was sent by post to 41 surgical departments (general surgery and subspecialties, pediatric surgery, plastic surgery, maxillofacial surgery, orthopedic surgery, urology or neurosurgery) in Łódź Province (Voivodeship, Nomenclature of Territorial Units for Statistics – NUTS 2 region). Each envelope contained 15 copies of the questionnaire (translated in Tab. I.). The questions concerned:

- demographic data (age, gender, specializations),
- type of surgical gloves used, allergy to latex,
- number of surgeries performed (per week),
- frequency of using double gloves and negative impressions from using them,
- frequency of needlestick injuries during surgical procedures.

In addition, the envelope contained a stamped, self-addressed envelope and short message about the study. Approval to carry out the study was received from the Local Bioethical Committee of the Medical University of Lodz. Statistical analysis included parametric and nonparametric tests for large samples

(including two-sample mean and variance test and  $\chi^2$  tests), as well as interval estimation (CI – confidence intervals) and odds ratios from logistic regression; STATA MP 11 software was used.

## RESULTS

We sent 615 questionnaires and received 179 (29%) back. It is worth mentioning that many of the departments that were sent surveys have less than 15 doctors. Since excess questionnaires were sent, it is impossible to calculate the real rate of return. 111 (62%) of the respondents work in departments of general, oncological or vascular surgery; 45 (25.1%) in orthopedic; 11 (5.6%) in maxillofacial; and the rest in plastic surgery (7 persons) and urology (5 persons). The average age of surgeons was 45 (+/- 11). 81.6% of respondents were specialists and 18.4% residents; 82.7% were male and 17.3% female.

Evaluating surgeons' preferences regarding surgical gloves, 108 reported (60%) using only latex gloves; 6.15% only nitrile; 19% were not sure which gloves they used most often; and 8 (4.5%) marked both nitrile and latex gloves. Gloves made from other materials were used by merely a few surgeons.

A latex allergy was reported by 15.1% (95% CI: 9.8% – 20.4%) of respondents. Doctors older than the median age of 46 are twice as likely to be allergic as younger ones (odds ratio of 2.04 with  $p = 0.097$ ).

More than 62% of the surgeons believe that double gloves provide better protection than a single pair, 24% do not believe in this, and 14% have no opinion.

Only 0.6% of respondents always use double gloves during surgery, 19% do so in at least 25% of cases (95% CI, 13%, 25%), and 68% do it occasionally. 13% of the surgeons declared that they had never worn double gloves. The provided explanations are shown in Tab. II.

During high-risk procedures, 86% of respondents wear double gloves (95% CI: 80% – 92%). When the surgeons wear double gloves, usually both are the same size (73.5%); everybody else uses a larger outer pair.

About half of respondents (50.3%) report discomfort while wearing double gloves; 45% – decreased dexterity; about 30% complain of numbness and tingling; and 64% – decreased sensation. Persons feeling decreased sensation are less likely to use double gloves (based on a  $\chi^2$  independence test with  $p = 0.098$ ). The remaining symptoms do not significantly affect the use of double gloves.

Among the surveyed surgeons, 66.3% (95% CI: 59.3% – 73.3%) routinely change gloves during long procedures, even if they have not found the gloves to be damaged. Gloves were changed

Tab. I. Questions asked in survey.

1. Age
2. Sex (M/F):
3. Specialist Resident (PGY.....)
4. Department: <input type="checkbox"/> General/ Oncologic/ Vascular Surgery <input type="checkbox"/> Pediatric Surgery <input type="checkbox"/> Plastic Surgery <input type="checkbox"/> Maxillofacial Surgery <input type="checkbox"/> Cardiothoracic Surgery <input type="checkbox"/> Orthopedic <input type="checkbox"/> Urology <input type="checkbox"/> Neurosurgery
5. What material are the surgical gloves you most often use? <input type="checkbox"/> Latex <input type="checkbox"/> Nitrile <input type="checkbox"/> Polyurethane <input type="checkbox"/> Neoprene <input type="checkbox"/> Polyisoprene <input type="checkbox"/> Other(what? .....) <input type="checkbox"/> I do not know what material they are made from <input type="checkbox"/> I do not know what material they are made from, but it is not latex
6. Are you allergic to latex? (Y/N)
7. On average, how many times per year do you hurt yourself with sharp objects (like a scalpel or needle) during surgery?
8. What percentage of needlestick injuries do you report ?
9. What is the average number of surgical procedures you participate in per week?
10. Do you routinely change your gloves during a long surgery, if you have not found them to be damaged?
11. If yes, how often (after how many hours)?
12. Do you think that double gloves provide better protection than a single pair? Y/N/I don't know
13. In what percentage of surgeries (approximately) do you use double gloves <input type="checkbox"/> 100% <input type="checkbox"/> 75% <input type="checkbox"/> 50% <input type="checkbox"/> 25% <input type="checkbox"/> Occasionally <input type="checkbox"/> Never
14. If you marked "Never" in the previous question, please select the main reason: <input type="checkbox"/> I do not believe in their effectiveness <input type="checkbox"/> Cost <input type="checkbox"/> Decreased dexterity <input type="checkbox"/> Decreased sensation <input type="checkbox"/> Discomfort <input type="checkbox"/> Other (what? .....)
<b>ATTENTION!!! If you never use double gloves, please do not answer the following questions!</b>
15. Do you use double gloves for high-risk patients? (e.g.: drug-addicted, HIV positive, HCV positive)? Y/N
16. Do you feel discomfort while wearing double gloves? Y/N
17. Do you feel decreased sensation when wearing double gloves? Y/N
18. Do you feel decreased dexterity when wearing double gloves? Y/N
19. Do you have any numbness / tingling of your fingers when wearing double gloves?
20. When you use double gloves: <input type="checkbox"/> both pairs are the same size <input type="checkbox"/> the inner pair is smaller and the outer is larger <input type="checkbox"/> the inner pair is larger, the outer is smaller

**Tab. II.** The responses marked by the surgeons (n = 23) who declared that they never wear double-gloves. Usually, more than one answer was selected.

MARKED EXPLANATION	NUMBER OF ANSWERS
I do not believe in their effectiveness	13
Cost	4
Decreased dexterity	16
Decreased sensation	16
Discomfort	12
Other	1

every 2.05 h on average (95% CI: 1.9–2.2). Half of the respondents change gloves more often. Physicians who regularly use double gloves reported changing gloves less frequently than those who did not (based on a two-sample proportion test,  $p = 0.08$ ), but there was no significant difference in the time between changes (two-sample mean test,  $p = 0.256$ ).

The declared frequency of needlestick injuries ranged from 0 to 60 per year, 5.58 on average (95% CI: 4.31–6.85); 88% of participants in the study had at least one injury per year. Only 20.8% of events are reported (95% CI: 15.2%–26.4%). The rate of needlestick injuries per 100 (NSIP100) surgeries (calculated by treating the average number of cases per week as a constant throughout a year) was 1.32 among the respondents (95% CI, 1.04–1.59). The survey shows that specialists have more sharp injuries during the year (8.32) than residents (4.91) (two-sample mean test,  $p = 0.07$ ) in absolute terms. However, there is less difference in NSIP100 between specialists (1.65) and residents (1.23) (two-sample mean test,  $p = 0.23$ ). Finally, we compared the rates of NSIP100 for the two department types with the most respondents – general surgery (and subspecialties) versus orthopedic surgery. The average ratio of sharp injuries for surgery (1.22) is slightly lower than for orthopedics (1.75) (two-sample mean test,  $p = 0.095$ ).

Interestingly, doctors declaring decreased sensation while using double gloves exhibited significantly fewer annual needlestick injuries (4.79) than other doctors (7.07) (two-sample mean test,  $p = 0.04$ ). Their NSIP100 (1.15) was also lower than for other doctors (1.61) (two-sample mean test,  $p = 0.054$ ). Other adverse effects of double gloves showed no significant correlation with needlestick injuries.

More than half of the doctors (51.3%) who had at least one needlestick injury during the year did not make any reports about it. Only 14% report all injuries.

To assess factors linked with the probability of using double gloves regularly (at least 25% of the time), we incorporated logistic regression with single potential exogenous variables to calculate odds ratios. Most associations are not statistically significant. For instance, we found no grounds to consider sex ( $p = 0.655$ ), above-median age ( $p = 0.206$ ), latex allergy ( $p = 0.550$ ), specialist/resident status ( $p = 0.691$ ), negative effects of using double gloves ( $p > 0.15$ ) or the number of needlestick injuries per year ( $p = 0.548$ ) as determinants of using double gloves regularly. The only variable showing significant influence is whether doctors declare they

“think that double gloves provide better protection than a single pair”. Those who do report using double gloves at over 7.5 times for the rate of doctors who do not (odds ratio: 8.63,  $p = 0.001$ ).

## DISCUSSION

Healthcare workers are at risk of acquiring viral diseases such as hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV) through exposure to contaminated blood and body fluids. Palmer and Rikett estimated that every surgeon will have at least one chance of HCV infection during their professional career due to a damaged glove. Moreover, 1 out of 1500 surgeons might be exposed to HIV for the same reason. According to observations made by Thomas et al., almost 20% of surgeons operate with pre-existing hand abrasions, which are an “open door” for bloodborne pathogens [10]. Studies have shown that the perforation of gloves during surgery is quite common, with rates estimated at 7.8 to 30% [11, 12]. Even over 80% of glove perforations during surgery go unnoticed [10].

The largest number of perforated gloves is noted in orthopedics, thoracic surgery and maxillofacial surgery, where sharp bone edges and specialized tools lead to increased risk of damage. There is surprisingly high perforation frequency in scrub nurses; according to Hollaus, it reaches even 40% [14]. Finally, it is worth mentioning that almost 4% of brand new surgical gloves have pre-existing perforations [10].

The number of glove perforations increases with the duration of the surgical procedure. The study performed by Sayın et al. has shown that the rate of glove perforation is higher for surgical procedures longer than 60 minutes [15]. Similarly, in the research published by Çalışkan et al., more glove punctures were identified in colorectal abdominal surgery that lasted longer than one hour [16]. On the other hand, Cole and Gault reported that glove punctures increase during plastic surgery procedures that lasted two hours and more [17]. Laine and Aarnio demonstrated that after two hours, the number of perforations increased two-fold while after five hours three-fold [11]. Many authors suggested that latex gloves should be changed at intervals of less than 120 minutes [18].

A study performed by Gerberding et al. at San Francisco General Hospital found that, with double-gloving, the inner glove prevented up to 20% of cutaneous exposure to blood and the outer glove had triple the rate of perforations of the inner glove [19].

Bennett estimated that HIV transmission is reduced from 0.3% to 0.009% during injury through the double layer of gloves [20]. A recent Cochrane review concluded that surgeons and surgical staff can reduce their risk of contracting a serious viral infection by wearing two pairs of gloves instead of one. The evidence of the preventive effect of double gloves is so convincing that it has been concluded that further research is not needed [21].

Many surgeons have an aversion to this type of protection. In our study, a total of 86% of our respondents reported double-gloving in the operating room, but only one-fourth of them did so regularly (in at least 25% of cases). In contrast, in a study performed by Lipson et al. in Canada, a total of 78% of surgeons reported double-gloving, two-thirds of whom reported to be practicing it

routinely [22]. Al Jehani found that less than half of the respondents (44.3%) at King Abdulaziz University Hospital in Saudi Arabia use double gloving, 52.1% of the subgroup does it always/routinely. The frequency of "routinely" was not defined in either study [23].

The main reasons cited for not wearing double gloves in the current study were decreased dexterity and sensation. However, Fry et al. performed an objective study that did not show a relationship between double-gloving and impaired manual dexterity or tactile sensitivity. To avoid numbness of the fingers due to pressure exerted by double gloves, they propose wearing a larger inner glove than is usually used. For example, a surgeon who ordinarily wears a size-7½ glove can avoid the ischemic sensation and maximize comfort with a size 8 inner glove and a size 7½ outer glove [24]. A survey conducted by Paterson showed that a surgeon usually gets used to double gloves in two days, although in some cases it may take up to four months of continuous practice [25]. On the other hand, surgeons who consistently double-glove indicate that the unique feel of double-gloving becomes comfortable and that the hands feel almost "naked" without the surgical double glove after sustained, consistent practice [24].

However, the afore-mentioned studies are contradicted by the latest experimental study carried out by British researchers [26]. It found that the quality of surgical knots tied under double-gloved conditions was significantly reduced relative to knots with one pair. The authors suggest that the results question the recommendation that surgeons routinely double-glove. However, it is worth noting that most participants either never double-glove or do so only occasionally, and that the number of routine double-glovers was relatively small.

The second important aspect that we have touched on in our research is the frequency of needlestick injuries during surgical procedures. The results of our survey have shown that this is a huge problem and concerns almost 90% of respondents annually. In comparison, Thomas reported the British surgeons' incidence of injury from sharp objects as 44% over 6 months [27]. In a Chinese

study by Shi et al., the rate of needlestick and other sharps injuries in a surgical department was 93.09%, with an average of 4.46 episodes per person during one year [28].

The results of our survey do not indicate that work experience is related to the frequency of needlestick injuries. Although consultants have more sharp injuries during the year in absolute terms, they perform more surgeries, so the NSIP100 ratio is not significantly different. Orthopedic surgeons have a slightly higher rate of injuries than general surgeons. This may be due to the fact that they are exposed to sharp bone edges and specialized tools [11].

Despite the high prevalence of needlestick injuries, surgeons do not report them. A UK study found a reporting rate of 9% [27] while a similar study in Nigeria showed 9.2% of surgeons observing the protocols [29]. Our questionnaire has recorded a higher level of reporting (20.8%), although these results are still not up to standard. There are several reasons for non-reporting of needlestick injuries by surgeons, including: time-consuming reporting processes, low transmission probability from sharp object injuries, reluctance to interrupt surgery, high workloads, and low efficacy of treatment and prevention post-injury [30]. Our survey did not study this issue.

## CONCLUSIONS

Due to the high number of surgical glove perforations and relatively high prevalence of needlestick injuries, it is necessary to use methods that reduce the risk of transmission of pathogens. The use of double gloves seems the simplest, most effective and economically advantageous way. The question of whether they impair manual dexterity or tactile sensitivity is still open. However, we believe that the habit of using a double pair of gloves should be implemented especially among young surgeons starting to train in their specialities. Consequently, the period of initial discomfort will be combined with the acquisition of surgical skills, which will allow for gradual acclimatization.

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