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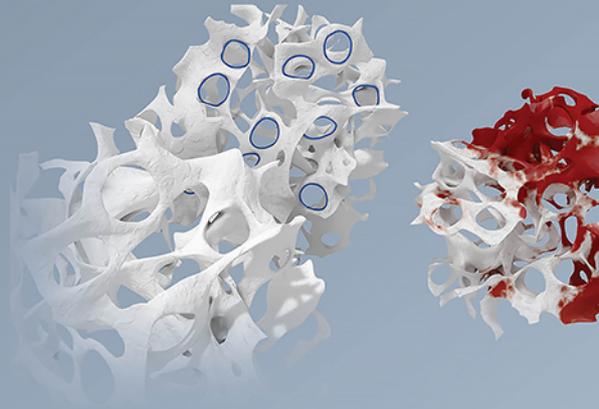
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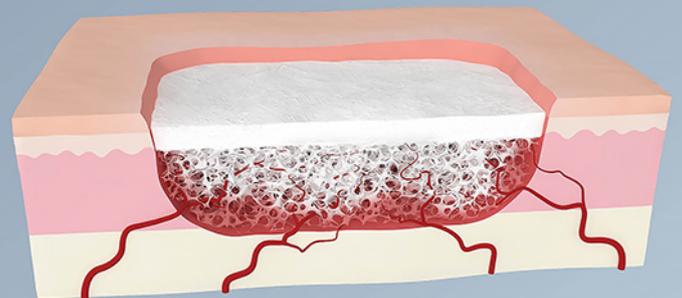
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ORIGINAL ARTICLE

Preventing facial pressure injuries among health care staff working in diverse COVID-19 care environments

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Abstract

The aim of this study was to determine the impact of a specially designed care bundle on the development of facial pressure injuries among frontline health care workers wearing personal protective equipment (PPE) during the COVID-19 pandemic. This was a mixed methods study. First, a pre-posttest observational design was employed to evaluate the impact of the pre-piloted intervention, a care bundle including skin cleansing and hydration, protective material use, facemask selection and skin inspection, developed in line with international best practice guidelines. Data were collected using survey methodology. Frontline COVID-19 staff working in acute, community and ambulance services were invited to participate. Then, judgemental and volunteer sampling was used to select participants to undertake semi-structured interviews to elicit feedback on their perceptions of the care bundle. The sample included 120 acute hospital staff, 60 Ambulance staff, 24 Community Hub staff and 20 COVID-19 testing centre staff. A survey response rate of 61% was realised ($n = 135/224$). Of the participants, 32% ($n = 43$) had a facial pressure ulcer (FPI) pre-intervention and 13% ($n = 18$) developed an FPI while using the care bundle. The odds ratio (OR) was 0.33 (95% CI: 0.18 to 0.61; $P = .0004$), indicating a 77% reduction in the odds of FPI development with use of the care bundle. Analysis of the qualitative data from 22 interviews identified three key themes, the context for the care bundle, the ease of use of the care bundle and the care bundle as a solution to FPI development. The care bundle reduced the incidence of FPI among the participants and was found to be easy to use. Implementation of skin protection for frontline staff continues to be important given the persistently high incidence of COVID-19 and the ongoing need to wear PPE for protracted durations.

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Funding information

Science Foundation Ireland/Enterprise Ireland/IDA Ireland, Grant/Award Number: 20/COV/0093

KEYWORDS

COVID-19, facial pressure injury (FPI), personal protective equipment (PPE), staff safety

Key Messages

- facial pressure injuries (FPI) are a significant problem for health care staff wearing protective facemasks, which, without a skin protector, can mechanically indent the skin
- the care bundle reduced the incidence of FPI among the participants and was found to be easy to use
- implementation of skin protection for frontline staff continues to be important given the persistently high incidence of COVID-19 and the ongoing need to wear PPE for protracted durations

1 | INTRODUCTION

As of November 16, 2021, there have been more than 500 000 confirmed cases of COVID-19 and 5278 COVID-19 related deaths in Ireland.¹ Over 19 000 people have been hospitalised in Ireland with COVID-19, and over 2027 people have been admitted to ICU.¹ Although the overall percentage of COVID-19 positive cases requiring ICU care is low (less than 1%), within older age groups ICU admission rates are as high as 25%.¹ This has meant a significant increase in workload for frontline COVID-19 health care staff across multiple health care areas. The care delivered by frontline COVID-19 staff has necessitated the wearing of PPE. It is recommended that these staff wear gloves, masks, goggles or face shields, and long-sleeved gowns.^{2,3} The type of face masks used depends on the setting, personnel and level of activity,² with masks including medical masks, respirator N95 or FFP2 standard, or equivalent.²

Until now, device related pressure injury prevention strategies have been mainly directed towards prevention in patient groups.⁴ However, recent national and international anecdotal information suggests that FPIs are a significant problem for health care staff wearing protective facemasks,^{4,5} which, without a skin protector, can mechanically indent the skin.⁶ The most common facial injury sites have been reported as the bridge of the nose, cheeks, ears, and forehead.⁵ Of note, one COVID-19 study has reported that the overall prevalence of skin injuries in medical staff, caused by PPE, to be 42.8% (95% CI: 41.30%-44.30%),⁵ consistent with data published after the SARS epidemic.⁷

Pressure injuries (PIs) are a localised injury to skin or underlying tissue, usually over a bony prominence, because of prolonged pressure or shear.⁸ FPIs develop when the skin is indented with the continuous use of facemasks.⁹ Notably, FPIs can have a significant negative impact on staff who are already overworked and anxious, placing them at an increased risk of developing an

infection, including COVID-19 itself.¹⁰⁻¹² In addition, single-use face masks were not originally designed to be worn continuously for several hours. An unintended consequence of this has been the prolonged use of PPE further contributing to the occurrence of FPI's among frontline COVID-19 health care workers.⁴

To address this significant pandemic related problem, the research team developed an evidence-based care bundle¹³ for use by COVID-19 frontline staff. The bundle was initially evaluated among staff working in an intensive care unit, with outcomes proving positive in terms of a reduction in the incidence of FPIs and feedback from staff regards the user-friendly nature of the care bundle.¹³ Health care staff in diverse clinical settings are also wearing PPE for prolonged periods of time and are thus, at risk of FPI development. Therefore, we wished to implement the care bundle in these wider care settings, such as broader COVID-19 hospital wards and community care areas, to further evaluate its impact. The study was funded by the Science Foundation Ireland/Enterprise Ireland/IDA Ireland COVID-19 Rapid Response Funding Call, 20/COV/0093 with the industry partner IREMA Ireland supporting the project.

2 | METHODS

2.1 | Research question

What is the impact of a specially designed FPI prevention care bundle among frontline COVID-19 health care workers?

2.2 | Design

This was a mixed methods study including a pre-posttest design and one-to-one qualitative interviews with some participants.

2.3 | Outcomes

2.3.1 | Primary

The primary outcome of interest for the pre-posttest element was the incidence of FPI. For the one-to-one interview, the primary outcome of interest was the participant's perceptions of the care bundle.

2.3.2 | Secondary

The secondary outcomes of interest were pain and ease of use of the care bundle.

2.4 | Sites

This study took place in two large Irish acute hospitals, one COVID-19 testing centre, one COVID-19 Community Hub and the National Ambulance Service, over a 3-month period. Approval to proceed was sought and given from site directors and/or local research audit committees.

2.5 | Population and sample

A total of 224 COVID-19 facing health care staff took part in the study. This comprised 120 acute hospital staff, 60 Ambulance staff, 24 Community Hub staff and 20 testing centre staff. Judgemental and volunteer sampling was used to select 22 semi-structured interview participants who used the bundle. All staff ($n = 224$) working across the aforementioned COVID-19 facing areas were given a kit bag containing the elements of the care bundle and were then invited to participate voluntarily in the study by first of all completing a survey. At each of the research sites, participants who took part were asked by research site link clinicians to volunteer for interview. The 22 staff who were interviewed all had to be working in one of the COVID-19 facing areas, wearing PPE and using the care bundle.

2.6 | Intervention

The care bundle¹³ was developed in line with international best practice.^{6,8,14,15} The bundle included five steps incorporating WaterWipes baby wipes, (WaterWipes UC, Drogheda, Ireland), Eucerin Aquaphor Soothing Skin Balm (Beiersdorf, Hamburg, Germany) and Mepitac™ tape (manufactured by Mölnlycke Health Care AB,

Gothenburg, Sweden). The elements of the bundle have been detailed extensively in a previous paper.¹³

The five steps to the bundle are as follows:

1. Skin protection, using cleansing and moisturisation.
2. Selection of a facemask appropriate to the level of care to be provided.
3. Material use, application of tape and facemask.
4. Skin and facemask inspection during the clinical shift as appropriate.
5. Skin inspection, cleansing and hydration on removal of the PPE and tape.

The care bundle was available on a smartphone app that could be downloaded by all participants. Each participant also received a care bundle kit containing the elements of the care bundle.

2.7 | Data collection

Data were collected between September and December 2020. After three work shifts using the care bundle, each participant was invited to complete a survey on their smartphone. Some areas also distributed paper versions of the survey to ensure ease of response. Qualitative data were collected via semi-structured interviews once surveys were completed. Interview questions were built on survey questions with a particular focus on safety and usefulness. The interview guide allowed participants to elaborate further on safety and their overall perceptions of the usefulness of the care bundle.

2.8 | Data analysis

Survey data were entered onto Stata MP Version 15.1 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC.) and analysed initially using descriptive statistics. Inferential statistical analysis using the OR was undertaken using RevMan (Review Manager (RevMan) [Computer program] Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014). Thematic analysis reduced and categorised qualitative data gathered during the semi-structured interviews, using the approach designed by Attride-Stirling.¹⁶ The interviews were carried out by two members of the research team, and once the interviews were transcribed, each of the two research team members separately reduced and then categorised the data into preliminary themes. Discussion then took place between the two members of the team plus a third member, with a final agreed and validated set of themes emerging.

3 | RESULTS

3.1 | Quantitative

A survey response rate of 61% was realised ($n = 135/224$). As would be expected, nursing staff accounted for the largest group (69%; $n = 93$). However, a range of staff used the care bundle as seen in Table 1.

3.2 | Skin injury prior to use of the care bundle

In total, 32% ($n = 43$) of the staff had a skin injury before using the care bundle. Table 2 outlines the type of skin injury experienced, and as be seen, discomfort was the most common (22%; $n = 29$), followed by a skin tear (4%; $n = 6$) and abrasion (3%; $n = 4$).

3.3 | Skin injury while using the care bundle

In total, 13% of the staff ($n = 18$) had a skin injury while using the care bundle. Table 3 outlines the type of skin injury experienced, and as can be seen, discomfort (11%; $n = 15$) was the most common. The mean number of days to skin injury development was 2.33 (SD: 0.71; median 2; min 1, max 3).

3.4 | Odds ratio of skin injury development, care bundle versus usual care

The odds ratio of FPI development was 0.33 (95% CI: 0.18-0.61; $P = .0004$), meaning that there is a 77%

TABLE 1 The professional discipline of the staff using the care bundle

Discipline	Frequency	Percent
Nurse	93	69
Paramedic	18	13
Health care Assistant	9	7
Dentist	9	3
EMT	11	2
Doctor	2	1
Occupational Therapist	2	1
Speech and Language Therapist	2	1
COVID-19 Swabber	1	1
Dental Nurse	1	1
Total	135	100

reduction in the odds of FPI development with the use of the care bundle. Further, we are 95% confident that the true population parameter lies between a 39% and 82% reduction in the odds of skin injury development with the use of the care bundle.

3.5 | Pain while wearing and removing the personal protective equipment with the care bundle

Participants rated their pain on a scale of 0 to 10, with 0 being no pain, while using PPE with the care bundle. The mean pain score was 1.45/10 (SD: 2.21; median: 0; min 0, max 10). Participants also rated their pain, on the same scale once the PPE was removed. The mean pain score on removal of PPE was 0.98/10 (SD: 1.83; median: 0; min 0, max 9).

3.6 | How easy was the care bundle to use?

Participants rated, on a scale of 0 to 10, how easy they found the care bundle to use. A higher score indicates greater ease with the use of the bundle. The mean score was 7.58 (SD: 2.39; median: 8; min 0, max 10), indicating that participants, on average, found the bundle easy to use.

3.7 | Would you recommend this care bundle to a colleague?

Participants rated on a scale of 0 to 10 how likely they would recommend the care bundle to a colleague. A higher score indicates a greater likelihood of recommending the care bundle. The mean score was 7.30 (SD: 2.68; median: 8; min 0, max 10), indicating that, on average, participants were likely to recommend the care bundle.

TABLE 2 Type of skin injury, pre-use of the care bundle

Type of skin injury	Frequency	Percent
Discomfort	29	22
Skin tear	6	4
Abrasion	4	3
Blister	3	2
Deep sore	1	1
Unanswered	1	1
None	91	76
Total	135	100

TABLE 3 Type of skin injury, while using the care bundle

Type of skin injury	Frequency	Percent
Discomfort	15	11
Abrasion	1	1
Skin tear	2	1
None	118	92
Total	114	100

3.8 | Qualitative results

Twenty-two semi-structured interviews were completed across four sites: acute hospital, COVID-19 testing centre, community COVID-19 hub and the National Ambulance Service. Participants were asked to elaborate further on safety and their overall perceptions of the care bundle. Most respondents were nurses (73%; $n = 16$), and the remaining (27%; $n = 6$) were paramedics.

Following thematic analysis, three key themes emerged in relation to the safety and usefulness of the bundle. These were:

1. Context for the care bundle.
2. Ease of use of the care bundle.
3. The care bundle as a solution to FPI development.

3.8.1 | Context for the care bundle

The COVID-19 pandemic brought with it the challenge of health services purchasing many protective masks in a short period of time, to enhance staff and patient safety by limiting the potential for the spread of the virus. Ensuring masks were safe was a challenge. The fast roll out of mask-wearing necessitated additional staff education in the area on how to wear masks properly. One participant talked at length about the important role that education had in helping people come to terms with the importance of how to wear a mask properly.

(P2) There was a large amount of ongoing training on how to wear a mask, how to put it on and how to take it off, how to ensure it was a good fit and the importance of not touching it when it's in place, that was endless there was a lot of on the spot training.

(P2) Yeah, well, I suppose our concern was people were wearing them inappropriately when they should not be wearing them ... Now at the height of it we actually had four to six nurses on a daily basis, going around

every single clinical area because staff were moving, staff were being redeployed, staff were coming in from other areas and they were not used to wearing PPE.

In terms of length of time wearing the mask, this varied from site to site, with hospital staff wearing masks for longer than staff working in community services who were doing remote testing across different sites. Here are some examples of the mask-wearing time lengths.

(P21) The maximum I would have worn a mask was 5 hours.

(P20) I would not have worn a mask for 5 hours, it would have been on and off in 30 minutes, serial testing would have been 4 hours ...With the serial testing you would have had it on for about 4 hours in factories, etc...Community testing would have been half an hour.

(P19) I wore a mask from a minimum of 2 hours to 6 to 8 hours maximum.

(P18) I was wearing the mask 1 to 2 hours at a time doing pop up sites and house calls and helping overflow from nursing homes and setting up pop up tents.

It became apparent relatively quickly that some staff were starting to experience FPIs, although this was not universal. In some cases, staff were experiencing problems with the seal and fitting of masks potentially compromising safety.

(P2) I did not hear anything about the FFP2 and 3 causing damage to people's faces, but what I did hear was people saying they did not fit properly, or they kept slipping or they were not happy with the strapping, again we found that it would happen with certain brands and we did take those masks out of circulation ... masks that were not of any use to us were used for training purposes ...

(P3) I got a really sore cheekbone and nose every day when I got home after wearing the mask for long periods.

(P5) They're quite tight and they leave huge imprints on your face for quite a while afterwards.

(P18) Most of the time behind the ears I'd get a red rash, a blister behind the ear, purely from ensuring the mask was tight ... when I got the blister, I just usually put on hand cream.

(P19) Under the chin and nose were the areas of discomfort ... the ears were a problem; the mask would slip ... I also had pressure under my right eye, a discomfort that turned into redness, I started using face wipes and Nivea face cream.

Overall, the sudden onset of the pandemic meant that services and staff had to readjust practices quickly. One practice was the wearing of PPE, especially facemasks for long periods of time. This necessitated the provision of masks that fitted and ongoing education on how to use masks in a way that optimised safety for staff and patients. What became apparent quickly was that staff began to develop FPIs from the wearing of protective facemasks for much longer than usual. This provided the immediate impetus to continue the wider roll out and evaluation of the facial skin safety care bundle.

3.8.2 | Ease of use of the care bundle

The five-step care bundle was implemented across several hospital wards and within the community care setting. Participants were asked for their views on the bundle elements and how they found using the bundle in practice. The consensus was that the bundle was easy to use.

(P3) I found the bundle easy to use.

(P7) It was easy to use and very straightforward... and I would have used it instead of what I would ordinarily use.

(P19) I used wipes on my face and being cleanly shaven was important, I put the tape at my eye where it was sore on both sides, it made a big difference, I put on the cream in the morning and it made a huge difference, a bit oily around the nose, it did not feel rough though. I just used one wipe, this was much more efficient when busy, when swabbing, things happen fast and the wipes were perfect for this, we were in places with no water etc, no facilities and the wipes made a massive difference.

(P18) The tape was very good across the nose, I stopped getting marks across my nose ... I put the cream behind my ear I found it grand ... The wipes were handy in the home testing setting, just one wipe as you want to get in and out of the home as quick as you can.

The individual elements of the bundle were also talked about. All participants agreed that the wipes were an effective skin cleanser and were very comfortable and gentle to use.

(P13) They were lovely to use, very gentle in the skin.

(P15) They were very refreshing, especially after wearing the mask.

(P16) They were lovely quality and did not irritate the skin in any way.

(P17) The wipes I felt were excellent, in-between changing of the masks I would have used those, and it would have freshened up the skin and the skin felt better.

The moisturiser was also found to be effective, although some participants found it hard to immediately transition from their usual moisturiser to this new one, as they felt it might not suit everyone.

(P16) its brilliant, it really is excellent...its just very soothing, even for putting on afterwards because your face is just sore and it is really soothing... it does not leave a sticky residue and it is just a lovely quality cream really.

(P17) I did have a flair up from the masks and I used the cream for a while, and it made a big difference.

(P13) I found it nice at night going to bed, after wearing a tight-fitting mask all day.

(P4) I do not think it's a cream that would suit everyone's skin type ...

The protective tape was also evaluated positively as participants felt it protected facial areas around the nose and cheekbones from pressure-related injuries.

(P4) I found the tape very good ... the tape was good as it stayed in place until every time I had to replace my mask and I found it comfortable around the pressure areas where the mask may have been hurting me.

(P6) I did not mind the tape at all, I found it good along the bridge of the nose and each cheek at the same level as the nose.

(P10) I used the tape behind my ears, I did not use it on my nose as we are wearing the surgical masks at the time, and I used the cream ... the tape stayed on behind my ears and it's hard to get tape on stay on there.

However, two participants talked about the need not to place moisturiser under the area where the tape is to be applied and to avoid re-applying the tape frequently as staff move from patient to patient as this could be cumbersome to some.

(P21) I tried the tape but I had moisturised too close to it, so the tape did not stick.

(P22) Due to frequently taking on an off my mask due to dealing with different patients I did not continue using the tape after the first couple of patients ... I found the process of putting on sticky tape and then securing my mask on the way to an emergency painstaking. It required attention to detail and time ... and over a longer period of time the mask becomes detached from the tape.

This theme shows that participants positively evaluated the bundle in its entirety and its different elements. From this feedback, it can be deduced that the bundle, when comprising all elements, provides an effective safety barrier for staff at risk of developing an FPI because of facemask PPE.

3.8.3 | The care bundle as a solution to FPI development

During the current study (September-December 2020), most staff were wearing softer surgical masks. Participants were asked to think back to the earlier part of the pandemic when they would all have been wearing tight-fitting masks. Participants were asked to think about whether the care bundle would have been of benefit while wearing these masks and to talk about their views on the bundle being a viable FPI prevention solution

going forward. It was universally held that the tape would have formed a safe barrier between the face and tight mask, with some caution around the need for staff to ensure they do not apply tape onto the balm. This is best represented by what these participants said.

(P7) Yes, the bundle would have made me more comfortable ... I would recommend the bundle if using the masks for a long time.

(P10) The bundle would have helped when I wore a tight mask during the crisis, it would have protected my nose bridge from the tight-fitting mask.

(P10) The bundle would definitely have helped at the height of the pandemic as we were wearing the FFP masks, we are wearing the surgical masks now which have a poor seal and aren't tight ... behind the ears, on the nose and at the top of the face would get sore with the FFP mask, moisture would build up under the mask and that would irritate your skin.

(P11) Especially with the FFP2 mask the bundle would have helped.... Some of the masks were sore on your nose and behind the ear and the Mepitac tape would have been a protective measure ... the WaterWipes were soothing and very cooling and would have been very appropriate at the time.

(P1) The tape would have helped along the bridge of the nose, there were certain different makes of FFP masks throughout the crisis, and there would have been some that you would have felt more on your nose ... I just felt that the cream may have contributed to the fact that the tape was slipping.

This theme augments the previous one. Staff were asked to think back to the peak of the pandemic and were of the view that the bundle would have helped prevent the development of FPI.

4 | DISCUSSION

The COVID-19 outbreak is challenging for all health care professionals on a collective and individual level.¹⁷ During the COVID-19 emergency, the development of FPIs because of the prolonged wearing of protective facemasks

emerged as a significant threat to the safety of frontline COVID-19 staff. The importance of training and providing safe PPE for frontline staff is crucial in ensuring the health and well-being of staff and ensuring safe staffing of COVID-19 care areas.¹⁸ This study achieved this by developing a new skin care bundle specific to the prevention of FPIs in frontline COVID-19 staff.

This study involved the evaluation of an evidence-based five-step care bundle that was easy to use by COVID-19 frontline staff in different hospital and community areas.¹³ The key elements of the bundle included the face wipe, moisturiser and protective tape, and each element acted in synergy. Thus, the bundle emerged as an all-in-one protector for staff against FPIs. This is of particular importance given the negative impact that FPIs have in terms of the risk of pain, discomfort and infection, including that of COVID-19 itself.¹⁰⁻¹²

Crucially, this study sought to ascertain if the care bundle reduced the chances of staff acquiring an FPI and if the care bundle enhanced comfort. Interview data show clearly that using the care bundle made it less likely that staff would develop an FPI and that it was easy to use. This was the overall finding from the earlier Moore¹³ study that this study followed. The current study had participants working across different acute hospitals and community COVID-19 facing areas. It has clearly expanded upon the findings of the earlier Moore¹³ study that included only acute hospital COVID-19 facing staff. More specifically, in this study, 32% of staff who completed the survey reported a skin injury before using the care bundle, reducing to 13% while using the bundle. In the previous Moore¹³ study, 29% of participants reported an injury, reducing to 8% when using the bundle. In terms of recommending the bundle to a colleague, in this study, the mean score was 7.30/10: the mean score was 8.25/10 in the Moore¹³ study. As can be seen, these key results were broadly similar.

Some elements of bias could have affected the study. For example, the staff who were interviewed either volunteered or were approached to be interviewed. Interview responses were based solely on self-report with no validation of injuries received prior to using the bundle. The improvement in skin condition attributed to the care bundle may have been because of other factors, such as different lengths of time wearing PPE or the clinical setting where participants worked. Length of wear time is a particular factor that should be addressed in future studies. Related to this point is that while the care bundle consisted of five sequential steps, it is not clear what the critical step or steps were. This issue needs further study. Nonetheless, it has been highlighted that when using

care bundles in clinical practice, it is the consistent application of all the elements of the bundle that brings success.¹⁹ We followed this guidance, and as such, the purpose was not to explore the impact of one element of the bundle over another, rather it was to explore the effect of the bundle as a collective.

5 | CONCLUSION

Protection of frontline health care workers is a priority to ensure that staff may work without harm from the use of protective PPE. Throughout this COVID-19 pandemic, it has become apparent that staff have suffered FPIs from the prolonged use of PPE, thus the need for this care bundle intervention emerged. The research team developed an easy-to-use five-step care bundle and evaluated its use across multiple COVID-19 facing areas. Interviews with 22 health care workers found that the bundle was needed at a crucial time during the pandemic, it was easy to use, and it was safe. As with evidence from the international literature, this study has identified that when skincare is prioritised, and a systematic prevention care bundle approach is adopted, there are clear benefits for the individuals involved.

ACKNOWLEDGEMENTS

This research was funded by Science Foundation Ireland/Enterprise Ireland/IDA Ireland COVID-19 Rapid Response Funding Call 20/COV/0093.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study

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How to cite this article: Moore Z, Moore D, McEvoy NL, et al. Preventing facial pressure injuries among health care staff working in diverse COVID-19 care environments. *Int Wound J*. 2022; 1-9. doi:10.1111/iwj.13768