



Original Article

## Facial topical cream promotes facemask tolerability and compliance during COVID-19 pandemic



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### المخلص

**أهداف البحث:** يعتبر استخدام قناع الوجه ضروريا للعلاج أثناء جائحة كوفيد-19. قد تسبب اقنعة الوجه اعتلال جلدي بالوجه. قد تقلل الكريمات الموضعية من مضاعفات اقنعة الوجه. تبحث هذه الدراسة السريرية تأثير الكريمات الموضعية المختلفة على تحمل قناع الوجه ومضاعفاته.

**طرق البحث:** أجريت هذه الدراسة المستقبلية المبنية على المشاهدة على 80 بالغاً. اختار المشاركون طواعية استخدام الكريمات الموضعية أثناء استخدام قناع الوجه. تم جمع البيانات باستخدام مقاييس تم التحقق من صحتها قبل وبعد وضع الكريم الموضعي.

**النتائج:** استخدم 23,8% من المشاركين جل ليدوكاين، استخدم 17,5% الفازلين، استخدم 16,2% كريم الهيدروكورتيزون، استخدم 16,2% كريم دايفين هيدرامين، استخدم 13,8% كريم أرنیکا، واستخدم 12,5% كريم أوكسيد الزنك. كانت مدة استخدام قناع الوجه 6 ساعات بين الموظفين و 4 ساعات بين المرضى. كانت مدة استخدام قناع الوجه مماثلة مع الكريم الموضعي وبدونه. كان ارتفاع درجة حرارة الوجه أقل مع جميع الكريمات. كان احمرار الوجه أقل مع جميع الكريمات. كان ألم الوجه أقل لجميع الكريمات. كان التوافق مع قناع الوجه أفضل مع جميع الكريمات. كان ارتفاع درجة حرارة الوجه الأقل مع ليدوكاين الموضعي. كان احمرار الوجه المبكر الأقل مع الهيدروكورتيزون الموضعي أو دايفين هيدرامين. كان الاحمرار الشديد الأقل مع الهيدروكورتيزون الموضعي أو

أوكسيد الزنك. كان ألم قناع الوجه الأقل مع ليدوكاين الموضعي. كان التوافق مع قناع الوجه الأفضل مع ليدوكاين الموضعي. حصل الفازلين على أفضل رضا ورائحة من قبل المستخدمين.

**الاستنتاجات:** تقلل الكريمات الموضعية مضاعفات قناع الوجه، وذلك بتعزيز توافق قناع الوجه. يعتبر الليدوكاين الموضعي الأكثر فعالية في تقليل الألم وتمكين التوافق لقناع الوجه. تعتبر الكريمات الموضعية الهيدروكورتيزون ودايفين هيدرامين وأوكسيد الزنك فعالة لتقليل احمرار الوجه. حصل الفازلين الموضعي على أفضل رضا من المستخدمين.

**الكلمات المفتاحية:** أمراض قناع الوجه الجلدية؛ الليدوكاين الموضعي؛ الستيرويد الموضعي؛ مضادات الهيستامين الموضعية؛ الفازلين الموضعي

### Abstract

**Objectives:** Facemask use is essential for managing the COVID-19 pandemic, but may cause facial dermatopathy. Topical creams may minimise facemask complications. This clinical study explores the impact of different topical creams on facemask tolerability and complications.

**Methods:** This was a prospective observational study involving 80 adults. Participants voluntarily chose and used topical creams during facemask use. Data were collected using validated scales before and after topical cream application.

**Results:** About 23.8% of the participants used lidocaine gel, 17.5% used petrolatum, 16.2% used hydrocortisone cream, 16.2% used diphenhydramine cream, 13.8% used

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arnica cream, and 12.5% used zinc oxide cream. Duration of facemask use was 6 h amongst staff and 4 h amongst patients, and was similar both with and without topical cream. Facial temperature rise was lower with all creams ( $p = 0.033$ ), as was facial redness ( $p = 0.037$ ) and facial pain ( $p = 0.025$ ). Facemask compliance was better for all creams ( $p = 0.015$ ). The facial temperature rise was the lowest with topical lidocaine ( $p = 0.021$ ). Early facial redness was lowest with topical hydrocortisone or diphenhydramine ( $p = 0.042$ ). Severe redness was lowest with topical hydrocortisone or zinc oxide ( $p = 0.044$ ). Facemask pain was lowest with topical lidocaine ( $p = 0.035$ ), and facemask compliance was best with topical lidocaine ( $p = 0.001$ ). Petrolatum had the best user satisfaction and odour ratings ( $p = 0.041$ ).

**Conclusion:** Topical creams minimise facemask complications, thereby promoting compliance; topical lidocaine was the most effective in reducing pain and enabling facemask compliance. Topical hydrocortisone, diphenhydramine, and zinc oxide were effective in reducing facial redness, and topical petrolatum produced the best user satisfaction.

**Keywords:** Facemask dermatosis; Topical antihistamine; Topical lidocaine; Topical petrolatum; Topical steroid

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## Introduction

The coronavirus 2019 (COVID-19) pandemic is a lethal viral respiratory infection.<sup>1–5</sup> Facemask use by the general population and healthcare workers is a crucial part of managing the pandemic.<sup>5</sup> Short-term and prolonged facemask use may be associated with localised facial skin complications<sup>6,7</sup> related to facemask material, moisture, heat, and pressure,<sup>7,8</sup> including skin rash, bruising, acne, discomfort, pruritus, indentation, dyspigmentation, hotness, ulceration, redness, crusting, infection, and dermatitis.<sup>6–9</sup> The complications may be bothersome for many medical staff and patients who wear facemasks repeatedly, frequently or for prolonged periods.<sup>10</sup> These complications may provoke face touching, scratching, or facemask non-compliance, which undermines facemasks' protective efficacy and COVID-19 infection control.<sup>11</sup>

Hydrogel, strip, or other device skin dressings may minimise facemask dermopathy; however, these dressings are expensive, imported, inconvenient, and may impair facemask efficacy.<sup>12,13</sup> However, topical application of suitable non-prescription creams may provide simpler, affordable, and better prophylactic management of facial skin complications. There are currently no published studies regarding using topical creams for the prophylactic management of facial mask skin complications. This clinical study examined the

impact of different non-prescription topical creams on facemask tolerability, compliance, and related skin complications during the COVID-19 pandemic. This research explored the types of skin complications related to facemask use, factors that influence their severity, factors that impact facemask compliance, the efficacy of different topical creams regarding facemask tolerability, and user satisfaction with topical creams.

## Materials and Methods

This was a prospective observational clinical study. It was also a quality assurance study of routine clinical practice and social behaviour, and was approved by the Health Authority Research Office and Healthcare Facilities. The study was conducted in two pain clinics in Canada, from May 2020 to April 2021. The clinics provided a variety of complimentary topical creams in individual small tubes for staff and patients to apply on their face under their facemasks to enhance facemask tolerability and compliance. All staff and consecutive patients who were interested in the study were provided with essential information about all available topical creams. When they selected their preferred cream, more detailed product information about their selected cream was provided. All participants voluntarily selected their preferred cream, applied it themselves, and kept the tube for personal exclusive use. Each participant selected a cream that they were relatively familiar with or were comfortable using and provided informed consent before selection and use. All eligible staff and patients who consented were included in the study.

All participants used the same type of surgical mask with an ear loop, pleating, and American Society for Testing and Materials (ASTM) level 3 barrier (Pri-Med Medical Products Inc., Edmonton, Canada). The six types of creams available were petrolatum (Unilever, Ontario, Canada), 1% hydrocortisone acetate (Taro Pharmaceuticals Inc., Ontario, Canada), 4% lidocaine gel (Mentholatum Company Ltd, Ontario, Canada), 15% zinc oxide (H.J. Sutton Industries Ltd, Ontario, Canada), 25% arnica (Church & Dwight Corp, Ontario, Canada), and 2% diphenhydramine (Johnson & Johnson Inc, NJ, USA). All the creams have a shelf-life of 3 years and good stability when stored within a temperature range of 13–32 Celsius. After being opened, the creams were suitable for repeated use and stable storage at 13–32 Celsius. Exclusion criteria were atopic eczema, contact dermatitis, skin diseases, allergy to topical cream products, allergy to facemask material, refusal of facemask, contraindication to facemask use, and cognitive impairment. All clinic staff and patients were eligible to participate in the study.

Measurements were taken at baseline before the first facemask use and during the first four facemask sessions. Each session was performed on a different day. In the first and third sessions, a facemask was used without any topical cream. In the second and fourth sessions, participants were advised to apply the same topical cream before facemask use. An observer blinded to the session number and topical cream type recorded the measurements and data. Each date was matched to the number of sessions.

The temperature of the rooms was maintained at  $21 \pm 1$  °C, and the relative humidity was maintained at  $50 \pm 4\%$ .

Using the CEM© infra-red thermometer (Lotus NL BV, The Hague, Netherlands), cheek skin temperature was recorded at zero hour, and hourly until discharge from the clinic or until the participant discontinued facemask use. Changes in skin temperature were also calculated. Hourly evaluations of facial skin redness or increased pigmentation were graded as none, mild, or severe, based on the Taylor hyperpigmentation scale (THS), a validated tool for evaluating skin pigmentation and colour change.<sup>14</sup>

Hourly evaluations of facemask-related facial discomfort were recorded based on the numeric pain rating scale (NPRS). NPRS scores were grouped into three categories: 0, no discomfort, 1–4 = mild pain, and 5–10 = severe pain. Facemask compliance was recorded when the observer made unannounced half-hourly checks on participants to observe facemask removal, face touching, or face scratching. Observation of any of these behaviours was noted as non-compliance, while non-occurrence was recorded as good facemask compliance. The participants rated the topical cream regarding odour (good or bad), satisfaction (satisfied or dissatisfied), and localised complications (none or present).

The quantitative and qualitative data are presented in the tables, and includes numbers, ranges, categories, and descriptions. The data were compared, analysed, and interpreted objectively. Data were analysed with IBM® SPSS® Statistics 25 (IBM Corp, Armonk, NY, USA), using Student's t-test, ANOVA, and Pearson Chi-square test. Statistical significance was set at  $p < 0.05$ .

## Results

Table 1 shows the general characteristics of the study population. The study included 80 participants, comprising 19 healthcare workers and 61 chronic pain patients. The healthcare workers included 10 clinical staff and 9 trainees. The chronic pain patients included 30 patients undergoing lidocaine infusion therapy and 31 undergoing interventional regional analgesia blocks. The average age of the clinical staff was 38 years, and that of the trainees was 27 years. The average age of lidocaine infusion patients was 51 years, and that of regional analgesia block patients was 56 years. The average body mass index (BMI) of the healthcare workers was similar at  $25 \text{ kg/m}^2$ ; the patients' average BMI was similar at  $36 \text{ kg/m}^2$ . The male-

to-female ratio for healthcare workers was 1:4. The male-to-female ratio for the patients was 1:2. Overall, there were 37 non-Caucasian (46.3%) and 43 Caucasian (53.7%) participants. Among the healthcare workers, the population of non-Caucasians was twice that of Caucasians. Among the lidocaine infusion patients, the population of Caucasians was twice that of non-Caucasians, and among the regional block patients, the population of Caucasians was 1.5 times that of non-Caucasians.

Table 2 shows the participants' choices of topical creams. Lidocaine gel was used by 23.8% of the total study population, 26% of healthcare workers, 23% of patients, 30% of lidocaine infusion patients, and 16.1% of regional analgesia block patients. Petrolatum was used by 17.5% of the total study population, 20% of lidocaine infusion patients, and 19.4% of regional analgesia block patients. Of the total study population, 16.2% used hydrocortisone cream, 16.2% used diphenhydramine cream, 13.8% used arnica cream, and 12.5% used zinc oxide cream. Lidocaine gel was the most popular, and zinc oxide cream was the least popular.

Table 3 shows the measurements during facemask use without topical cream application. The average duration of continuous facemask use was about 6 h in the staff and trainee subgroups ( $p = 0.790$ ) and 4 h in both patient subgroups ( $p = 0.860$ ). Facial skin temperature rise at 2–4 h was similar in all subgroups ( $p = 0.511$ ), and did not change after 4 h in all subgroups. The incidence of mild facial redness at 2 h was similar in all subgroups ( $p = 0.620$ ), and of severe facial redness at 4 h was also similar in all subgroups ( $p = 0.464$ ). The incidence of mild facial pain at 2 h ( $p = 0.036$ ) and of severe facial pain at 4 h ( $p = 0.011$ ) were both lowest in lidocaine infusion patients. The average rate of facemask compliance was highest in lidocaine infusion patients ( $p = 0.045$ ).

Table 4 shows the measurements during facemask use with topical cream application. The duration of facemask use was similar for days with and without topical cream application ( $p = 0.860$ ). The average and range of facial skin temperature rise at 2–4 h were lower after all topical cream applications ( $p = 0.033$ ), and facial skin temperature did not change after 4 h in all subgroups. The incidence of mild facial redness at 2 h was lower after topical cream application ( $p = 0.042$ ), and incidence of severe facial redness at 4 h was also lower ( $p = 0.037$ ). The incidence of mild facial pain at 2 h was lower after topical cream application ( $p = 0.025$ ), as was the incidence of severe

**Table 1: Participants' general characteristics.**

	Clinical staff	Clinical trainees	Patients for lidocaine infusion	Patients for regional analgesia block
Age yrs Mean $\pm$ SD (range)	38 $\pm$ 14 (24–52)	27 $\pm$ 8 (19–35)	51 $\pm$ 15 (36–66)	56 $\pm$ 14 (42–70)
BMI $\text{kg/m}^2$ Mean $\pm$ SD (range)	25 $\pm$ 2 (23–27)	25 $\pm$ 2 (23–27)	36 $\pm$ 14 (22–50)	36 $\pm$ 12 (24–48)
Sex Male:Female	2:8	2:7	9:21	11:20
Race Non-Caucasian:Caucasian	7:3	6:3	11:19	13:18
Total n (%)	10 (12.5)	9 (11.3)	30 (37.5)	31 (38.7)

SD=Standard deviation.

**Table 2: Participants' topical cream choice.**

	Clinical staff	Clinical trainee	Patient for lidocaine infusion	Patient for regional analgesia block	Total. n (%)
Arnica 25%	3	2	4	2	11 (13.8)
Diphenhydramine 2%	1	2	5	5	13 (16.2)
Hydrocortisone 1%	1	1	3	8	13 (16.2)
Lidocaine 4%	3	2	9	5	19 (23.8)
Petrolatum	1	1	6	6	14 (17.5)
Zinc Oxide 15%	1	1	3	5	10 (12.5)
Total. N (%)	10 (12.5)	9 (11.3)	30 (37.5)	31 (38.7)	80 (100)

facial pain at 4 h ( $p = 0.019$ ). The average rate of facemask compliance was better after topical cream application ( $p = 0.015$ ).

Table 5 shows the measurements during facemask use and the effects of each topical cream. The average and range of duration of facemask use were similar in all the topical cream subgroups ( $p = 0.900$ ). The average and range of facial skin temperature rise at 2–4 h was lowest with topical lidocaine gel ( $p = 0.021$ ), and facial skin temperature did not change after 4 h in all subgroups. The incidence of mild facial redness at 2 h was lowest with topical hydrocortisone or diphenhydramine cream ( $p = 0.042$ ). The incidence of

severe facial redness at 4 h was lowest with topical hydrocortisone or zinc oxide cream ( $p = 0.044$ ). The incidence of mild facial pain at 2 h ( $p = 0.001$ ) and of severe facial pain at 4 h ( $p = 0.035$ ) were both the lowest with topical lidocaine gel. The average rate of facemask compliance was the highest with topical lidocaine gel ( $p = 0.001$ ). The positive rating for cream odour was best with topical petrolatum ( $p = 0.031$ ), as was overall user satisfaction rating ( $p = 0.041$ ). The only localised skin complication that occurred was transient numbness for an average period of 60 min, which only occurred in 50% of patients who used topical lidocaine gel ( $p = 0.001$ ).

**Table 3: Measurements during facemask use without topical cream application.**

	Clinical staff	Clinical trainees	Patients for lidocaine infusion	Patients for regional analgesia block
Duration of facemask wear or use, range	6–8 h	6–7 h	4–5 h	3–5 h
Duration of facemask wear or use, average	7 h	6 h	4 h	4 h
Face temp rise at 2–4 h, range. Not changed >4 h.	1.55 ± 1.21 °C	1.53 ± 1.21 °C	1.55 ± 1.2 °C	1.53 ± 1.2 °C
Face temp rise at 2–4 h, average. Not changed >4 h.	1.38 °C	1.37 °C	1.375 °C	1.365 °C
Mild face redness at 2 h; incidence rate. Not severe.	23%	21%	22%	25%
Severe face redness at 4 h; incidence rate. Not mild.	25%	24%	21%	26%
Mild face pain at 2 h; incidence rate. Not severe.	29%	30%	18%	28%
Severe face pain at 4 h; incidence rate. Not mild.	33%	35%	15%	35%
Facemask non-compliance rate.	20%	30%	15%	30%

**Table 4: Measurements during facemask use with topical cream application.**

	Clinical staff	Clinical trainees	Patients for lidocaine infusion	Patients for regional analgesia block
Duration of facemask wear or use, range	6–8 h	6–7 h	4–5 h	3–5 h
Duration of facemask wear or use, average	7 h	6 h	4 h	4 h
Face temp rise at 2–4 h, range. Not changed >4 h.	1.0 ± 1.0 °C	1.0 ± 1.0 °C	1.0 ± 0.8 °C	1.0 ± 1.0 °C
Face temp rise at 2–4 h, average. Not changed >4 h.	1.01 °C	1.01 °C	1.0 °C	1.0 °C
Mild face redness at 2 h; incidence rate. Not severe.	11%	11%	10%	10%
Severe face redness at 4 h; incidence rate. Not mild.	7%	6%	5%	6%
Mild face pain at 2 h; incidence rate. Not severe.	11%	11%	8%	10%
Severe face pain at 4 h; incidence rate. Not mild.	5%	5%	1%	4%
Facemask non-compliance rate.	3%	3%	1%	3%

**Table 5: Measurements during facemask use and effects of each topical cream.**

	Arnica 25%	Diphenhydramine 2%	Hydrocortisone 1%	Lidocaine 4%	Petrolatum	Zinc Oxide 15%
Duration of facemask wear, range	4–8 h	4–8 h	4–8 h	4–8 h	4–8 h	4–8 h
Duration of facemask wear, average	5 h	5 h	5 h	5 h	5 h	5 h
Face temp rise at 2–4 h, range.	1.2 ± 1.0 °C	1.2 ± 1.0 °C	1.2 ± 1.0 °C	1.0 ± 0.8 °C	1.2 ± 1.1 °C	1.2 ± 1.1 °C
Not changed >4 h						
Face temp rise at 2–4 h, average.	1.15 °C	1.15 °C	1.15 °C	0.9 °C	1.15 °C	1.15 °C
Not changed >4 h						
Mild face redness at 2 h; incidence rate. Not severe.	9%	7%	7%	12%	10%	9%
Severe face redness at 4 h; incidence rate. Not mild.	5%	5%	4%	9%	9%	4%
Mild face pain at 2 h; incidence rate. Not severe.	9%	9%	9%	2%	5%	9%
Severe face pain at 4 h; incidence. Not mild.	5%	4%	4%	1%	4%	5%
Facemask non-compliance rate.	4%	3%	4%	0%	5%	4%
Topical cream odour, good rating.	60%	70%	70%	70%	90%	70%
Overall satisfaction rate.	67%	80%	80%	80%	90%	80%
Localised complications rate	None	None	None	Numbness 50% rate	None	None

## Discussion

Managing the COVID-19 pandemic necessitates the general use of personal protective equipment, especially N95 or surgical facemasks.<sup>5</sup> Surgical facemasks provide effective protection when fitted to the face appropriately, covering the nose and mouth properly, and worn continuously while around other people.<sup>5</sup> However, the associated complications of facial dermatopathy may be problematic.<sup>6–10</sup> The current study of facemask dermatopathy in healthcare workers and patients is unique and involves a reliable crossover methodology where measurements were recorded from each participant during sessions of facemask use without topical cream, and during other sessions of facemask use with topical cream application. The general characteristics of the clinical staff and trainee subgroups were comparable. The general characteristics of lidocaine infusion patients and regional analgesia block patients were comparable. The populations of the non-Caucasian and Caucasian subgroups were comparable, and the Taylor hyperpigmentation scale was reliably used to evaluate different skin pigmentations or colour changes.<sup>14</sup> The study measurements were mostly objective and performed on validated measurement scales, providing reliable and valid outcomes.

Patients' average duration of facemask use was 4 h and was complicated by dermatopathy, which corroborates other studies.<sup>7,9,10</sup> The average duration of facemask use by the healthcare workers was 6 h and this long duration was also complicated by dermatopathy, corroborating other publications.<sup>6,8,10</sup> Without topical cream, the facemask dermatopathy features of facial redness, hotness, and pain were noticeable after 1 h, and increased with time, consistent with a previous study.<sup>8</sup> The current study confirms that facemask use for more than 4 h may be complicated by facial dermatopathy; however, it also showed that facial skin temperatures did not increase significantly after 4 h, which is an interesting finding that may be due to

homeostatic response. Without topical cream, facemask-related pain was lowest in the lidocaine infusion patient subgroup, which was due to the mild analgesic effect of systemic lidocaine administration. Without topical cream application, facemask compliance was best in the lidocaine infusion patient subgroup, and this is related to the systemic lidocaine analgesic effect. The average duration of systemic lidocaine analgesia was 1 h.<sup>15</sup> Measurements from the lidocaine infusion patients were taken after 2 h; therefore, they should not be confounded by systemic analgesic effects.

All the topical creams evaluated in this study were non-prescription and readily available. Arnica cream costs 19 cents/g, diphenhydramine cream costs 37 cents/g, hydrocortisone cream costs 33 cents/g, lidocaine gel costs 24 cents/g, petrolatum costs 8 cents/g, and zinc oxide cream costs 12 cents/g. However, hydrogel dressing costs 355 cents per session, and strip skin dressing costs 595 cents per session. Thus, the prophylactic management of facemask dermatopathy by topical cream application is easier and cheaper than hydrogel or strip device skin dressings. Topical lidocaine was the most popular choice among the majority of participants; it provides effective relief of facial cutaneous pain or pruritus with minimal adverse effects.<sup>16</sup> Topical petrolatum was the second choice by the total study population. Petrolatum is popular and efficacious for facial skin protection and healing.<sup>17</sup> Topical diphenhydramine and hydrocortisone were the joint third choice, and were used by one-third of all participants. Topical diphenhydramine has potent anti-histamine and anti-inflammatory cutaneous activity.<sup>18</sup> Topical hydrocortisone produces reliable anti-inflammatory and immunomodulatory cutaneous effects.<sup>19</sup> Topical arnica and zinc oxide were the last choices and were used by a quarter of all participants. Topical arnica promotes facial skin restoration and healing of bruises.<sup>20</sup> Topical zinc oxide provides excellent cutaneous photoprotection, antioxidant, and antibacterial activity.<sup>21</sup>

The current study shows that all topical creams significantly minimised facial skin temperature elevation during 4 h

of facemask use. This is an interesting outcome that will enhance the appearance, morale, and satisfaction of facemask users. The study confirms that all topical creams significantly decreased facial redness and pain during the initial 4 h of facemask use. This is a positive finding that supports the comfort, cosmesis, and confidence of facemask users. However, all the topical creams had insignificant effects on facial skin temperatures, redness, and pain after 4 h, which may be related to their half-life and effect duration. Nonetheless, all the topical creams are very safe and may be re-applied after 4 h.<sup>15–21</sup> This study highlights that all the topical creams significantly enhanced facemask use or compliance. All the creams provided effective skin barrier protection, thereby keeping the skin closer to its physiological state. These are exciting findings that will promote facemask use and the management of respiratory infections, such as the COVID-19 pandemic. Enhanced facemask use by the general population will significantly aid the global control of the COVID-19 pandemic.<sup>5</sup>

The current study revealed that topical creams have different efficacy levels for producing certain effects. Topical lidocaine was the most effective in minimising facial skin temperature elevation during facemask use. The skin-cooling activity is due to lidocaine's complex effects on the cutaneous vasculature or perfusion.<sup>16</sup> Topical lidocaine was the most efficacious in diminishing facemask-related pain, and it produced the highest rate of facemask compliance. These positive effects result from lidocaine's anti-nociceptive and local neuronal blockade activity.<sup>15,16</sup> However, it also caused transient facial skin numbness in half of the study population, which was the only type of localised skin complication reported in this clinical study. The mild complication of skin numbness is very short-lived and is a reversible local anaesthetic effect.<sup>15,16</sup> Nonetheless, topical lidocaine had the second highest user satisfaction rating. Topical petrolatum had the highest user satisfaction rating and the most positive rating for cream odour. The high satisfaction rating could be attributed to its good odour, minimisation of skin temperature elevation, reduction of redness, pain suppression, and low cost. Petrolatum is renowned, very cheap, and effective for skin protection or restoration.<sup>17</sup> Topical arnica had the lowest user satisfaction rating and the least favourable rating for odour, and these qualities may be interdependent. Topical hydrocortisone or diphenhydramine was the most efficacious in reducing mild or early facial redness at 2 h of facemask use. These creams have potent anti-inflammatory activity, which significantly reduces cutaneous swelling, redness, and itching.<sup>18,19</sup> However, these are the most expensive creams that were evaluated: diphenhydramine cream costs 37 cents/g, and hydrocortisone cream costs 33 cents/g. Topical zinc oxide or hydrocortisone was the most effective in reducing severe or delayed facial redness at 4 h. Both creams have durable anti-inflammatory and antioxidant activities, which significantly reduce skin redness, swelling, and pruritus.<sup>19,21</sup> This study confirmed that topical zinc oxide is cheap, has a moderately positive odour rating, and moderately high user satisfaction rating. However, it was the least popular choice, which may be attributed to its strong white colouration or poor cosmetic appearance on the face.

Without topical cream application, the lidocaine infusion patients had better facemask compliance rates, which may be related to the systemic lidocaine analgesic effect. However, the average duration of systemic lidocaine analgesia was 1 h, and study measurements from the lidocaine infusion patients were taken after 2 h. Therefore, the study measurements may not be confounded by the analgesic effect of systemic lidocaine.

## Conclusion

Facemask use for more than 4 h may be complicated by facial dermatopathy and pain. Facemask dermatopathy may provoke face scratching or facemask under-use, which compromises facemasks' protective effectiveness. Topical application of suitable non-prescription creams effectively minimises facemask complications, thereby promoting facemask tolerability and compliance during the COVID-19 pandemic. Topical lidocaine was the most effective in reducing facemask-related pain and facial hotness, and it enabled the best facemask compliance. Topical petrolatums had the best user satisfaction and cream odour ratings. Topical arnica had the lowest user satisfaction ratings and the least favourable odour ratings. Topical hydrocortisone and diphenhydramine were the most effective at reducing early facial redness, but were the most expensive. Topical zinc oxide and hydrocortisone were the most effective at reducing severe or delayed facial redness. Topical petrolatum and zinc oxide are the cheapest and most cost-effective.

People who wear facemasks frequently or for considerable periods should protect their facial skin with topical petrolatum, zinc oxide, or arnica cream. People who experience severe facial redness from facemasks should protect their skin with topical hydrocortisone or diphenhydramine cream. People who experience significant facemask-related facial pain should use topical lidocaine gel for relief.

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## Conflict of interest

The authors have no conflict of interest to declare.

## Ethical approval

This clinical study was approved by the Fraser Health Authority and Healthcare Facilities, who confirmed that it is a quality assurance study and does not require a formal research ethics board review.

## Authors contributions

OAB, RNR, MM, RNA, LMM, and BTO were involved in the conception, design, data collection, data analysis and interpretation, writing initial and final drafts, proofreading, critical review, and approval of the final draft of the article. All authors are responsible for the content and similarity

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