

A decade of developments in dermatological care within Dutch nursing homes: a repeated cross-sectional study

M. (Marleen) van Oosterhout

`marleen.vanoosterhout@radboudumc.nl`

Radboud University Medical Center

J. (Jos) M.G.A. Schols

Maastricht University

R. (Raymond) T.C.M. Koopmans

Radboud University Medical Center

E. (Elke) M.G.J. de Jong

Radboud University Medical Center

S.(Satish) F.K. Lubeek

Radboud University Medical Center

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A decade of developments in dermatological care within Dutch nursing homes: a repeated cross-sectional study.

M. (Marleen) van Oosterhout^a, J. (Jos) M.G.A. Schols^b, R. (Raymond) T.C.M. Koopmans^c,
E.(Elke) M.G.J. de Jong^a, S. (Satish) F.K. Lubeek^a

^a Department of Dermatology, Radboud university medical centre, Nijmegen, the Netherlands

^b Department Health Services Research, CAPHRI, Maastricht University, Maastricht, the Netherlands

^c Department of Primary and Community Care, Radboud university medical centre, Nijmegen, the Netherlands

Correspondence

E-mail: marleen.vanoosterhout@radboudumc.nl / Phone: +/ 616096349

Postal Address: Department of Dermatology, Radboudumc, Post office box 9101, 6500 HB Nijmegen, the Netherlands

Abstract

Background: Managing skin diseases in nursing homes (NHs) is increasingly challenging, necessitating sustainable, and efficient dermatological care provision. Our main aim is to investigate developments in dermatological care within NHs over the past decade, and to identify recommendations for further quality improvement.

Methods: A repeated cross-sectional nationwide survey was conducted among elderly care physicians (ECP) working in NHs, comparing data with a ten-year interval (2013-2014 and 2024). The survey assessed the burden of skin diseases, diagnostics, treatments, collaboration with

dermatologists, physician education/skills, and suggestions for improvement of dermatological care.

Results: A total of 744 physicians were included for comparison between the current (n= 397, response rate 25.5%), and historical (n=347, response rate 30.6%) survey. Current respondents were significantly younger than historical respondents (40.6 ± 11.5 vs 43.9 ± 11.4 years, $p<.001$). Almost all (99.0%) ECPs regularly encountered dermatological problems in their patients. Confrontation with cutaneous (pre)malignancies (59.4% vs 71.0%, $p<.001$) increased the most over time, and remained the primary reason for dermatologist consultation (78.8%). Over time, the proportion of respondents using teleconsultation increased (31.6% vs 85.6%, $p<.001$), while telephone and on-site consultations declined ($p<.001$). There was an increase in availability of cryotherapy (25.6% vs 48.5%, $p<.001$), punch biopsy (15.4% vs 29.7%, $p<.001$), and dermoscopy (6.1% vs 11.9%, $p=.007$) within the NHs. Respondents suggested targeted (disease-specific) education and practical training to improve their knowledge and skills. To improve collaboration with dermatologists, respondents suggested dermatologists to further integrate patients' general health status, and improve communication during medical decision making.

Conclusions: ECPs are frequently confronted with skin diseases. Encounters with cutaneous (pre)malignancies increased the most over time, and remained the primary reason for dermatologist consultation. Over the last decade, the use of teleconsultation, and the availability of diagnostic and treatment procedures in NHs increased. However, to bridge the gap between ECPs' tool availability and their actual experience, future initiatives should focus on cutaneous (pre)malignancy education and skills training embedded within an interprofessional collaboration framework.

Key words

Elderly care physician, nursing home, dermatology, skin neoplasms, teleconsultation

Introduction

Many nursing home (NH) patients with (chronic) skin diseases experience a significant impact on their quality of life (QoL).[1-3] Elderly care physicians (ECPs) are regularly challenged in diagnosing and treating these conditions within the nursing home setting.[4]

As the ageing population continues to grow, the prevalence of skin diseases in NHs is likely to increase.[5,6] Simultaneously, limited capacity in health care, including our Dutch system, underscore the need for maximum efficiency, whilst safeguarding optimal patient-centred care.[7-10] Therefore, adequate and sustainable dermatological care within NHs is urgently required.

A nationwide survey in the Netherlands in 2013-2014 identified challenges in achieving optimal dermatological care within NHs, including limited dermatological knowledge and training among ECPs, limited availability of diagnostic and therapeutic tools, inadequate logistical support within NHs, and insufficient collaboration with hospital-based dermatologists.[4] Suggested improvements included enhanced education, greater use of teledermatology, expanded diagnostic and treatment options within NHs, and more intense interprofessional collaboration.

Over the past decade, various initiatives have been introduced to improve dermatological care for NH patients nationally and internationally. For example, dermatological education is now integrated in the postgraduate Elderly Care Medicine curriculum in the Netherlands.[11,12] Additionally, teleconsultation has developed globally, presenting opportunities for improving dermatological care and cost-efficiency in NHs worldwide.[13-15] Furthermore, effective interprofessional collaboration between ECP and hospital-based specialists is increasingly recognised as essential for optimizing medical care quality for NH patients.[17]

This study explores the current provision of and need for dermatological care in NHs according to ECPs, and the uptake of previously proposed suggestions. Thereby, we aim to provide new recommendations on further improvement of dermatological care for NH patients, which may be

useful for NHs worldwide as well.

Methods

Study design and setting

We conducted a repeated cross-sectional nationwide survey and compared the current survey data, collected between June and December 2024, with the historical survey, conducted between October 2013 and April 2014. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline.[18]

Questionnaire design

For this study, we re-used a previously developed questionnaire covering sections on the burden of skin diseases in NH patients, diagnostics and therapeutic procedures, collaboration with dermatologists, ECPs' level of education/skills, and suggestions for dermatological care improvement. Survey validation and initial results were reported previously.[4] For the current survey, additional questions addressed collaboration with non-physician practitioners (an English version of this questionnaire is available on request). Competence levels were self-assessed using 5-point Likert scales (1 = completely incompetent to 5 = completely competent). Dermatologists' medical decision-making was similarly rated, with higher scores indicating greater consideration.

Study participants and questionnaire administration

The survey was developed using Castor EDC and distributed via the Dutch association of ECP (Verenso) using QR-codes and a digital newsletter. Recipients were asked to share the QR-code with all ECPs, trainees, and junior doctors working at their organisation. To maintain our specific focus on physicians, non-physician practitioners were excluded, due to differences in scope and training. A reminder was sent after three months. The QR-code was open for completion for seven-months. During the historical survey, NH organisations were approached by telephone and requested to

further distribute the questionnaires to all physicians working in their organisation, as *Verenso* did not yet exist and no digital distribution channel was available.

Statistical analysis

Continuous data were expressed as means and standard deviations (SD) or median (range).

Categorical data were expressed as numbers and percentages. To explore the potential impact of clinical experience on management of skin diseases a sub-analysis was conducted based on years of professional experience, dividing participants into 'less experienced' physicians (<10 years of experience), and 'more experienced' physicians (≥ 10 years of experience).

For comparison over time, we used independent t-tests for continuous variables and chi-square or Fisher's exact test for categorical variables. For comparison of competence, 5-point Likert scales were interpreted as continuous variables and a Mann-Whitney U test was performed. The current and historical cohorts were analysed as independent samples, as most respondents (98.8%) did not complete both surveys. A non-responder analysis was performed using available demographic characteristics.

To correct for proportional differences in physician type (ECPs versus trainees/junior doctors) over time, a sensitivity analysis was performed on relevant outcomes after exclusion of trainees/junior doctors. Missing data were handled using pairwise deletion, thereby maximizing the use of all available data and preserving statistical power for each specific analysis. Differences were considered statistically significant when $p < .05$. Data analysis was performed using IBM SPSS (version 29.0).

Results

The current survey reached 1,554 health care professionals, of whom 411 (26.4%) completed the questionnaire. After exclusion of 14 non-physicians, 397 questionnaires (25.5%) remained eligible.

The historical survey reached 1,133 health care professionals, of whom 347 physicians (30.6%)

completed the questionnaire, resulting in a higher ($p < .001$) response rate compared to the current survey.

Therefore, a total of 744 questionnaires were included for comparison over time, of which 9 physicians (1.2%) completed both surveys. No statistical significant differences were found between responders and non-responders regarding age, gender, and type of physician (data available on request). Comparison between the historical and the current survey respondents showed a comparable gender distribution, younger current survey respondents (43.9 ± 11.4 vs 40.6 ± 11.5 years, $p < .001$), and an increased proportion of trainees in the current survey (9.8% vs 23.2%, $p < .001$) (Table 1).

[Insert Table 1]

1. Confrontation with different skin diseases

Almost all current respondents (99.0%) encountered a dermatological problem in ≥ 1 patients during the past three months. The skin diseases most frequently encountered were eczema (93.6%), (pressure) ulcers (91.2%), fungal infections (76.1%), cutaneous (pre)malignancies (71.0%), and pruritus sine materia (70.3%).

Compared to the historical survey, the current survey showed an increase in confrontation with cutaneous (pre)malignancies (59.4% vs 71.0%, $p < .001$), viral skin infections (27.4% vs 37.5%, $p < .001$), and eczema (88.4% vs 93.6%, $p = .010$). A complete overview is shown in Table 2.

[Insert Table 2]

2. Diagnostic Procedures and treatments

2.1 Availability of and experience with diagnostic and non-pharmacological treatment procedures

Respondents were asked about the availability of diagnostic and non-pharmacological treatment procedures. The procedures most commonly available within their NH were incision (87.0%), excision (62.5%), cryotherapy (60.2%), punch biopsy (56.5%), and curettage (49.0%). A small proportion of respondents had access to dermoscopy (11.9%) within their NH.

Compared to the historical survey, availability increased for dermoscopy (6.1% vs 11.9%, $p=.007$), punch biopsy (32.2% vs 56.6%, $p<.001$), curettage (40.9% vs 49.0%, $p=.029$), and cryotherapy (38.4% vs 60.2%, $p<.001$), while it decreased for incisions (91.9% vs 87.0%, $p=.029$) and excisions (70.6% vs 62.5%, $p=.022$). (Table 3.)

[Insert Table 3]

Regarding the respondent's experiences with these procedures and treatments, a smaller proportion had actual experience with these procedures than had access to it (Table 3). Respondents had most experience with incision (57.6%), and the least with dermoscopy (3.4%). Respondents with ≥ 10 years of experience within NHs were more likely to have experience with incisions than less experienced (<10 years) physicians (65.6% vs 51.9%, $p=.010$).

Over time, the proportion of respondents with actual experience increased for punch biopsy (15.4% vs 29.7%, $p<.001$) and cryotherapy (25.6 vs 48.5%, $p<.001$), while it declined for incisions (77.6% vs 57.6%, $p<.001$) and excisions (38.2% vs 30.4%, $p=.030$).

These findings were comparable after performing a sensitivity analysis restricted to registered ECPs (excluding residents/junior doctors; Supplemental Table 1).

2.2. Pharmacological Dermatological Treatment

Most respondents in the current survey were experienced with topical and systemic pharmacological

treatments, including topical corticosteroids (100%), topical antifungals (99.4%), systemic antibiotics (99.4%) and topical antibacterials (98.3%). (Table 3). Compared to the historical survey, experience increased mostly over time for topical 5-fluorouracil cream (53.4% vs 87.0%, $p<.001$) and topical calcineurin inhibitors (19.0% vs 45.5%, $p<.001$). The sensitivity analysis yielded comparable findings (Supplemental Table 1).

2.3 Self-assessed level of competence of elderly care physicians

Median self-assessed competence level in diagnostics and treatments were highest for cryotherapy (3.0; range 2.0-4.0) and lowest for dermoscopy (1.0; range 1.0 -2.0)).

Median self-assessed competence levels increased over time for punch biopsy (1.0 vs 2.0, $p<.001$), dermoscopy (1.0 vs 1.0, $p=.042$), and cryotherapy (3.0 vs 3.0, $p=.002$). Reported competence levels decreased for incision (4.0 vs 3.0, $p<.001$) and excision (3.0 vs 2.0, $p<.001$). (table 4) Results were consistent following a sensitivity analysis limited to registered ECPs (Supplemental Table 2).

[Insert Table 4]

3. Collaboration between elderly care physicians and dermatologists

3.1. Outpatient visits of nursing home patients

Next, respondents were asked how many of their patients had visited a hospital-based dermatologist during the past year. Most respondents (87.7%) referred ≥ 1 patients, and most reported reasons were cutaneous (pre)malignancies (86.0%), (pressure) ulcers (24.8%), and eczema (16.4%) (Table 5). Compared to the historical survey, a smaller proportion reported bacterial infections (6.8% vs 11.8%, $p=.034$), and bullous diseases (21.1% vs 14.0 %, $p=.049$) as reasons for outpatient visits.

[Insert Table 5]

3.2 Consultation of a dermatologist

Dermatologist consultation was reported by 76.3% of the respondents for ≥ 1 patients during the past year. The most reported reasons were cutaneous (pre)malignancies (78.8%), followed by eczema (35.6%). Compared to the historical survey, the current survey showed an increase for both cutaneous (pre)malignancies (69.4% vs 78.8%, $p=.010$) and eczema (25.5% vs 35.6%, $p=.008$). Furthermore, the proportion of respondents using teleconsultation increased (31.6% vs 85.6%, $p<.001$), while phone (76.4% vs 63.1%, $p<.001$), and on-site consultations (31.3% vs 12.1%, $p<.001$) decreased (Table 5). Total consultation frequency remained stable over time. Results were consistent after sensitivity analysis restricted to registered ECPs (Supplemental Table 3).

3.3 Management recommendations by dermatologists

Respondents were also asked to what extent important patient-related factors were taken into account by dermatologists in medical decision-making. QoL received the highest median score (4.0; range 3.0 - 4.0, followed by multimorbidity (3.0; range 3.0 - 4.0), (limited) life expectancy (3.0; range 2.5 - 4.0), and cognitive impairment (3.0; range 2.0 - 3.0). Over time, the extent to which cognitive impairment was taken into account by dermatologists according to respondents decreased (4.0 vs 3.0, $p=.010$).

4. Dermatology (continuing medical) education of physicians

4.1 Basic training

The subsequent questions focused on dermatology education. Most respondents attended basic training during an undergraduate medical school course (90.0%) or clinical rotation (85.5%). A

minority attended additional training during an elective course, clinical rotation, or clinical experience (5.5%, 4.8%, and 5.5% respectively). Less experienced physicians were less likely to have attended basic training (86.1% vs 95.2%, $p=.007$), and clinical rotation (79.4% vs 93.8, $p<.001$) compared with more experienced physicians.

A decrease was observed for the proportion of respondents attending basic training (95.7% vs 90.0%, $p=.003$) and clinical rotation (94.5% vs 85.5%, $p<.001$), over time. A sensitivity analysis confirmed these findings (Supplemental Table 4).

4.2 Continuing medical education

Continuing medical education (CME) on a dermatology-related subject had ever been attended by 61.0% of respondents. More experienced physicians were more likely to have attended CME than their less experienced peers (81.5% vs 46.1%, $p<.001$). No differences were observed between the current and historical survey. Sensitivity analysis confirmed the robustness of these findings.

4.3 Demand for more education and suggested improvements of education

Next, respondents were asked how education could be improved. A total of 221 respondents provided suggestions, of which most (58.8%) requested disease-specific education, particularly about cutaneous (pre)malignancies, followed by education on diagnostic/therapeutic procedures (31.9%), and on general (geriatric) dermatology (27.3%). To improve knowledge transfer, respondents suggested bedside teaching (19.6%), optimised residency programmes (11.5%), sub-specialisation for ECPs with special interest in dermatology (8.8%), attendance at a dermatology outpatient clinic (6.1%), and e-learning (4.7%).

Compared to the historical survey, the current survey showed a higher proportion of respondents requesting targeted (disease specific) education (58.8% vs 44.2%, $p=.011$), and sub-specialisation (8.8% vs 3.2%, $p=.042$).

5. Suggestions for general improvement of dermatological care among nursing home patients

In the current survey, a total of 111 respondents reported suggestions on general improvement of dermatological care. Most respondents suggested on-site consultations (31.3%), more education (23.4%), and better availability of diagnostic and treatment procedures (21.4%), consistent with proportions in the historical survey. Teleconsultations were suggested in a smaller proportion of respondents (8.0% vs 16.5%, $p=.044$), compared to the historical survey, while a greater proportion suggested improvement of availability of and experience with treatment procedures (21.6% vs 7.2%, $p<.001$). The demand for hands-on training about diagnostic/therapeutic procedures also increased over time (8.2% vs 17.4%, $p<.001$).

Respondents were also asked how collaboration with dermatologists could be improved. Of the 125 respondents, the most suggested improvement included integrating patient health status (47.0%). Also, improved communication during the dermatological decision-making process (20.2%), more complete specialist letters (15.7%), and greater consideration of NH logistical limitations (9.6%) were suggested. Over time, less respondents suggested improvement of specialist letters (30.2% vs 15.7%, $p=.011$).

Discussion

Skin diseases among NH patients are frequently seen in daily practice and remain a significant challenge for ECPs. Similar to ten years ago, ECPs report the most frequent encounters with eczema, (pressure) ulcers, and fungal infections in their patients. Notably, encounters with cutaneous (pre)malignancies marked the most significant increase. This trend aligns with rising incidence rates of cutaneous (pre)malignancies among older adults, but potentially also reflects greater awareness.[18,20] Furthermore, viral skin infections were reported more often, possibly reflecting post-pandemic immunity changes, or improved recognition.[21-23] Higher eczema reporting is

probably multifactorial, including intrinsic factors, environmental conditions, improved detection, and potentially seasonal variance due to differences in survey timelines.[24,25]

A positive development over the past decade is the reported improved access to therapeutic and diagnostic resources within NHs. Dermoscopy, punch biopsy, curettage, and cryotherapy have become more widely available, fulfilling a key recommendation from the historical survey. In practice, increased availability did not fully translate into ECPs' actual experience; increased experience was reported only for punch biopsy and cryotherapy. This suggests that access alone is insufficient, and that competence, confidence and a low number of procedures performed by ECPs remain barriers.

Improving access to procedures and strengthening the gatekeeper's expertise could reduce unnecessary referrals and ensure appropriate care.[26] This approach is essential for proactively managing foreseen workforce challenges within an increasingly complex and vulnerable patient population, a concern that affects both ECPs and dermatologists.[27-29] Our findings identify skin cancer care as a major opportunity for quality improvement. Cutaneous (pre)malignancies not only showed the largest increase in reported encounters, but also remained the leading reason for dermatologist consultation. Consequently, optimizing management of cutaneous (pre) malignancies is the *low-hanging fruit* of dermatological care within NHs, demanding shared efforts from ECPs and dermatologists.

Interprofessional collaboration between ECPs and dermatologists has shifted significantly. Reported teleconsultations increased remarkably, while phone consultations have declined. This aligns with broader trends in health care digitalisation, where technology allows for remote specialist assessments.[30-31] Conversely, reported on-site consultations declined despite being named a key suggestion by both current respondents and those from ten years ago. This decline may be driven by

the diminished dermatologist capacity, logistical or financial barriers to visit the NH, and the rise of teledermatology.[15,32,33]

Nevertheless, this development towards digitalisation requires nuance. While inflammatory skin diseases are often well managed remotely, managing (pre)malignancies remains challenging due to limitations of imaging, necessity of dermoscopy and palpation, and the barrier to instant procedural interventions.[34,35] Therefore, a hybrid model using teleconsultation for triage and reserving on-site consultation for complex cases where remote assessment is inadequate, appears most appropriate.[16,33] Additionally, artificial intelligence (AI) in dermoscopic imaging could further enhance dermatological care.[36,37] Further research should evaluate the effectiveness of AI-guided teledermatology within the NH setting, and determine which patients with skin diseases can be managed via teleconsultation and which would benefit most from on-site consultations.

Despite historical recommendations, the current findings indicate that dermatology education for ECPs remains inconsistent. While dermatology may have gained a more prominent place within ECP residency programmes, basic dermatology education remains underrepresented in medical curricula. ECPs suggested targeted, disease-specific education (particularly regarding cutaneous (pre)malignancies), and practical skills training (e.g. excision and dermoscopy). Literature demonstrates that targeted theoretical and practical training can reduce non-acute hospital admissions of NH patients, a trend also observed in management of complex geriatric syndromes.[38] Such training should be implemented carefully, as dermoscopy performed by untrained health care professionals may compromise diagnostic accuracy.[39,40]

Managing skin diseases within NH patients requires not only dermatological knowledge but also complex treatment decision-making. Particularly, for vulnerable NH patients with cutaneous (pre)malignancies treatment decisions should balance cognitive impairment, life expectancy, mobility limitations, treatment burden, patient preferences, and NH logistics.[41-43] Despite increasing

attention to person-centred care, respondents reported no improvement in the extent to which dermatologists incorporate patients' general health status in decision making, highlighting a persistent opportunity for improvement.

To structurally embed person-centred care within the dermatological treatment plan, respondents increasingly suggested the dermatological sub-specialisation of ECPs (similar to the existing sub-specialist in geriatric rehabilitation and palliative care). This approach allows for the concentration of expertise and maintenance of sufficient skills without requiring all ECPs to develop advanced dermatological skills.

Concentrated expertise is likely to be most effective when embedded within sustainable interprofessional collaboration.[44-47] Encouragingly, ECPs' concerns about referral letters from dermatologists decreased, suggesting some improvement in the area of interprofessional communication. Nevertheless, communication alone does not constitute collaboration. Effective interprofessional collaboration also requires shared-decision making, value of each other's knowledge, and opportunities to re-evaluate.[47-49]

Previous research indicates that sustainable interprofessional collaboration between ECP and hospital-based medical specialist may be achieved when consultations are combined with professional learning possibilities, regionally structured and coordinated care, and intermediary support.[16]

The next step is to explore ECPs' and dermatologists' willingness, experiences and expectations regarding interprofessional collaboration, and to identify educational and training interventions with the highest impact on dermatological care.

Strengths and limitations of this study

This large-scale nationwide analysis provides a valuable impact measurement over a decade, within an internationally understudied patient population. However, some limitations must be

acknowledged. The response rate in the current survey was lower than for the historical survey, possibly due to different recruitment methods. This low response rate may introduce selection bias, potentially limiting the generalizability of the findings if non-responders hold different perspectives, with physicians having stronger opinions about dermatological care being more likely to respond. Secondly, the fact that we evaluated registered ECPs in Dutch nursing homes, could limit the international generalizability of our national results, given the unique nature of the Dutch elderly care system.

Conclusions

ECPs are frequently confronted with skin diseases in their patients. Encounters with cutaneous (pre)malignancies increased the most over time and remained the primary reason for dermatologist consultation. While the upward trend in teleconsultation use and access to diagnostic and treatment procedures has improved substantially, a considerable competence gap remains. To bridge this gap, targeted education on cutaneous (pre)malignancies and hands-on skills training are essential. To achieve sustainable quality improvement for dermatological care within NHs, future initiatives should focus on developing an interprofessional collaboration-training programme with the highest impact on skin cancer care while maintaining NH patient-centred care.

List of abbreviations

NH: nursing home

ECP: Elderly care physician

Declarations

Human Ethics

383 The Medical Ethical Committee Oost-Nederland waived the need for formal approval because of the
384 nature of the study (protocol 2024-17477).

385

386 **Informed consent**

387 Written informed consent to participate was obtained from all respondents.

388

389 **Conflict of interest**

390 Submission for publication has been approved by all authors and all authors declare no conflicts of
391 interest.

392

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395

396 **Clinical trial number**

397 Not applicable.

398

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402 the Groenhuysen Long-Term Care Organisation in the Netherlands.

403

404 **Availability of Data and Materials**

405 The questionnaire and data are available from the corresponding author upon reasonable request.

406

407 **Appendix**

408 Supplemental files

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Table 1. Responder characteristics of the historical survey (2013-2014), current survey (2024), and the total population included in this repeated cross-sectional survey study. For comparison over time, we used independent t-test for continuous variables and Chi-square or Fisher's exact test for categorical variables.

Responder characteristics	Historical Survey (n=347)	Current Survey (n=397)	Total (n=744)	p-value
Age , in years, mean $\pm$ standard deviation	43.9 $\pm$ 11.5	40.6 $\pm$ 11.5	42.1 $\pm$ 11.6	<.001*
Gender , n(%)				.361
Male	105 (30.3%)	106 (26.7%)	211 (28.4%)	
Female	242 (69.7%)	290 (73.0%)	531 (71.5%)	
Other	NA	1 (0.3%)	1 (0.1%)	
Years of experience in NH medicine , mean $\pm$ standard deviation	11.8 $\pm$ 9.5	11.0 $\pm$ 9.4	11.4 $\pm$ 9.4	.221
Type of physician , n(%)				<.001*
ECP	244 (70.3%)	263 (66.2%)	507 (68.1%)	
ECP trainee	34 (9.8%)	92 (23.2%)	126 (16.9%)	
Junior doctor	59 (17.0%)	39 (9.8%)	98 (13.2%)	
Other (general practitioner, general practitioner trainee attending the NH)	10 (2.9%)	3 (0.8%)	13 (1.7%)	
Number of patients (medical caseload) , mean $\pm$ standard deviation	58.4 $\pm$ 25.8	58.5 $\pm$ 45.5	58.5 $\pm$ 37.7	.974

* p < .05

NH: nursing home

ECP: elderly care physician

Table 2. Current and historical confrontation with skin diseases by physicians in Dutch nursing

homes (in ≥ 1 patients during the past 3 months). For comparison over time, we used the Chi-square test and the 95% confidence intervals (CI) were calculated using the independent-samples proportions test.

	Historical Survey (n=347)	Current Survey (n=397)	Trend	(95% CI)	p-value
Confrontation with skin diseases, n(%)					
(Pressure) ulcers	327 (94.2%)	379 (91.2%)	▼ 3.0%	(-5.5% to 0.9%)	.153
Eczema	306 (88.2%)	367 (93.6%)	▲ 5.4%	(1.3% to 9.8%)	.010*
Fungal infections [†]	302 (87.0%)	318 (76.1%)	▼ 10.9%	(-1.4% to 0.9%)	.060
Pruritus sine materia	272 (78.4%)	292 (70.3%)	▼ 8.1%	(-2.1% to 10.1%)	.193
Bacterial infections [†]	214 (61.7%)	257 (61.5%)	▼ 0.2%	(-10.8% to 3.0%)	.272
(Pre)malignant skin diseases	206 (59.4%)	294 (71.0%)	▲ 11.6%	(8.7% to 22.1%)	<.001*
Bullous diseases	91 (26.2%)	98 (25.0%)	▼ 1.2%	(-5.0% to 7.6%)	.688
Viral infections [†]	95 (27.4%)	148 (37.5%)	▲ 10.1%	(3.5% to 16.9%)	.003*
Psoriasis	130 (37.5%)	131 (32.9%)	▼ 4.6%	(-2.9% to 10.8%)	.261
Other	20 (5.8%)	18 (4.8%)	▼ 1.0%	(-2.1% to 4.6%)	.467

[†] of skin, hair and/or nails.

▲ increase, ▼ decrease,

* $p < .05$

Table 3. Current and historical availability of and experience with diagnostic procedures and

629 treatment in skin disease by physicians in Dutch NHs. For comparison over time, we used the Chi-
630 square and the 95% confidence intervals (CI) were calculated using the independent-samples
631 proportions test.

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	Historical Survey (n=347)	Current Survey (n=397)	Trend	(95% CI)	p-value
Availability of diagnostics, n(%)					
Dermoscopy	21 (6.1%)	44 (11.9%)	▲ 5.8%	(1.2% to 9.3%)	.007*
Punch biopsy	111 (32.2%)	209 (56.5%)	▲ 24.3%	(16.9% to 30.7%)	< .001*
Availability of non-pharmacological treatments, n(%)					
Incision	318 (91.9%)	314 (87.0%)	▼ 4.9%	(0.4% to 9.4%)	.033*
Excision	245 (70.6%)	225 (62.5%)	▼ 8.1%	(1.2% to 15.0%)	.022*
Curettage	141 (40.9%)	117 (49.0%)	▲ 8.1%	(0.8% to 15.5%)	.029*
Cryotherapy	133 (38.4%)	218 (60.2%)	▲ 21.8%	(14.6% to 29.0%)	< .001*
Experience with diagnostics, n(%)					
Dermoscopy	14 (4.0%)	14 (3.4%)	▼ 0.6%	(-2.7% to 3.0%)	.860
Punch biopsy	53 (15.4%)	107 (29.7%)	▲ 14.3%	(7.8% to 19.6%)	< .001*
Experience with non-pharmacological treatments, n(%)					
Incision	264 (77.6%)	208 (57.6%)	▼ 20%	(13.3% to 26.8%)	< .001*
Excision	129 (38.2%)	109 (30.4%)	▼ 7.8%	(0.8% to 14.8%)	.030*
Curettage	65 (19.3%)	83 (23.0%)	▲ 3.7%	(-9.8% to 2.3%)	.230
Cryotherapy	87 (25.6%)	175 (48.5%)	▲ 22.9%	(16.0% to 29.8%)	< .001*
Experience with pharmacological treatments, n(%)					
Topical:					
Antibacterials	326 (93.8%)	348 (98.3%)	▲ 4.5%	(1.5% to 7.2%)	.003*
Antifungals	346 (99.7%)	353 (99.4%)	▼ 0.3%	(-0.7% to 1.2%)	.576
Capsaicin	98 (28.2%)	160 (45.2%)	▲ 17.0%	(9.9% to 23.9%)	< .001*
Calcineurin inhibitors	66 (19.0%)	161 (45.5%)	▲ 26.5%	(19.8% to 33.1%)	< .001*
Corticosteroids	345 (99.4%)	357 (100%)		(-1.4% to 0.2%)	.151

Emollients	334 (96.3%)	347 (98.3%)	▲ 0.6%	(-0.4% to 4.5%)	.096
5-Fluorouracil	181 (53.4%)	309 (87.0%)	▲ 2.0%	(27.0% to 39.7%)	< .001*
Imiquimod	51 (14.7%)	45 (12.7%)	▲ 33.6%	(-3.1% to 7.1%)	.436
Vitamin D analogues	150 (43.2%)	171 (48.2%)	▼ 2.0%	(-12.3 to 2.4%)	.189
Systemic:			▲ 5.0%		
Antibiotics	336 (96.8%)	334 (99.4%)		(0.6% to 4.6%)	.012*
Antifungals	263 (75.8%)	265 (76.4%)	▲ 2.6%	(-0.9% to 0.3%)	.588
Antiviral	256 (73.8%)	291 (84.3%)	▲ 0.6%	(8.0% to 15.8%)	.001*
Prednisolone	314 (90.5%)	325 (93.9%)	▲ 10.5%	(-1.6% to 0.8%)	.112
			▲ 3.4%		

633 ▲ increase, ▼ decrease,

634 * p < .05

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651 **Table 4.** Self-assessed level of competence of physicians in Dutch NHs to perform several diagnostic
652 and therapeutic procedures for the historical and current survey with a 5 point Likert scale (1 =

completely incompetent , 5 = completely competent). For comparison over time, we used the Mann-Whitney U test. The range indicates the 25th to the 75th percentiles of distribution.

Level of competence, n(%)						Median [range]	Mann-Whitney U	Z-score	p-value
Procedure	Completely incompetent (1)	Somewhat competent (2)	Average competent (3)	Above Average competence (4)	Completely competent (5)				
Dermoscopy							71491.0	2.04	.042*
historical	222 (64.5%)	64 (18.6%)	36 (10.5%)	20 (5.8%)	2 (0.6%)	1 [1-2]			
current	221 (54.7%)	111 (28.8%)	49 (12.3%)	15 (3.9%)	0 (0.0%)	1 [1-2]			
Punch biopsy							76243.5	3.79	<.001*
historical	175 (51.0%)	53 (15.5%)	47 (13.7%)	59 (17.2%)	9 (2.6%)	1 [1-3]			
current	136 (35.3%)	78 (20.3%)	81 (21.0%)	65 (16.9%)	25 (6.5%)	2 [1-3]			
Incision							40644.5	-8.35	<.001*
historical	24 (7.0%)	24 (7.0%)	71 (20.6%)	185 (53.6%)	41 (11.9%)	4 [3-4]			
current	56 (15.5)	64 (7.7%)	126 (34.9%)	90 (24.9%)	25 (6.9%)	3 [2-4]			
Excision							48993.0	-4.88	<.001*
historical	79 (23.0%)	66 (19.2%)	82 (23.9%)	102 (29.7%)	14 (4.1%)	3 [2-4]			
current	118 (32.8%)	96 (26.7%)	85 (23.6%)	47 (13.1%)	14 (3.9%)	2 [1-3]			
Curettage							62339.0	0.24	.811
historical	161 (47.1%)	60 (17.5%)	57 (16.7%)	51 (14.9%)	13 (3.8%)	2 [1-3]			
current	152 (42.1%)	93 (25.8%)	59 (16.3%)	47 (13.0%)	10 (3.8%)	2 [1-3]			
Cryotherapy							70148.0	3.08	.002*
historical	88 (25.6%)	55 (16.0%)	71 (20.6%)	106 (30.8%)	24 (7.0%)	3 [1-4]			
current	53 (14.7%)	54 (15.0%)	94 (26.0%)	128 (35.5%)	32 (8.9%)	3 [2-4]			

* p < .05

Table 5. Percentages of respondents confronted with different skin diseases during the past year as a reason for dermatologist consultation and outpatient visits of NH patients and the type of

663 consultation used. For comparison over time, we used the Chi-square test and the 95% confidence
664 intervals (CI) were calculated using the independent-samples proportions test.
665

	Historical Survey (n=304)	Current Survey (n=293)	Trend	(95% CI)	p-value
Dermatology out-patient visit, n(%)					
(Pre)malignant skin diseases	245 (80.6%)	252 (86.0%)	▲ 5.4%	(-11.4% to 0.5%)	.077
(Pressure) ulcers	79 (26.0%)	72 (24.8%)	▼ 1.2%	(-5.8 to 8.2%)	.746
Eczema	48 (15.8%)	48 (16.4%)	▲ 0.6%	(-6.5% to 5.3%)	.844
Bullous diseases	61 (20.1%)	41 (14.0%)	▼ 6.1%	(0.1% to 12.1%)	.049*
Psoriasis	47 (15.5%)	38 (13.0%)	▼ 2.5%	(-3.1% to 8.1%)	.384
Pruritus sine materia	46 (15.1%)	33 (11.3%)	▼ 3.8%	(-1.5% to 9.3%)	.163
Bacterial infections	36 (11.8%)	20 (6.8%)	▼ 5.0%	(0.4% to 9.7%)	.034*
Fungal infections	5 (1.6%)	8 (2.7%)	▲ 1.1%	(-3.4% to 1.3%)	.364
Viral infections	5 (1.6%)	5 (1.7%)	▲ 0.1%	(-2.1% to 2.0 %)	.944
Other	28 (9.2%)	24 (8.2%)	▼ 1.0%	(-0.7% to 1.8%)	.668
Consultation of Dermatologist, n(%)					
(Pre)malignant skin diseases	188 (69.4%)	241 (78.8%)	▲ 9.4%	(2.2% to 16.5%)	.010*
(Pressure) ulcers	75 (27.2%)	81 (26.6%)	▼ 0.6%	(-6.2% to 8.4%)	.763
Bullous diseases	80 (29.5%)	89 (29.2%)	▼ 0.3%	(-7.1% to 7.8%)	.929
Eczema	69 (25.5%)	109 (35.6%)	▲ 10.1%	(2.7% to 17.6%)	.008*
Psoriasis	53 (19.6%)	46 (15.0%)	▼ 4.6%	(-1.7% to 10.7%)	.150
Pruritus sine materia	51 (18.8%)	54 (17.6%)	▼ 1.2%	(-5.1% to 7.5%)	.716
Bacterial infections	35 (12.9%)	30 (9.8%)	▼ 3.1%	(-2.1% to 8.3%)	.238
Fungal infections	26 (9.6%)	24 (7.8%)	▼ 1.8%	(-2.9% to 6.4%)	.456
Viral infections	11 (4.1%)	24 (7.2%)	▲ 3.1%	(-6.9% to 0.6%)	.106
Other	37 (13.6%)	24 (7.8%)	▼ 5.8%	(0.7% to 10.0%)	.025*
Type of consultation, n(%)					
Teleconsultation	88 (32.0%)	262 (85.6%)	▲ 53.6%	(46.8% to 60.4%)	<.001*
Email	60 (21.8%)	57 (18.6%)	▼ 3.2%	(-3.4% to 9.7%)	.338
Phone	211 (76.7%)	193 (63.1%)	▼ 13.6%	(6.3% to 21.0%)	<.001*
On-site consultation					.001*

Other	86 (31.3%) 18 (6.5%)	37 (12.1%) 12 (3.9%)	▼ 19.2% ▼ 2.6%	(12.6% to 25.8%) (-1.0% to 6.3%)	.154
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* p < .05

Supplemental table 1. Sensitivity analysis of current and historical experience with diagnostic procedures and treatment in skin disease by physicians in Dutch NHs. For sensitivity analysis ECP trainees and junior doctors were excluded, to analyse trends for registered ECPs only. For comparison

690 over time, we used the Chi-square test and the 95% confidence intervals (CI) were calculated using
691 the independent-samples proportions test.

	Historical Survey (n=244)	Current Survey (n=240)	Trend	(95% CI)	p-value
Experience with diagnostics, n(%)					
Dermoscopy	8 (3.3%)	10 (3.9%)	▲ 0.6%	(-3.8% to 2.6%)	.719
Punch biopsy	36 (14.9%)	78 (30.4%)	▲ 14.6%	(8.3% to 22.7%)	<.001*
Experience with non-pharmacological treatments, n(%)					
Incision	201 (83.8%)	152 (62.8%)	▼ 20.9%	(13.1% to 28.4%)	<.001*
Excision	100 (41.8%)	79 (32.9%)	▼ 8.9%	(0.3% to 17.6%)	.044*
Curettage	49 (20.6%)	54 (22.3%)	▲ 1.7%	(- 9.0% to 5.6%)	.645
Cryotherapy	63 (26.4%)	124 (51.2%)	▲ 25.9%	(16.5% to 33.3%)	.001*
Experience with pharmacological treatments, n(%)					
Topical:					
Antibacterials	235 (96.3%)	237 (99.2%)	▲ 2.8%	(0.2% to 5.5%)	.036*
Antifungals	243 (99.6%)	239 (99.6%)	▼ 0.1%	(-1.1% to 1.1%)	.991
Capsaicin	82 (33.6%)	125 (52.3%)	▲ 18.7%	(10.0% to 27.4%)	<.001*
Calcineurin inhibitors	54 (22.1%)	120 (50.2%)	▲ 28.1%	(19.9% to 36.3%)	<.001*
Corticosteroids	243 (99.6%)	240 (100%)	▲ 0.4%	(-1.2% to 0.4%)	.321
Emollients	244 (100%)	240 (100%)	▲ 2.9%	(0.2% to 5.5%)	.036*
5-Fluorouracil	153 (63.7%)	222 (92.2%)	▲ 28.5%	(21.5% to 35.4%)	<.001*
Imiquimod	38 (15.6%)	34 (14.2%)	▼ 1.5%	(-4.9% to 7.7%)	.664
Vitamin D analogues	109 (44.7%)	122 (50.8%)	▲ 6.1%	(-15.0% to 2.7%)	.175
Systemic:					
Antibiotics	239 (98.0%)	231 (99.6%)	▲ 1.6%	(-3.6% to 0.3%)	.114
Antifungals	198 (81.1%)	190 (81.5%)	▲ 0.4%	(-7.2% to 0.8%)	.911
Antiviral	205 (84.0%)	215 (92.7%)	▲ 8.7%	(3.0% to 14.3%)	.008*
Prednisolone	229 (93.9%)	225 (97.0%)	▲ 3.1%	(-6.9% to 0.6%)	.104

692 ▲ increase, ▼ decrease

693 ECP= elderly care physician

694 * p < .05

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716 **Supplemental table 2.** Sensitivity analysis of self-assessed level of competence of physicians in Dutch
717 NHs to perform several diagnostic and therapeutic procedures for the historical and current survey
718 with a 5 point Likert scale (1 = completely incompetent , 5 = completely competent). For sensitivity
719 analysis ECP trainees and junior doctors were excluded, to analyse trends for registered ECPs only.

For comparison over time, we used the Mann-Whitney U test. The range indicates the 25th to the 75th percentiles of distribution.

	Sensitivity analysis of trends for subgroup ECPs (total n=502; historical n=244; current n=258)						
Level of competence, n(%)						Median [range]	p-value
Procedure	Completely incompetent (1)	Somewhat competent (2)	Average competent (3)	Above Average competence (4)	Completely competent (5)		
Dermoscopy							.003*
historical	170 (69.7%)	40 (16.4%)	22 (9.0%)	10 (4.1%)	2 (0.8%)	1 [1-2]	
current	142 (55.0%)	73 (28.3%)	29 (11.2%)	14 (5.4%)	0 (0.0%)	1 [1-2]	
Punch biopsy							<.001*
historical	138 (56.8%)	38 (15.6%)	30 (12.3%)	32 (13.2%)	5 (2.1%)	1 [1-3]	
current	67 (37.7%)	49 (19.1%)	48 (18.7%)	48 (18.7%)	15 (5.8%)	2 [1-3]	
Incision							<.001*
historical	16 (6.6%)	13 (5.4%)	48 (19.8%)	140 (57.9%)	25 (10.3%)	4 [3-4]	
current	34 (14.0)	39 (16.1%)	80 (33.1%)	74 (30.6%)	15 (6.2%)	3 [2-4]	
Excision							<.001*
historical	60 (24.9%)	43 (17.8%)	58 (24.1%)	73 (30.3%)	7 (2.9%)	3 [2-4]	
current	80 (33.2%)	64 (26.6%)	50 (20.7%)	38 (15.8%)	9 (3.7%)	2 [1-3]	
Curettage							.314
historical	131 (54.6%)	37 (15.4%)	35 (14.6%)	32 (13.3%)	5 (2.1%)	1 [1-3]	
current	112 (46.3%)	62 (25.6%)	33 (13.6%)	31 (12.8%)	4 (1.7%)	2 [1-3]	
Cryotherapy							<.001*
historical	67 (27.8%)	43 (17.8%)	49 (20.3%)	73 (30.3%)	9 (3.7%)	3 [1-4]	
current	33 (13.6%)	37 (15.3%)	69 (28.5%)	86 (35.5%)	17 (7.0%)	3 [2-4]	

* p < .05

ECP = elderly care physician

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Supplemental table 3. Sensitivity analysis of trends between historical and current survey for the type of consultation respondents used. For sensitivity analysis ECP trainees and junior doctors were excluded, to analyse trends for registered ECPs only.

	Historical Survey (n=204)	Current Survey (n=206)	Trend	(95% CI)	p-value
Type of consultation, n(%)					
Teleconsultation	68 (33.3%)	172 (85.6 %)	▲ 50.3%	(41.9% to 58.4%)	<.001*
Email	41 (20.1%)	41 (19.9 %)	▼ 0.2%	(-7.5% to 7.9%)	.691
Phone	158 (77.5%)	144 (69.9 %)	▼ 7.6%	(-0.9% to 16%)	.005
On-site consultation	71 (34.8 %)	23 (11.2 %)	▼ 23.6%	(15.3% to 31.6%)	<.001*
Other	12 (5.9%)	6 (2.9 %)	▼ 3.0%	(-1.0% to 6.9%)	.142

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753 ▲ increase, ▼ decrease

754 * p < .05

755 ECP = elderly care physician

756 **Supplemental table 4.** Primary and sensitivity analysis of current and historical respondents who attended dermatology basic training or continuing
757 medical education. For sensitivity analysis trainees and junior doctors were excluded, to analyse trends for registered ECPs only. For comparison over
758 time, we used the Chi-square test and the 95% confidence intervals (CI) were calculated using the independent-samples proportions test.

	Primary analysis of trends, for total population					Sensitivity analysis of trends, for subgroup registered ECP				
	Historical Survey (n=347)	Current Survey (n=310)	Trend	(95% CI)	p-value	Historical Survey (n=244)	Current Survey (n=212)	Trend	(95% CI)	p-value
Dermatology education, n(%)										
Basic medical school course	332 (96.0%)	279 (90.0%)	▼ 6.0 %	(2.0% to 9.9%)	.003*	236 (97.1%)	192 (90.6%)	▼ 6.5%	(2.1% to 11.0%)	.003*
Basic clinical rotation	328 (94.8%)	265 (85.5%)	▼ 9.3 %	(4.7% to 13.9%)	<.001*	233 (95.9%)	191 (90.1%)	▼ 5.8%	(1.1% to 10.5%)	.014*
Elective dermatology course	16 (4.6%)	17 (5.5%)	▲ 0.9%	(-2.5% to 4.5%)	.609	12 (4.9%)	12 (5.7%)	▲ 0.8%	(-3.4% to 4.9%)	.723
Elective clinical rotation	18 (5.2%)	15 (4.8%)	▼ 0.4%	(-3.7% to 3.0%)	.818	7 (2.9%)	13 (6.1%)	▲ 3.2%	(-0.6% to 7.1%)	.095
Elective clinical experience	26 (7.6%)	17 (5.5%)	▼ 2.1%	(-5.8% to 1.7%)	.285	14 (5.8%)	15 (7.1%)	▲ 1.3%	(-3.2% to 5.8%)	.575
Continuing medical education	222 (64.0%)	189 (61.0%)	▼ 3.0%	(-10.1% to 4.7%)	.433	189 (77.5%)	156 (73.6%)	▼ 3.9%	(-11.3% to 4.5%)	.383

759 ▲ increase, ▼ decrease

760 * p < .05

761 ECP = elderly care physician