

Remote Monitoring of Psoriasis: Comparing Care Models and Evaluating Quality of Life Outcomes - a mixed methods study

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Submitted to: Journal of Medical Internet Research
on: March 11, 2025

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Jana Arsenjeva^{1*} BSc; Priit Kruus^{1, 2*} MSc; Riina Hallik¹ MSc, MMS; Secil Matasova¹ MSc, BSc; Laura Prett³ MD; Katrin Kaarna⁴ MD; Liisi Raam⁵ MD, PhD; Oliver Taul⁵ MD; Liis Ilves⁵ MD; Kaisa Viljar⁵ MD; Pille Konno⁶ MD; Peeter Ross¹ MD, PhD; Külli Kingo⁴ MD, PhD

¹ Tallinn University of Technology Tallinn EE

² Dermtest OÜ Tallinn EE

³ Linnamõisa Family Medicine Centre Tallinn EE

⁴ University of Tartu Tartu EE

⁵ Tartu University Clinic, University of Tartu Tartu EE

⁶ Confido Healthcare Centre Tallinn EE

*these authors contributed equally

Corresponding Author:

Jana Arsenjeva BSc

Tallinn University of Technology

Ehitajate tee 5

Tallinn

EE

Abstract

Background: Remote monitoring is increasingly used for psoriasis care, with the International Psoriasis Council (IPC) endorsing teledermatology (TD) as a feasible alternative to in-person visits. While evidence supports dermatologist-led (specialist) remote monitoring, there is limited research on its effectiveness in primary care. A publicly reimbursed remote monitoring program was piloted at both primary and specialist care levels, allowing comparative analysis of quality of life (QoL) outcomes and insights into factors contributing to better management outcomes.

Objective: The aim of study was to evaluate the feasibility and effectiveness of remote psoriasis monitoring at both primary and specialist care levels, identifying factors that influence better outcomes at the primary care level.

Methods: Study employed a retrospective convergent parallel mixed-methods approach to analyze data from 110 patients initially recruited into a publicly reimbursed remote monitoring program between January 2022 and July 2023 at 7 family medicine centers and 1 outpatient dermatovenerology center. The study utilized data from a public insurance claims database and a TD platform, which included reports on the Dermatology Life Quality Index (DLQI) and additional metrics. The effectiveness of remote monitoring at both care levels was assessed via baseline-to-average DLQI comparisons. The minimal clinically important difference (MCID) was set at ≥ -3 , and odds ratios (OR) between care levels were calculated, with specific cases analyzed via case series. Additionally, correlation analysis examined associations between DLQI changes and variables such as baseline Psoriasis Area Severity Index (PASI) scores, patient demographics, and collaborative care tools like e-consultation.

Results: The specialist care group (n=39) showed a significant mean reduction in DLQI of -1.33 ($p = .011$), whereas the primary care group (n=37) demonstrated a non-significant change of -0.34 ($p = .359$). Patients receiving specialist care were 3.91 times more likely to achieve a clinically significant improvement (MCID ≥ -3) compared to those in primary care ($p = .042$). Collaborative care between Primary Care Practitioners (PCPs) and specialists was linked to more favorable changes in DLQI scores ($r = -.339$, $p = .040$) at the primary care level. Case series analysis of patients achieving MCID in primary care revealed variability in management approaches, including PCP-led models incorporating collaborative care elements and nurse-led models without such collaboration.

Conclusions: This study is the first to compare remote psoriasis monitoring across specialist and primary care levels. While effective in specialist care, remote management at primary care shows less significant patient outcome improvements, mirroring findings from in-person PCP-led care. Using public claims data, the study highlights that integrating specialist support into PCP-

led care through standardized e-consultation may enhance outcomes. It underscores the need for further research and standardized collaborative care models between primary care providers and specialists in psoriasis remote management. Clinical Trial: The study received approval from the Research Ethics Committee of the University of Tartu, Estonia (ethical approval code: 350/T-14)

(JMIR Preprints 11/03/2025:73664)

DOI: <https://doi.org/10.2196/preprints.73664>

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Original Manuscript

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Background: Remote monitoring is increasingly used for psoriasis care, with the International Psoriasis Council (IPC) endorsing teledermatology (TD) as a feasible alternative to in-person visits. While evidence supports dermatologist-led (specialist) remote monitoring, limited research exists on its effectiveness in primary care. A publicly reimbursed remote monitoring program was piloted at both primary and specialist care levels, allowing comparative analysis of quality of life (QoL) outcomes and insights into factors contributing to better management outcomes.

Objective: The aim of the study was to evaluate the feasibility and effectiveness of remote psoriasis monitoring at both primary and specialist care levels, identifying factors associated with improved primary care outcomes.

Methods: Study employed a retrospective convergent parallel mixed-methods approach to analyze data from 110 patients recruited to a publicly reimbursed remote monitoring program between January 2022 and July 2023 at 7 family medicine centers and 1 outpatient dermatovenerology center. Data sources included public insurance claims and a TD platform, which captured Dermatology Life Quality Index (DLQI) and related metrics. Effectiveness of remote monitoring at both care levels was assessed via baseline-to-average DLQI comparisons; a minimal clinically important difference (MCID) was defined as ≤ -3 . Odds ratios (ORs) were calculated to compare outcomes between care levels. Correlation analysis examined associations between DLQI changes and variables such as baseline Psoriasis Area and Severity Index (PASI), demographics, and use of e-consultations. Qualitative insights from patient feedback and system usability surveys were analyzed to illustrate care process variability.

Results: The specialist care group ($n=39$) showed a significant mean reduction in DLQI of -1.33 ($p = .011$), whereas the primary care group ($n=37$) demonstrated a non-significant change of -0.34 ($p = .359$). Patients receiving specialist care were 3.91 times more likely to achieve a clinically significant improvement ($\text{MCID} \leq -3$) compared to those in primary care ($p = .042$). Collaborative care between Primary Care Providers (PCPs) and specialists was linked to more favorable changes in DLQI scores ($r = -.339$, $p = .040$) at the primary care level. Case series analysis of patients achieving

MCID in primary care revealed variability in management approaches, including PCP-led models incorporating collaborative care elements and nurse-led models without such collaboration.

Conclusion: This study is the first to compare remote psoriasis monitoring across specialist and primary care levels. While effective in specialist care, remote management at primary care shows less significant patient outcome improvements, mirroring findings from in-person PCP-led care. Using public claims data, the study highlights that integrating specialist support into PCP-led care through standardized e-consultation may enhance outcomes. It underscores the need for further research and standardized collaborative care models between PCPs and specialists in psoriasis remote management.

Trial Registration: The study received approval from the Research Ethics Committee of the University of Tartu, Estonia (ethical approval code: 350/T-14)

Keywords: Psoriasis, remote management, primary care, specialist care, collaborative care, tele dermatology

Introduction

Psoriasis is a chronic inflammatory skin condition affecting approximately 2% of the global population [1-4]. The disease presents a significant burden, impacting physical, social, and psychological well-being, with severity closely linked to reduced quality of life (QoL) [3, 5-7]. Psoriasis is also associated with comorbidities such as psoriatic arthritis, cardiovascular disease, and depression, further increasing its burden [5, 7, 8]. QoL is widely recognized as an essential measure in psoriasis management, reflecting the disease's broad effects [3, 5].

There is a growing shift from traditional in-person specialist consultations to patient-centered remote care models, particularly for chronic dermatologic conditions like psoriasis [6, 9-11]. Tele dermatology (TD) has emerged as a cost-effective [12, 13] and comparably effective [9] alternative to conventional care, improving accessibility and supporting early interventions [6, 7, 14]. TD encompasses several approaches, including synchronous (real-time video consultations) [1] and asynchronous store-and-forward systems, which allow patient data to be reviewed remotely by clinicians at a later time [9, 15]. Advanced TD models, such as Collaborative Connected Health (CCH), facilitate continuous monitoring through the integration of patient-reported outcomes, image uploads, and asynchronous communication, supporting proactive and timely intervention [8, 9]. Remote monitoring represents a key component of TD, enabling continuous assessment of disease severity and treatment response beyond traditional clinic visits [6, 11].

CCH models can empower primary care providers (PCPs) to play a role in the treatment of psoriasis. Digital platforms provide PCPs with tools to manage patients and submit data for specialist evaluation as needed. This enables specialists to monitor changes in psoriasis severity, adjust treatment plans in a timely manner, and reduce the need for in-person referrals [11]. E-consultations, a form of asynchronous TD, enable PCPs to obtain timely specialist input without requiring real-time interaction [15]. This approach has been shown to improve access to specialists, reduce unnecessary referrals, and streamline decision-making in primary care [16]. Furthermore, collaborative e-consultation models, when integrated with remote monitoring, can enhance continuity of care and optimize treatment adjustments [8, 11, 14].

The International Psoriasis Council (IPC) framework outlines the potential role of TD in psoriasis management, emphasizing its ability to improve accessibility, streamline workflows, and enhance treatment efficiency [17]. While TD provides a viable alternative to in-person visits, its successful integration into primary care remains a challenge, with key barriers including limited dermatology expertise, resource constraints, and the need for standardized implementation protocols [18-20].

However, despite growing adoption, there is still limited knowledge on how TD and remote monitoring are used in everyday primary care workflows, particularly in models without direct specialist involvement [2, 21]. Most existing studies have focused on specialist-led interventions, leaving a gap in understanding the feasibility, effectiveness, and challenges of remote psoriasis care managed by primary care providers [6, 22, 23]. Questions remain about whether primary care models can achieve similar patient outcomes, how remote tools affect clinical decision-making, and how collaborative practices (such as e-consultations) influence care quality. Despite the growing adoption of TD, research on its impact at the primary care level remains limited [18]. PCPs often serve as the first point of contact for psoriasis patients, yet they face substantial challenges, including insufficient dermatological training [19, 24], multimorbidity complexities [25], and delayed access to specialists [20]. These challenges can lead to delays in diagnosis, suboptimal treatment decisions, and insufficient consideration of QoL outcomes [18, 19].

Specifically, there is limited evidence on how remote care models affect diagnostic confidence, treatment decision-making, and QoL outcomes in primary care settings [4, 9, 26, 27]. Additionally, implementation barriers such as lack of dermatology-specific training for PCPs, unstructured e-consultation pathways, and inconsistent referral protocols have not been systematically studied [22, 28].

Remote monitoring offers a potential solution by bridging the gap between primary and specialist care, facilitating continuous disease assessment, and supporting early intervention. However, its impact on primary care workflows and patient outcomes remains underexplored.

To address both outcome effectiveness and contextual implementation, this study used a mixed-methods approach. Given the variability in care delivery across settings, and the role of both clinical and contextual factors in influencing outcomes, a combination of quantitative and qualitative methods was necessary. Quantitative analysis allowed for comparison of QoL outcomes across care levels, while qualitative case series insights provided an understanding of care process variability and collaboration practices in real-world settings. This combination was necessary to capture both measurable impacts and the care dynamics influencing those outcomes—especially in primary care, where workflows and resources vary widely [29-31].

This study aims to evaluate the feasibility and effectiveness of remote psoriasis monitoring in both specialist-led and primary care settings, identifying factors influencing better outcomes at the primary care level, and examining how collaborative digital tools, including e-consultations and continuous monitoring systems, impact QoL.

Methods

Study Design

The study is based on data from a publicly reimbursed pilot program, implemented as part of a quasi-experimental multi-site trial in Estonia between January 2022 and July 2023 across seven family medicine centers and one dermatovenerology outpatient clinic [32]. This design enabled the combined analysis of both quantitative and qualitative data, offering a comprehensive understanding of the intervention's effectiveness, feasibility, and real-world implementation. Mixed-methods approaches are widely recognized as appropriate for complex health service evaluations, particularly where both outcomes and adoption processes are central concerns [29-31].

To comprehensively evaluate both the clinical outcomes and contextual implementation of remote psoriasis monitoring, the study employed a retrospective, convergent parallel mixed-methods design. Quantitative data included patient-reported QoL scores of Dermatology Life Quality Index (DLQI), clinician-reported Psoriasis Area and Severity Index (PASI) scores, and claims-based healthcare utilization data. Quantitative analyses—such as comparative effectiveness and correlation techniques—were used to measure changes in QoL and identify clinical or demographic factors influencing these outcomes.

To complement the quantitative findings, a qualitative case series was conducted to examine variations in care pathways and management practices at the primary care level. Although no formal thematic analysis was conducted, the qualitative component provided illustrative, patient-level insights using observational and contextual data. These data were drawn from pseudonymized patient feedback questionnaires (administered online using Google Forms) and system usability assessments. This approach helped to better interpret the findings by capturing care process differences and patterns that wouldn't have been visible through quantitative analysis alone, and was used to illustrate individual variability and highlight possible mechanisms of improvement.

Due to feasibility and ethical constraints, patients were assigned to groups based on the level of care (primary or specialist) and their willingness to participate. Randomization was not possible within the scope of the publicly funded pilot intervention.

Data sources included a country-wide public insurance claims database covering all publicly reimbursed patient interactions, visits, and medications during the study period and a secure TD platform database, where DLQI and other remote monitoring measures were reported.

While the broader pilot project evaluated multiple metrics (e.g., adherence, cost, usability), this study focuses specifically on QoL outcomes (DLQI) and comparative analysis of care models, using a subset of the intervention group data.

Outcome Measures

The primary outcome of this paper was the effectiveness of remote psoriasis management, measured by changes in the DLQI across primary and specialist care levels [33, 34]. The DLQI, a validated 10-question tool, assesses psoriasis's impact on QoL. Scores range from 0 to 30, with higher scores indicating a greater effect [35, 36]. This tool is widely used in dermatological studies, facilitating comparisons and insights into factors influencing outcomes [5, 36, 37].

Effectiveness was analyzed first for the entire intervention group, then compared between primary and specialist care, and evaluated separately for detailed insights. PASI was used at baseline to categorize psoriasis severity (mild: 1-4, moderate: 5-10, severe: >10) [38], providing a clinical context for examining relationships between disease severity and QoL outcomes.

Correlation analysis explored clinical factors associated with DLQI changes in primary care. The odds ratio (OR) for achieving a meaningful DLQI improvement ($MCID \leq -3$) was calculated, informed by prior studies on MCID ranges in dermatological conditions [39, 40]. Specific cases achieving the MCID in psoriasis management at the primary care level were selected for case series analysis, incorporating qualitative and quantitative data such as patient feedback questionnaires, claims data [41, 42], and medication prescriptions.

Study Population

This study employed the data from 110 patients participating in the remote monitoring group at both care levels of the real-life reimbursed remote monitoring pilot trial [32]. There were 55 men and 55 women initially recruited, with 74% (56) aged 50 or below and 26% (20) aged above 50. The inclusion criteria for remote monitoring included: (1) a diagnosis of plaque psoriasis, (2) age between 18 and 75 years, (3) access to a smartphone or computer, and (4) willingness to provide informed consent and commit time to the study. Exclusion criteria included (1) a non-plaque psoriasis diagnosis, (2) a history of alcohol or drug abuse within six months preceding the study, (3) an inability to fulfill study requirements, and (4) any other reasons deemed by the investigator or sponsor that rendered the patient ineligible.

Quantitative Data Collection and Exclusion

Data were collected at both specialist and primary care levels. Initially, patient eligibility was confirmed and informed consent obtained, followed by the first completion of Patient-Reported Outcome Measures (PROMs) [43] and PASI, which were securely stored in a specialized TD database built for the use case by a TD company. The study protocol required patients to regularly complete online questionnaires like DLQI, Psoriasis Symptoms and Signs Diary [44] and Early Arthritis for Psoriatic Patients [45], facilitated through a web-based platform with 2-factor authentication login. DLQI questionnaires were scheduled to be sent to patients monthly every 15th date of the month, allowing completion at home. Email reminders were sent, including follow-up reminders. Doctors were also encouraged to actively engage with patients. The platform enabled real-time transmission of patient-generated data, allowing physicians to securely and conveniently access and review the results. PCPs or specialist-dermatologists could review this information asynchronously to provide recommendations to patients, initiate treatment adjustments, or refer patients to other specialists as needed.

The System Usability Scale (SUS) was used to assess system usability using a 10-item questionnaire. Participants rated each item on a 5-point Likert scale, ranging from 0 (Strongly Disagree) to 4 (Strongly Agree). Scores ranging from 0 to 100, where higher scores reflect better usability, were derived by converting individual responses and scaling the total by a factor of 2.5 [46]. SUS scores were obtained directly from the pilot study [32] without adjustments and analyzed as part of the case series outcomes for this study.

Additionally, e-consultations were facilitated through the Health Information System. PCP submitted detailed referrals to a chosen specialist, including information about the patient's condition, test results, clinical observations, and secure access to previous remote monitoring data conducted at the

primary care level. Specialists reviewed the referral information and provided recommendations or requested in-person visits, responding within four working days. The PCP and the patient had access to the consultation records, fostering transparency and efficient communication [47].

The intervention was financed through a public reimbursement model implemented as part of a nationwide remote care pilot project by the Estonian Health Insurance Fund, the sole public payor of the solidary health care system. This ensured that TD services were accessible to the population without additional costs to the patient [48]. The intervention payment model included value-based payment model elements, including an outcome-based payment to participating healthcare providers at the end of the 1-year remote monitoring period.

Participants were enrolled in the study at different times throughout the study period. To address this, the first DLQI entry within 45 days of enrollment in the study was considered the baseline score. In cases where the QoL questionnaire was completed twice during the initial or any follow-up month of observation, the average of the two scores was taken. Each participant's follow-up timeline was anchored to their individual start date, and the first month of follow-up was defined based on whether they enrolled before or after the 15th of the calendar month. This approach ensured alignment across patients despite rolling enrollment.

Participants were excluded from the study if they had more than six months of inactivity or if they did not complete a baseline DLQI questionnaire within 45 days of enrollment. Additionally, those who met both exclusion criteria were not included in the final analysis.

Qualitative data collection

Patient satisfaction was measured using a feedback form adapted from the Estonian Society of Family Physicians' standard questionnaire, with detailed information provided in Multimedia Appendix 1. The questionnaire was administered during the final quarter of the pilot project using Google Forms. Responses were collected online, pseudonymized by the research team, and subsequently linked to individual patients in the study database for integration with quantitative data.

Statistical Analysis

Quantitative data analysis

Descriptive and Comparative Analyses

For both groups, descriptive statistics were used to summarize demographic characteristics and baseline clinical features, including DLQI and PASI scores. The average DLQI change was calculated for each participant using all available follow-up data to account for variability in follow-up completion and differing study start times. This approach ensured the inclusion of participants

with incomplete follow-ups while providing a comprehensive measure of QoL improvement. The DLQI change was determined by subtracting the baseline score from the average follow-up score over 11 months.

An independent sample t-test [49] compared the mean DLQI change scores between specialist and primary care groups, with Levene's test [50] assessing variance equality. The Wilcoxon signed-rank test evaluated treatment effectiveness within the combined care group [51]. Due to non-normal distribution, the Wilcoxon test was applied to the primary care group, while a one-sample t-test [52] assessed effectiveness in the specialist care group. Data normality was verified using the Shapiro-Wilk test [53].

Odds Ratios and Correlations

OR analysis [54] was conducted to compare the likelihood of achieving MCID ($DLQI \leq -3$) in specialist versus primary care. Additional comparative analyses, including independent sample t-tests and chi-square tests [55], examined differences between patients who achieved MCID and those who did not. Within the primary care group, Pearson's correlation analysis [56] explored associations between DLQI changes and clinical factors, such as baseline PASI score, age, sex, disease duration, and e-consultation.

Selection Bias and Enrollment Timing

To assess the potential for selection bias introduced by exclusion criteria, a comparative analysis of baseline characteristics was conducted between included participants and excluded patients. Variables assessed included age, sex, baseline DLQI, PASI, years since onset, and clinic type (primary care vs. specialist care). Independent samples t-tests and chi-square tests were used to evaluate differences across groups.

Additionally, to explore whether staggered enrollment may have introduced temporal confounding, a post hoc linear regression model was specified. This model included "Enrollment Month" as a covariate, alongside clinic type, baseline PASI score, age, and e-consultation frequency. This allowed for statistical adjustment of potential differences related to timing of study entry in the outcome analysis.

All results achieving p-values $< .05$ were considered statistically significant. Calculations were performed with JAMOV software version 2.3.28.

Qualitative case series analysis

A case series analysis [57] was conducted on PCP patients with an MCID in DLQI (≤ -3) to explore factors influencing treatment effectiveness at the primary care level. Data sources included

reimbursement claims (e.g., visits, collaborative care, lab tests, diagnoses, and prescriptions), SUS scores, patient feedback. Although case series analysis carries a higher risk of bias, it is valuable for identifying patterns and building medical knowledge [58]. Subjects were selected based on exposure (remote monitoring at PCP level) and outcome ($\text{MCID} \leq -3$), ensuring straightforward and replicable criteria.

Patient-reported experience data were also used to provide additional context for each cases. This included the SUS and a structured feedback form with both closed-ended and open-ended questions about onboarding, communication, usability, and satisfaction. While no formal thematic analysis was conducted, selected responses were used descriptively to illustrate variations in patient experience, particularly in relation to care communication and perceptions of remote monitoring. Although SUS scores were available for additional participants, analysis was restricted to the primary care patients included in the case series who achieved a clinically meaningful DLQI improvement. This was done to provide contextual insights in an exploratory, illustrative manner rather than a full usability evaluation.

Given the multifactorial influence on QoL—such as treatment type, medication, and collaborative care—remote monitoring has been linked to patient security [59] and may also relate to anxiety factors [60]. These insights were incorporated to identify patterns of DLQI improvement and guide future research.

The study received ethical approval from the Research Ethics Committee of the University of Tartu, Estonia (ethical approval code: 350/T-14)

Results

Participant Demographics and Baseline Characteristics

Of the 110 patients enrolled in the intervention ($N=110$), 103 provided DLQI scores. These 76 met the criteria for inclusion in the analysis, with a balanced distribution of males (48.7%, $n = 37$) and females (51.3%, $n = 39$). The mean age of the participants was 43.46 years ($SD = 10.86$), with a range encompassing early to middle adulthood. The mean PASI score at baseline was 3.94 ($SD = 4.46$), indicating that, on average, participants had mild to moderate psoriasis. Participants' baseline DLQI score had a mean of 5.28 ($SD = 4.90$), reflecting a moderate impact of the condition on their QoL. Additionally, 36% of the participants ($n=27$) reported having associated diseases, like hypertension (31%, $n=8$), dyslipidemias (19%, $n=5$), and enteropathic arthropathies (16%, $n=4$), among other conditions. The mean duration of the condition (years since onset) was 11.70 years ($SD = 6.12$), suggesting that many participants had lived with psoriasis for a significant portion of their lives. All results are shown in Table 1.

Table 1. Baseline characteristics of included patients (n = 76)

Characteristics	Combined		
	group (n=76)	Specialist Care (n=39)	Primary Care (n=37)
Gender			
Sex (Male), n (%)	37 (48.7%)	23 (62.2%)	14 (37.8%)
Sex (Female), n (%)	39 (51.3%)	16 (41.0%)	23 (59.0%)
	43.46		
Age (years), mean (SD)	(10.86)	44.33 (12.40)	42.54 (9.04)
PASI ^a , mean (SD)	3.94 (4.46)	3.45 (4.22)	4.47 (4.71)
DLQI ^b Baseline, mean (SD)	5.28 (4.90)	6.21 (5.16)	4.31 (4.49)
Associated diseases (%)	27 (36%)	13 (48.1%)	14 (51.9%)
Years Since Onset, mean	11.70		
(SD)	(6.12)	11.85 (6.60)	11.54 (5.65)

^aPASI: Psoriasis Area and Severity Index.

^bDLQI: Dermatology Life Quality Index.

^cAssociated diseases: comorbidities commonly linked with psoriasis such as essential (primary) hypertension, enteropathic arthropathies, disorders of lipoprotein metabolism, overweight and obesity, major depressive disorder, and gout.

A comparison of baseline characteristics between included (n=76) and excluded (n=27) patients was conducted to evaluate the risk of selection bias due to exclusion criteria. Among excluded patients, 15 were from primary care and 12 from specialist care.

No statistically significant differences were observed across any of the assessed variables, including age, sex, baseline DLQI, PASI score, years since onset, or clinic type (all $p > .05$), suggesting that exclusion did not systematically bias the final analytic sample. Full comparison results are provided in Multimedia Appendix 2.

DLQI Changes and Effectiveness Across Care Settings

In the remote monitoring group, DLQI scores decreased, with an average change of -0.85 (SD = 2.89), indicating a general improvement in QoL in the combined care group. Wilcoxon Signed-Rank test results show that the mean change in DLQI scores within the combined group is statistically significant (mean difference: -0.85, 95% CI -1.48 to -0.23, $W = 823$, $p = .009$).

In the specialist care group, the mean DLQI change was -1.33 (SD = 3.12), indicating significant improvement (mean difference: -1.33, 95% CI -2.34 to -0.32, $t = -2.66$, $p = .011$). The primary care group's mean DLQI change was -0.34 (SD = 2.57) and not statistically significant (mean difference: -0.34, 95% CI -1.00 to 0.42, $W = 259$, $p = .359$). Results are shown in Tables 2 and 3.

Table 2: Distribution and normality of DLQI change across care groups

Group	Mean DLQI ^a Change	Standard Deviation (SD)	Shapiro- Wilk ^b value	<i>p</i> - Normality ^c
Remote Monitoring Group	-0.85	2.89	.013	Not normal
Specialist Care Group	-1.33	3.12	.056	Normal
Primary Care Group	-0.34	2.57	.004	Not normal

^aDLQI - DLQI: Dermatology Life Quality Index.

^bShapiro-Wilk test assesses the normality of distribution.

^cNormality considered if $p > .05$.

Table 3. Statistical test results comparing baseline and follow-up DLQI scores within care groups

Group	Test Performed	95% Confidence Interval (CI)	Test Statistic (W^a or t^b)	<i>p</i> - value ^c	Statistical Significance ^c
Remote Monitoring Group	Wilcoxon Signed-Rank Test	-1.48 to -0.23	$W = 823$	.009	Yes
Specialist Care Group	One-sample t- test	-2.34 to -0.32	$t = -2.66$	.011	Yes
Primary Care Group	Wilcoxon Signed-Rank Test	-1.00 to 0.42	$W = 259$	.359	No

^aW: Wilcoxon signed-rank test statistic.

^bt: t-statistic from one-sample t-test.

^cStatistical Significance considered if $p < .05$.

In a post hoc linear regression model that included enrollment month, clinic type, age, sex, and e-consultation frequency as covariates, no significant association was found between enrollment timing and DLQI change ($\beta = -0.025$, $p = .921$), suggesting that staggered enrollment did not introduce meaningful bias. Full model coefficients are reported in Multimedia Appendix 3.

Comparison Between Care Types

An independent sample t-test was employed to compare the mean DLQI change scores between patients receiving care in specialist settings and those in primary care. The results were not

statistically significant (mean difference: 0.99, 95% CI 0.32 to 2.30, $t = 1.51$, $p = .136$). The detailed results are presented in Table 4.

Table 4. Independent Samples t-Test and Levene's Test for Equality of Variances (Primary Care vs. Specialist Care)

Test	Mean DLQI Difference	Levene 's Test ^a Statistic	Levene' s Test p-value	t-value	95% Confidence Interval (CI)	p- value ^b	Statistica l Significa nce
Independe nt Samples t-Test	0.99	2.12	.149	1.51	(0.32 to 2.30)	.136	No

^aLevene's test assesses equality of variances.

^bp: Statistical significance considered at $p < .05$.

Odds Ratio & MCID Achievement

Analysis was conducted on patients receiving specialist care ($n=39$) and primary care ($n=37$). An MCID in DLQI, defined as a change of ≤ -3 , was achieved by 10 patients in the specialist care group and 3 in the primary care group.

Statistical tests showed a significant difference in MCID achievement between care types ($\chi^2 = 4.12$, $p = .042$). Patients in specialist care were approximately 3.91 times more likely to achieve a clinically meaningful improvement in DLQI than those in primary care (Table 5).

Table 5: MCID achievement and odds ratio comparison between specialist and primary care groups

Metric	Specialist Group (n=39)	Primary Care Group (n=37)	Combined (n=76)
Total Participants Achieved	39	37	76
MCID ^a (DLQI $\leq$ -3), n (%)	10 (25.6%)	3 (8.1%)	13 (17.1%)
Chi-square Test (Independence)	$\chi^2 = 4.12$, $p = .042$		
Odds Ratio ^b	OR=3.91 (0.98 to		

(95% CI)	15.57)
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^aMCID: Minimal clinically important difference.

^bOR: Odds ratio.

Correlation Analysis in Primary Care Group

The analysis of the primary care group revealed no significant correlation between PASI scores and DLQI change ($r = 0.15$, $p = .384$). However, a moderate negative correlation was observed between the number of e-consultations (defined in this paper as the presence of collaborative care) between PCP and specialist and DLQI change ($r = -0.34$, $p = .040$), suggesting that more e-consultations were associated with a greater decrease in DLQI change score. These key findings are summarized in Table 6.

Table 6: Correlation between DLQI change and clinical variables in the primary care group (Pearson's r and two-tailed P value)

Variable	DLQI ^a change	PASI ^b	Sex	Age	Associated Diseases ^d	E consultation	Years - since onset
DLQI change	—						
r^c	—						
P value	—						
PASI	0.147	—					
r	.35	—					
P value	.384	—					
Sex	0.207	0.061	—				
r	.35	.35	—				
P value	.22	.722	—				
			-				
			0.12				
Age	-0.235	0.039	8	—			
r	.35	.35	.35	—			
			0.45				
P value	0.161	0.817	2	—			
			-				
Associated			0.13	-			
Diseases	0.033	0.046	6	0.006	—		
r	.35	.35	.35	.35	—		
P value	.845	.787	.423	.971	—		
			-				
E-			0.18	-			
consultation	-0.339	-0.198	4	0.034	-0.104	—	

<i>r</i>	35	35	35	35	35	—
<i>P</i> value ^e	.04	.24	.275	.841	.538	—
Years since onset			0.03	-		
<i>r</i>	-0.009	0.115	6	0.263	0.171	0.297
<i>P</i> value	35	35	35	35	35	35
	.958	.5	.834	.116	.313	.074

^aDLQI: Dermatology Life Quality Index.

^bPASI: Psoriasis Area and Severity Index.

^c*r*: Pearson correlation coefficient.

^dAssociated Diseases: comorbidities commonly linked with psoriasis such as essential (primary) hypertension, enteropathic arthropathies, disorders of lipoprotein metabolism, overweight and obesity, major depressive disorder, and gout.

^e*p*: Statistical significance considered at $p < .05$.

Case series analysis at the primary care level

Three cases were included in further case series analysis to reveal potential patterns and understandings of patient remote management at the primary care level.

Case 1

A woman in her sixties with mild (PASI 0.6) psoriasis and a baseline DLQI score of 16.0 points was enrolled in remote monitoring during the summer period and had been living for two years with the disease onset.

The patient's DLQI score decreased by -6.5 during the remote monitoring period. Treatment was managed by a large 10-PCP office with a nurse-led approach. The patient reported overall satisfaction with the remote monitoring service and its user experience (SUS score = 85), mentioned a sense of security, and suggested that she would rather continue with remote monitoring. The patient also suggested that remote monitoring did not reduce the need to visit a healthcare provider in person.

The patient reported that no one actively contacted her during the remote monitoring period. No known psoriasis comorbidities were detected during the study period. Additionally, no medications for psoriasis were prescribed during or before the study period, and no collaborative care episodes, such as e-consultations with specialists-dermatologists, were conducted during the study period by the PCP office for this patient. However, 21 days before the start of remote monitoring, the patient was prescribed methylprednisolone and bilastine for allergic reactions.

Case 2

A man in his forties with mild (PASI 0.2) psoriasis and a baseline DLQI score of 11.0 points. Patient was enrolled in remote monitoring during the spring period and had been living 16 years with the

disease onset.

During the remote monitoring period, his DLQI score decreased by -8.3 points. The patient was treated by a medium-sized 5-PCP office with a PCP-led approach. The patient reported overall satisfaction with the remote monitoring service and its user experience (SUS score = 70). The patient mentioned that he would like to continue with the remote care model structure and monitoring. He also suggested that remote monitoring reduced the need to visit a healthcare provider in person and helped him better manage his psoriasis.

The patient also reported that he was actively contacted during the remote monitoring period. No known psoriasis comorbidities were detected during the study period. Eight prescriptions for psoriasis medication were prescribed by the doctor and retrieved by the patient, including Calcipotriol + Betamethasone and Mometasone in the first months of the monitoring period and Methotrexate 4 months after the remote monitoring start and after the conclusion of the e-consultations with specialists-dermatologists. Four collaborative care episodes, such as e-consultations with specialists, were done during the study period by the PCP office for this patient.

Case 3

A woman in her forties with mild (PASI 0.5) psoriasis and a baseline DLQI of 8.0 points. Patient was enrolled in remote monitoring during the summer period and had been living for four years with the disease onset.

During the remote monitoring period, there was a reduction of -3.3 points in her DLQI score. Patient treatment was managed by a large 10-PCP office with a nurse-led approach. Patient reported overall satisfaction with the remote monitoring service and its user experience (SUS score = 72.5). Patient found the explanations from the healthcare providers clear and sufficient, felt well-informed about how to seek help, and appreciated the ability to express opinions or ask questions about her treatment. The patient was satisfied with the speed of in-person and remote appointments and noted that the remote monitoring helped manage psoriasis better, reducing the need for in-person visits. She expressed a desire to continue with remote monitoring after the pilot period.

The PCP office did not conduct collaborative care episodes, such as e-consultations with specialist-dermatologists, during the study period for that patient.

Key patient-level characteristics from the primary care case series are presented in Multimedia Appendix 4.

Discussion

Summary of Key Findings

This study employed a mixed-methods approach to explore the feasibility and effectiveness of remote monitoring for psoriasis across primary and specialist care settings and to identify factors contributing to better QoL outcomes at the primary care level.

Comparative effectiveness of remote psoriasis management

A comparative analysis measured the effectiveness of remote psoriasis management at both primary and secondary care levels. Consistent with previous studies [4, 11] the findings suggest that remote monitoring improves QoL in specialist care settings.

DLQI improvements in the specialist care intervention group (-1.33; $p = .011$) were comparable to those reported in a similar study [9], which observed a -1.64 change over a 12-month period. Although our study did not employ a formal equivalence design and was limited by a smaller sample size, the similarity in effect size adds support to the clinical relevance of remote monitoring in specialist care settings. These findings should, however, be interpreted with caution and validated in larger studies.

However, improvements in primary care remain limited [20], reflecting systemic challenges such as insufficient training, limited confidence, inadequate resources, and inconsistent guideline adherence among PCPs [18, 19, 61].

This study extended prior insights from in-person care to remote management, finding that patients in specialist care were 3.91 times more likely to achieve clinically meaningful DLQI improvements than those in primary care. These disparities align with earlier findings [19, 20], showing that PCPs are less likely to deliver consistent, guideline-based care due to gaps in knowledge and training [18-20]. Addressing these gaps through standardized guidelines could help ensure consistent care quality across primary and specialist settings, as supported by previous research [62].

Collaborative care impacts outcomes at the primary care level

Current study also explored factors influencing QoL outcomes at the primary care level. Previous research demonstrates that tools like e-consultations enhance PCP capacity to manage psoriasis [6, 10]. Structured referral protocols with frequent e-consultations have been shown to improve PCP confidence and patient QoL [10], while digital workflows reduce delays and improve outcomes [22]. In this study, PCPs could use e-consultations to collaborate with specialists. A correlation analysis found a moderate negative relationship between e-consultation frequency and DLQI change ($r = -0.339$, $p = 0.040$), supporting the role of frequent specialist involvement in improving outcomes [63,

64]. Similarly, the lack of significant correlation between PASI and DLQI change ($r = 0.142$, $p = .384$) in the primary care group aligns with previous research [3, 65] suggesting that QoL improvements may depend more on psychosocial support and treatment adherence than on clinical severity. This underscores the need to incorporate patient-centered care models alongside traditional severity metrics. A case-series example illustrated a patient achieving clinically meaningful DLQI improvement (MCID, defined as a change of ≤ -3 points) through multiple collaborative care interventions. The lack of standardized collaborative care protocols in the pilot study may have limited the consistency of these benefits.

Variability in remote care management practices at the primary care level

The case series analysis highlighted variability in remote care management among PCPs, which aligns with prior studies showing inconsistent practices in primary care psoriasis management [19, 20]. Some patients were managed solely by PCPs, while others were monitored by nurses, reflecting disparities in care approaches. However, the analysis did not identify consistent patterns linking management practices to QoL improvements. These findings reinforce the need for clear, protocol-driven collaborative care models to standardize remote monitoring practices and improve outcomes. The case series analysis at the primary care level provided additional context to illustrate individual variability in remote psoriasis care and highlight potential mechanisms contributing to QoL improvement. While the sample size was small, these patient-level narratives revealed meaningful differences in care approaches, such as the presence or absence of e-consultations, medication changes, or active patient engagement. This variability helps explain outcome differences that could not be fully captured by quantitative analysis alone. By examining patients who achieved clinically meaningful improvements in DLQI (MCID ≤ -3), the case series offered insight into how collaborative care, treatment intensity, and user satisfaction may interact to influence outcomes. These illustrative examples support the need for clearer remote care protocols and underscore the importance of personalized care pathways in primary care TD. These findings also reflect the strength of mixed-methods approaches in uncovering nuanced care dynamics [31, 66], and align with previous research showing that patient-reported outcomes are often influenced by psychosocial and engagement factors beyond clinical metrics [3, 65].

Limitations

As a mixed-methods study, it had to balance quantitative and qualitative data and integrate several complementary research methods, which introduced complexities in design and execution and increased the risk of bias [66].

The relatively small sample size ($n=76$) reduces the generalizability of the findings on comparative

effectiveness analysis and correlation analysis. A larger sample can provide more robust data and enable more definitive conclusions about differences in QoL outcomes between specialist and primary care settings. This study did not perform an a priori sample size calculation, as it was based on data from a real-world pilot intervention [67]. The final sample size was determined by pragmatic and logistical constraints, which may limit the statistical power of subgroup analyses and generalizability of the findings. Additionally, it lacks control for confounding factors, such as variations in psoriasis severity and treatment adherence.

Although the pilot study design did not explicitly control for time-varying external factors, post hoc analysis incorporating enrollment month found no significant association with DLQI change, indicating limited temporal confounding from staggered recruitment.

While DLQI improvements were observed, especially in the specialist group, these may partially reflect improved patient adherence or physician-led treatment adjustments in response to remote monitoring data. Although the pilot aimed for patients to complete at least one PROMs each month, DLQI responses were submitted only few times by several participants. This limits our ability to assess the long-term effectiveness and sustainability of remote care models based on DLQI data alone. While SUS scores were collected from a broader sample, analysis was limited to the three primary care patients included in the case series. As such, usability-related findings should be interpreted as illustrative and are not generalizable to the full cohort. Broader usability or access challenges—such as internet connectivity, device limitations, or low digital literacy—were not measured and could have influenced patient engagement and outcomes. These factors should be considered in future studies evaluating digital care models.

Although medication and prescription data were available for all participants, a detailed review was conducted only for the three primary care patients who achieved an MCID ≤ -3 in DLQI. This targeted review was designed to explore potential factors associated with clinically meaningful improvement in primary care settings, where overall outcomes were less favorable compared to specialist care. By focusing on patients who demonstrated significant QoL improvement, we aimed to identify possible contributors, such as treatment changes, collaborative care episodes, or patient engagement, that may explain better outcomes in the absence of specialist-led management.

These exploratory insights were used to highlight variability in treatment pathways [30] at the primary care level. However, future research should more systematically analyze medication use across the full cohort to better understand the relationship between treatment changes and patient-reported outcomes, and to distinguish these effects from other potential contributors—such as usability, communication, or perceived support.

In addition, comparisons of baseline characteristics between included and excluded patients revealed no statistically significant differences, suggesting minimal risk of selection bias in the final analytic sample.

The study included a case series analysis to detect factors and patterns. The case-series analysis did not reveal a common pattern that could contribute to QoL improvement at primary care level for psoriasis remote monitoring patients. It also did not disprove the potential factors shown in the existing literature and our correlation analysis [57]. The remote monitoring pilot had not prescribed clear protocols of collaborative care or referral practices. Thus, these factors were researched based on quantitative public claims data and by employing less rigorous explorative methods.

Variability in remote care management approaches among PCPs, combined with the absence of clear collaborative care protocols, may have limited the consistency and rigor of outcomes observed in this study. This study may also be subject to selection bias, as participants were recruited at different sites and levels of care. Differences in care delivery models—such as PCP-led versus nurse-led workflows—may have introduced performance bias, potentially influencing the consistency of outcomes.

Based on this, one can clearly conclude that any remote monitoring study conducted across different care levels (primary and specialist care) should rigorously consider the effect on QoL of the healthcare system's referral practices, e.g., are there any general referral, e-consultation, or collaborative care elements already a part of the healthcare system. This should be considered, and the protocol for using such referral practices should be clearly outlined for such study participants.

This is the first study of its kind to compare publicly reimbursed remote psoriasis monitoring at both specialist and primary care levels while also evaluating collaborative care tools such as e-consultations and standardized referral protocols for improving patient outcomes. Its limitations provide a foundation for future research, which should address these limitations through well-powered randomized controlled trials that account for this study's factors and learning points.

Suggestions for Future Research

Future studies should prioritize the development of structured collaborative care models, such as standardized e-consultations, to enhance PCP-led psoriasis management. Another promising avenue for research is leveraging public claims data to analyze care processes and identify patterns in referral and treatment behaviors. As noted in prior studies, investigating the psychological effects of remote monitoring could provide insights into how these interventions impact patient security and reassurance.

Moreover, future research should explore variations in care design and compare the effectiveness of nurse-led, PCP-led, and collaborative approaches. Randomized controlled trials with more extensive

and diverse populations are essential to validate findings and deepen our understanding of how remote monitoring can improve QoL outcomes, particularly in primary care settings.

Conclusion

With limited specialist access, PCPs play an important role in managing psoriasis, highlighting the importance of providing them with appropriate tools and support. Collaborative practices, such as e-consultations and standardized referral protocols, can enhance care coordination and complement specialist expertise. Supporting PCPs through improved resources and guidance can contribute to better patient outcomes, particularly in resource-constrained settings.

This study offers unique insights by directly comparing remote monitoring outcomes between specialist and primary care settings. It shows how primary care, when supported by structured resources, can approach specialist-level effectiveness. However, primary care remote management yields less significant improvements, reflecting systemic challenges seen in in-person PCP-led care. These findings highlight the potential of integrating specialist involvement into PCP-led care through standardized e-consultation practices. Leveraging public claims data in a mixed-methods approach underscores the need for collaborative care models to ensure consistent quality. Further research should refine and implement these models to optimize remote psoriasis management in primary care.

Acknowledgments

Funding statement: Estonian Health Insurance Fund Model Project Competition (Decision no.161; 28.04.2021), Enterprise Estonia Program for Applied Research (decision no. 1.1-5.1/21/2144; 22.12.2021), Estonian Research Council grant PRG1189.

Generative AI (ChatGPT, OpenAI) was used in a limited capacity to assist with language refinement, summarization, and preliminary idea development during the conceptualization and review stages. All scientific content, including study design, investigation, analysis, and interpretation, was conducted and verified solely by the authors.

Data Availability

The datasets generated or analyzed during this study are available from the corresponding author on reasonable request.

Author Contributions

Jana Arsenjeva: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – original draft, Data curation.

Priit Kruus: Conceptualization, Methodology, Validation, Software, Resources, Data curation,

Writing – original draft, Writing – review & editing, Project administration, Funding acquisition, Supervision.

Riina Hallik: Conceptualization, Methodology, Validation, Writing – review & editing, Supervision.

Secil Matasova: Conceptualization, Methodology, Validation.

Küllü Kingo: Validation, Writing – review & editing, Funding acquisition, Resources.

Katrin Kaarna: Investigation, Project administration.

Laura Prett, Liisi Raam, Oliver Taul, Liis Ilves, Kaisa Viljar, Pille Konno: Investigation.

Peeter Ross: Writing – review & editing, Resources, Funding acquisition.

Conflicts of interest

Priit Kruus, Riina Hallik, Külli Kingo, and Peeter Ross hold stocks or stock options in the company responsible for providing the remote monitoring software. Some authors (Liisi Raam, Oliver Taul, Liis Ilves, Kaisa Viljar, and Pille Kanno) received financial support for providing the service and participating in the study.

Abbreviations

CCH: Collaborative Connected Health

CI: Confidence Interval

DLQI: Dermatology Life Quality Index

IPC: International Psoriasis Council

MCID: Minimal clinically important difference

OR: Odds Ratio

PASI: Psoriasis Area Severity Index

PCPs: Primary Care Providers

PROMs: Patient-Reported Outcome Measures

QoL: Quality of Life

SD: Standard Deviation

SUS: System Usability Scale

TD: Tele dermatology

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Supplementary Files

Multimedia Appendixes

Patient satisfaction questionnaire adapted from the Estonian Society of Family Physicians' standard questionnaire.

URL: <http://asset.jmir.pub/assets/b8163f2e76e92ddf1b9f51172a659fab.pdf>

Exclusion Bias Analysis.

URL: <http://asset.jmir.pub/assets/dbe2b4e78e6adc3de22cac9df664b87.docx>

Regression Model DLQI Change.

URL: <http://asset.jmir.pub/assets/f147bfea37537ff2b525c94bcfdc35d2.docx>

Case Series Summary Table.

URL: <http://asset.jmir.pub/assets/91c93996135d66170b798c5814097912.docx>

CONSORT-EHEALTH checklist used for evaluating the completeness of reporting in the study.

URL: <http://asset.jmir.pub/assets/a8bc57f7fa292797d6b7f3e6b2aead07.pdf>