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RESEARCH ARTICLE

Omission of alcohol skin cleansing and risk of adverse events in long-term care residents undergoing COVID-19 vaccination: A cohort study

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ABSTRACT

Despite a lack of clinical data demonstrating the effectiveness of alcohol swab cleansing prior to vaccinations as a prophylactic measure to prevent skin infections, it is recommended for vaccine administration by the Canadian Immunization Guide. The objective of this study was to evaluate the risk of adverse events after omitting alcohol skin cleansing in long-term care (LTC) residents receiving vaccinations during the COVID-19 pandemic. Two medium-sized LTC homes participated in a cohort study, whereby one LTC used alcohol swab cleansing prior to resident vaccinations and the other did not. All residents received two doses of the BNT162b2 COVID-19 vaccine separated by an average (SD) 29.3 (8.5) days. The electronic chart records of participants were reviewed by researchers blinded to group allocation to assess for the presence of adverse events following immunization (AEFI), including reactogenicity, cellulitis, abscess, or systemic reactions. Log-binomial regression was used to compute risk ratios (with 95% confidence intervals) of an AEFI according to alcohol swab status. 189 residents were included, with a total of 56 AEFI between the two doses. The risk of reactogenicity (adjusted RR 0.54, 95% CI 0.17–1.73) or systemic reactions (adjusted RR 0.75, 95% CI 0.26–2.13) did not differ for the residents that received alcohol skin antisepsis compared to those that did not. There were no cases of cellulitis or abscess. This study did not demonstrate an elevated risk of AEFI in LTC residents receiving two doses of the BNT162b2 mRNA COVID vaccine without alcohol skin antisepsis.

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Introduction

During the COVID-19 pandemic, older adults above the age of 60 were demonstrated to be at a higher risk of hospitalization and death. In Canada, older adults accounted for 68.8% of hospitalizations and over 91.3% of deaths.[1] Long-term care (LTC) and retirement home (RH) residents were the most affected, accounting for 43% of all COVID-19 related deaths yet 3% of COVID-19 cases.[2] These deaths mostly occurred prior to the introduction of COVID-19 vaccines. The high COVID-19 vaccination rates in early 2021 (>95% of LTC patients received their 1st dose by March 31, 2021) resulted in a 90% decrease in expected infection and deaths.[2] More recently, Grewal et al. (2022) demonstrated a 40% marginal effectiveness against severe COVID-19 outcomes in Ontario LTC residents who received a 4th COVID-19 vaccine dose compared to residents who received a 3rd dose four or more months prior.[3] With booster COVID-19 vaccinations currently recommended to maintain vaccine effectiveness against SARS-CoV-2 variants,[4] it is important to ensure that older adults continue to accept vaccinations.

Minimizing the risk of adverse reactions from vaccination is key to promoting positive vaccination experiences and promoting vaccination.[5] A new evidence-based framework for vaccine delivery that improves the safety of vaccination and improves the vaccination experience was integrated into mass vaccination clinics during the COVID-19 pandemic. The CARD™ System (Comfort, Ask, Relax, Distract) includes interventions that promote positive vaccination experiences by reducing adverse reactions including pain, fear, and immunization stress related responses (ISRR) such as dizziness and fainting.[6] CARD was proven effective across vaccination settings, including school-based vaccinations,[7,8] community pharmacy vaccinations[9] and mass COVID-19 vaccination clinics.[10]

One of the interventions included in CARD is omitting alcohol skin cleansing prior to vaccine injection.[10] Alcohol swabs have long been recommended in Canada[11] and the U.S.[12] to reduce the risk of skin infection following vaccine injection despite lack of clinical evidence of effectiveness. The WHO recommends against cleansing the skin with alcohol prior to vaccination.[13,14] Omitting alcohol swabs can have several benefits. Acutely, it can decrease ISRR by reducing pre-procedural anxiety when waiting for the alcohol to dry[15] and by reducing pain that could ensue from tracking alcohol in the tissue during injection.[16–18] Omitting the alcohol swab can also lead to substantial cost-savings over time due to a reduction in vaccine administration time – about 1 minute saved per application – and reduction in cost of ongoing supplies.[18,19] There

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is also a decrease in the amount of environmental waste that is generated.

At the time this study was undertaken, CARD was being introduced into LTC homes as the framework for vaccination delivery.[20] There were no prior studies, however, that examined the effect of omitting the alcohol swab from the vaccination process in this population and there were concerns about whether the practice change was safe. Specifically, it was unknown if this high-risk population was at higher risk of adverse reactions post-immunization and institutional leaders considered it important to evaluate the impact of this practice change on residents. Because of access restrictions during the pandemic, it was not possible to record acute reactions (e.g., pain) of residents during vaccination. The current study therefore focused on adverse events following immunization (AEFI) that occur in the hours to weeks after vaccination. Specifically, we undertook a study to evaluate skin reactogenicity, cellulitis, skin abscess, and related systemic reactions (e.g., fever) after COVID-19 vaccination in residents. We hypothesized that there would be no significant increase in risk in AEFI following COVID-19 vaccination in LTC residents who were vaccinated without alcohol swab cleansing compared to those vaccinated with alcohol swab cleansing (usual care).

Methods

Study design and participants

This was a prospective cohort study involving two medium-sized non-for-profit LTC facilities (defined as between 97 and 160 beds[21]) in Sudbury, Ontario. Residents who did not receive COVID-19 vaccinations at their respective LTC facility were excluded from the analysis. It was part of a larger study evaluating a tailored CARD™ (Comfort, Ask, Relax, Distract) framework to improve the overall vaccine experience (receipt and deliverance) in residents, essential care givers and health care providers in an LTC setting and expands on the results for adverse reactions.[20]

Procedures

Facilities self-selected CARD™ interventions to use for vaccination to reduce ISRR. This included education about vaccines ahead of time, and using injection techniques that reduce pain (e.g., fast injections). In one facility, topical anesthetics were administered and alcohol skin antisepsis was omitted from the injection process. In both facilities, acetaminophen was administered to reduce post-injection reactions. All residents received two doses of the BNT162b2 mRNA (Pfizer-BioNTech™) COVID-19 vaccine.

The electronic medical charts of vaccinated residents were reviewed to ascertain adverse events by two researchers that were unaware of alcohol swab status of the participating facilities. Charts were also reviewed 14 days *prior* to vaccination to ensure a resident did not have preexisting symptoms that could have falsely counted as an adverse event to vaccination. If the post-COVID vaccination symptom was already reported in the baseline, it was not reported as an AEFI. A 14-day follow-up was believed to be an adequate amount of time to ascertain the presence of infection based on previous vaccination safety studies.[18] Baseline symptoms and post-COVID-19 vaccination symptoms were reviewed for the residents' first and second COVID-19 vaccinations. Data retrieval was double-checked and inputted into a Microsoft Excel™ spreadsheet. The primary outcome was any AEFI, categorized as reactogenicity (i.e., injection site swelling, redness, pain), and systemic reactions (i.e., fever, muscle aches, headaches), as documented by health care providers in the resident's medical chart. The Brighton Collaboration criteria[22,23] were used to confirm the presence of cellulitis or abscess and consisted of the presence of multiple symptoms (i.e., swelling, redness, pain) or laboratory confirmation/purulent drainage, respectively. This is similar to our prior study on this topic.[18]

The study was approved by the Health Sciences North Research Ethics Board (#23–014). All residents, caregivers, and staff were notified that a quality improvement project was being undertaken consisting of recording vaccination information, including uptake and side effects. Individuals (and caregivers) were able to disallow use of their vaccination records by opting out.

Statistical analyses

The sample size was fixed according to the number of eligible residents. Using the data from a prior study,[18] assuming an alpha of 0.05 and power set to 80%, a sample size of 85/group, would allow us to detect a 50% increase in reactogenicity reactions if the baseline incidence was 43%.[24] Descriptive statistics were provided for resident characteristics and AEFIs by swab status. Unadjusted relative risks were computed for observed AEFIs by dose and swab status. To explore the association of alcohol swabbing on AEFI outcomes, we employed log-binomial regression[25] and computed risk ratios (RR) and 95% confidence intervals of an AEFI with swab status. We adjusted for dose (1 or 2), the interaction of swab status by dose, age (in decades, centered at 85 years of age), and sex. We used generalized estimating equations with an exchangeable correlation structure to account for the correlated nature of multiple doses.[26,27] One model per AEFI was run. Statistical analyses were performed using IBM SPSS Statistics™ (Version 28).

Results

Of the 189 residents, 52.9% (100) were swabbed with the average time between doses of 29.3 (SD = 8.5) days. The mean age across all residents was 84.8 years of age and approximately two-thirds of residents were female. Age and sex proportions were similar by swab status (see Table 1).

Table 2 displays the unadjusted relative risks for AEFI in the alcohol and no alcohol groups. Reactogenicity (redness, swelling, or pain) or systemic reactions (fever, muscle ache, headache) did not differ between groups for dose 1 or dose 2. There were no cases of abscess or cellulitis.[18,22,23]

Table 3 presents the adjusted relative risks of reactogenicity and systemic reactions according to swab status (swabbed; not swabbed), dose (2 vs. 1), the swab status by dose interaction, age (in decades, centered on 85 years of age), and resident sex (female vs. male). Females had over three times the risk of reactogenicity compared to their male counterparts (RR: 3.29;

Table 1. Resident characteristics by swab status.

	Alcohol Swab $n = 100$	No Alcohol Swab $n = 89$	Statistic (df), p-value
Age, mean (SD)	84.5 (9.82)	85.1 (11.03)	$t(187) = 0.41$, $p = .68$
Female, % (n)	66% (66)	69.7% (62)	$\chi(1) = 0.29$, $p = .59$
Days between doses, mean (SD)	28.8 (4.10)	29.9 (11.54)	$t(187) = 0.88$, $p = .38$

Table 2. Adverse Events Following Immunization (AEFI) by swab status.

	Alcohol Swab $n = 100$	No Alcohol Swab $n = 89$	Unadjusted Relative Risk (95% CI)
Reactogenicity*			
@ Dose 1, % (n)	4% (4)	7.9% (7)	0.51 (0.15–1.68)
@ Dose 2, % (n)	10% (10)	15.7% (14)	0.76 (0.47–1.25)
Total, % (n)	14% (14)	23.6% (21)	0.59 (0.31–1.13)
Systemic Reaction**			
@ Dose 1, % (n)	6% (6)	7.9% (7)	0.76 (0.27–2.19)
@ Dose 2, % (n)	7% (7)	1.1% (1)	6.23 (0.78–49.66)
Total, % (n)	13% (13)	9.0% (8)	1.18 (0.83–1.68)

* defined as redness, swelling, or pain.
**defined as fever, muscles aches, or headache.

95% CI: 1.20–9.06, p =.02). There were no other significant differences.

Discussion

Alcohol is used to disinfect the skin prior to vaccine injections; however, it is not a routine practice around the world. While studies demonstrate a reduction in overall bacterial skin concentration when alcohol skin disinfection is practiced, there is no demonstrated clinical benefit.[18] This study examined whether omitting alcohol from the injection process was associated with a higher risk of adverse reactions following vaccination. We did not find a difference in the risk of an AEFI, including reactogenicity, cellulitis, abscess, and systemic reactions following COVID-19 vaccination in LTC residents when omitting alcohol swab cleansing prior to injection over a time frame of two weeks following injection. Together, the included outcomes encompass the spectrum of symptoms that could have resulted from contamination of tissue by skin bacteria being tracked by the needle during injection. A time frame of two weeks was used in keeping with prior studies on this topic and of vaccination studies in general.[18]

The results are consistent with a previous randomized control trial that did not find any difference in reactogenicity in vaccinated children who received an alcohol swab skin cleansing versus not.[18] Our findings also align with the multiple studies that suggest no risk of infection with subcutaneous insulin injections[14] or with Botulinum toxin type A injection[28] when pre injection alcohol swabbing is omitted. Zhang et al. (2022) investigated systemic adverse events (after the 3rd dose only) in Quebec LTC residents who received 3 doses of various COVID-19 vaccines and found a percentage range of 2% to 16%, depending on vaccine combination and without prior infection.[29] Numerous systemic reactions were included, the most common being fever and malaise. This range is similar to the 0.5%–10.1% of participants experiencing a systemic reaction AEFI (both doses and either dose). In participants over the age of 55, the original phase 2/3 BNT162b2 mRNA study reported local swelling or redness in 5%–7% of participants, and pain in 66%–71% of participants (mostly mild or not interfering with activity).[30] In the same age category, 1–7% had a fever, 25–29% had a headache, and 9–19% had joint pain.[30] We found 3.2–12.2% reactogenicity events (both doses and either dose) and 0.5–10.1% systematic reaction events (both doses and either dose) post-COVID-19 vaccination in our study. We believe that our results only compare with the objective findings (i.e., redness, swelling, fever) of the original BNT162b2 mRNA study as approximately 87% of LTC residents have some form of cognitive impairment,[21] and may not be able to express subjective findings such as pain or headaches. Lastly, women in our study had an increased risk of AEFI versus males (RR: 3.29; 95% CI: 1.20–9.06). Green et al.. (2022) also demonstrated increased risk of reactogenicity and systemic reaction in Israeli female healthcare workers after the BioNTech COVID-19 vaccine, regardless of dose status. Possible mechanisms include sex-hormone differences (e.g., depressed innate and adaptive immune response by testosterone) and genetic factors (e.g., higher expression of type 1 interferons (IFN), innate immune responses and T cell-associated genes; angiotensin converting enzyme (ACE) 2 and Ang-II receptor type 2 gene located on the X chromosome).[31]

Omitting alcohol swabs can be cost-effective and time effective. Using a similar estimation as Wong et al., (2019), if alcohol swabs cost 1 to 18 cents each (Canadian Dollars, CAD), and there about 79 000 long term care residents in Ontario that require 1 influenza vaccine and 1 COVID-19 booster per year,

Table 3. Coefficients and adjusted risk ratios of Adverse Events Following Immunization (AEFI) by swab status.

	AEFI			
	Reactogenicity		Systemic Reaction	
Factor, referent	β (S.E)	Risk Ratio (95% CI)	β (S.E)	Risk Ratio (95% CI)
Alcohol Swab, no swab	−0.63 (0.60)	0.54 (0.17–1.73)	−0.29 (0.53)	0.75 (0.26–2.13)
Dose 2, dose 1	0.70 (0.36)	2.0 (0.996–4.06)	−1.95 (1.07)	0.14 (0.02–1.16)
Alcohol Swab x Dose	0.20 (0.61)	1.23 (0.37–4.09)	2.10 (1.19)	8.12 (0.79–83.19)
Age (decades), 85 years	0.16 (0.22)	1.18 (0.77–1.80)	−0.11 (0.25)	0.89 (0.55–1.45)
Female, male	1.19 (0.52)	3.29 (1.20–9.06)*	−0.22 (0.43)	0.80 (0.34–1.87)
Intercept, na	−3.53 (0.57)	0.03 (0.01–0.09)	−2.40 (0.50)	0.09 (0.03–0.24)

*$p < .05$.

the yearly provincial cost would be $1,580 – $28,440 CAD. Adding an estimated 1 minute for administration for the yearly injections, alcohol swab adds a total of 2,633.3 hours to a healthcare sector already having challenges with staff shortages.[21] Omitting alcohol swabs can also reduce pre-procedural anxiety[15] and pain ,[16–18] which contribute to ISRR and AEFI.[5]

There are several limitations in this study that are acknowledged. First, this was a small sample which limits the ability to detect differences between groups. In our prior study,[18] we estimated that 4,710,000 individuals would be needed to detect a doubling in the risk of cellulitis or abscess if the baseline rate was 0.001%. Such data are unlikely to be obtained from a single study. Meta-analytic approaches utilizing pooled data from studies such as this one could be used to generate more robust estimates of risk. Alternatively, large scale registry data could be leveraged to determine risk if the relevant data were routinely collected. At present, registry data containing this information does not exist in Canada. Second, participants were not randomized and there may be differences between the sites that affect outcomes, such as a background difference in hygiene practices. Both LTC, however, were similar in measurable attributes, including size and funding (moderately-sized and non-for-profit) and patient demographic data. Third, a standardized protocol (e.g., diary or checklist) was not used to collect potential AEFI by nursing staff. It is possible that staff taking care of patients that did not receive an alcohol swab were more vigilant in observing residents and documenting adverse reactions because of the change in their practice compared to normal. This could lead to an over-estimate in the incidence of side effects in the group that did not receive alcohol. Since participants were in a monitored setting post-vaccination, it is less likely that any serious AEFI were missed, in particular, cellulitis and abscess. A participant diary could not be used given the elevated prevalence of cognitive impairment in LTC.[21] Fourth, the study did not assess acceptability of the practice change with residents. However, in a subsequent study we conducted in community pharmacy-based vaccinations, 65% of almost 300 included individuals aged 65 years and older elected to forego the alcohol swab when given the choice by pharmacy immunizers.[32] These results provide preliminary evidence of acceptability in the targeted population. Finally, we note that this study cannot speak to the efficacy of the vaccines with or without skin swabbing. Despite these limitations, this study presents novel information about the risk of an AEFI when omitting alcohol swab cleansing in this population.

In summary, this study did not demonstrate an elevated risk of AEFI (i.e., reactogenicity, cellulitis, abscess or systemic reaction) in LTC residents receiving two doses of the BNT162b2 mRNA COVID vaccine. These findings are consistent with prior studies demonstrating that alcohol skin antisepsis is an unnecessary aspect of vaccine administration and should be reconsidered in immunization injection guidelines. Future larger studies and meta-analyses of primary studies that examine this question as well as studies that evaluate the long-term benefits of reducing injection-related AEFI on vaccine attitudes and vaccine acceptance in this population are recommended.

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Disclosure statement

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Author contributions statement

BL and AT were involved in the conception and design; BL and JF were involved in the data collection; BL, SD and AT in the data analysis; BL, CV, NM, and AT revising it critically for intellectual content. All authors agree to be accountable for all aspects of the work.

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