Healthcare Providers Face Numerous Challenges in Treating Patients with Psoriasis: Results from a Mixed-Methods Study

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Abstract

Background: The paradigm shift toward biologic medications in psoriasis care requires healthcare providers (HCPs) to become acquainted with mechanisms of action and safety profiles of these new treatments to confidently use them in practice. A better understanding of this paradigm shift is necessary to provide adequate education for HCPs in psoriasis care. **Objectives:** This study assessed clinical practice gaps and challenges experienced by HCPs caring for patients with psoriasis. **Methods:** A mixed-methods approach was used to identify practice gaps and clinical challenges of dermatologists, rheumatologists, primary care physicians, physician assistants, and nurse practitioners with various levels of clinical experience in academic and community-based settings. Qualitative and quantitative data were collected sequentially. Interviews were transcribed and thematically analyzed. **Results:** A total of 380 psoriasis care providers in Canada and the US participated in this study. Analysis revealed challenges in establishing an accurate diagnosis of psoriasis (including screening for sub-type and distinguishing psoriasis from other skin conditions), selecting treatment (particularly regarding recently approved treatments), monitoring side effects, and collaborating with other HCPs involved in psoriasis care. **Conclusion:** These findings highlight educational needs of HCPs involved in psoriasis care that could have repercussions on accurate and timely diagnosis of the condition, treatment initiation, side effect monitoring, and continuity of care. Findings provide a starting point for clinicians to reflect on their practice and for the improvement of continuing professional development interventions that would bridge these gaps.

Keywords

psoriasis, treatment, collaboration, educational needs assessment, dermatologists, primary care

Introduction

Approximately 1 million people in Canada and 7 million people in the US suffer from psoriasis.[1,2] Comorbidities associated with psoriasis include psoriatic arthritis, atherosclerotic vascular disease, depression, hypertension, and inflammatory bowel disease, all of which have an important impact on treatment decisions.[3]

The paradigm shift toward biologic medications in psoriasis care requires healthcare providers (HCPs) to become acquainted with the mechanisms of action and safety profiles of these new treatments to confidently use them while monitoring for potential side effects.[4] Although they are effective for patients with moderate to severe psoriasis,[5] undertreatment and dissatisfaction with biologic treatment have been highlighted as important issues in psoriasis care.[2] Further complicating biologic treatment decisions for psoriasis are the

sheer number of approved options for patients (including drugs targeting TNF, IL-12, IL-17, and IL-23), with 11 approved biologics for psoriasis in the US and Canada as of early 2021.[6,7]

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There is a need to better understand what impedes optimal psoriasis care by identifying practice gaps and clinical challenges faced by HCPs, as well as their causalities, so that specific interventions can be developed to improve patient care.

Methods

Overview

A mixed-methods approach was used to identify practice gaps and clinical challenges of dermatologists (Derm), rheumatologists (Rheum), primary care physicians (PCP), primary care physician assistants (PA), and primary care nurse practitioners (NP). Two data collection phases were conducted sequentially. A qualitative exploration phase consisted of 45-minute semi-structured interviews with open-ended questions regarding psoriasis diagnosis, treatment decisions, monitoring, and HCP collaboration. Findings from this phase informed the development of a 20-minute online survey, which was distributed to a larger sample to quantify the clinical challenges and gaps previously identified.[8] Triangulation of sources (5 professions included in the study), methods (interviews and surveys), and investigational perspectives (multidisciplinary interpretation by educational experts [co-authors SM, SP, and PL] and clinical experts [co-authors JC, MJG, VC, AK, and PPD, CF]) was used to minimize self-reporting bias as well as single-observer and single-method bias.[9,10]

IRB Approval

The study was approved by VERITAS IRB (Quebec, Canada), an international independent ethical review board.

Recruitment

Participants were recruited by email to participate in either the interview or survey from 2 different panels, both in alignment with the guidelines of the ICC/ESOMAR International Code on Market, Opinion and Social Research and Data Analytics.[11] There were 1094 invitations sent for the interview and 2000 for the survey. The email included a secure link to a screener and informed consent form. Following the screener, eligible participants were asked either to share their availability for the interview or were redirected to the online survey. Participants received compensation according to country of practice, profession/specialty, and nature of participation (ie, interview or survey) as well as best practices in research.[12]

Inclusion Criteria

To be eligible, participants were required to (a) be actively practicing as a Derm, Rheum, PCP, PA, or NP either in Canada or in the US, (b) have practised a minimum of 3 years, and (c) have a minimum monthly caseload of patients with psoriasis (20 patients for Derm, 10 for Rheum, and 5 for PCP, PA, and NP).

Sampling

For both the qualitative and quantitative phases, a purposive sampling approach was used to ensure sample representation by gender, locality (eg, urban, suburban, or rural), care setting (eg, academic-affiliated, community-based, or specialized clinics), and years of experience for each country and each profession/specialty.

Data Collection

Interview guides were developed based on a review of the literature and discussions with a panel of clinical experts (co-authors JC, MJG, AK, VC, PPD, and CF) to identify gaps and challenges in clinical practice decision-making. A semi-structured format elicited contextual and in-depth responses, and ensured the questions were not biased.[13] The interview guide consisted of open-ended questions with probes to elicit further elaboration. The interviews, conducted in English between May 2019 and July 2019, were recorded with the participants' consent and transcribed. Examining causalities in the qualitative phase informed the development of the 20-minute online quantitative survey that was deployed online between October 2019 and November 2019. The survey included 127–138 items depending on the relevance to each profession and used a 5-point Likert-type scale to rate knowledge and skills compared to professional expectations (from 1 = no knowledge/skill to 5 = expert knowledge/skill), and to indicate their agreement with statements regarding psoriasis care (from 1 = strongly disagree to 5 = strongly agree). A visual analogue scale (0–100) was used to rate confidence performing certain clinical tasks. Each item included the response option "not relevant in my current role."

Qualitative Analysis

Upon completion of qualitative data collection, interviewers discussed the prioritization of general themes for analysis. Interviews were analyzed using NVivo (QSR International Pty Ltd, Version 12, 2018). The approach of the analysis was based on the principles of both thematic and direct content analysis.[14] A coding tree was developed deductively based on research questions, debriefing sessions, and literature review and then refined inductively as details emerged. This systematic categorization of themes identified areas of psoriasis care that represent challenges or barriers to optimal care, which were then quantified and validated in the subsequent quantitative phase.

Quantitative Analysis

Quantitative analysis was performed using SPSS (SPSS 26.0 software, IBM Corporation, Armonk, NY). Pearson's chi-squared test was used to determine differences in knowledge, skills, and agreement by country and profession. ANOVA and Kruskal–Wallis analyses were applied to self-reported

confidence levels and used to identify differences by country and profession. From the initial 5-point Likert-type scale, knowledge and skill ratings were regrouped into 2 categories: "sub-optimal" (for 1 = none, 2 = basic, 3 = intermediate) and "optimal" (for 4 = advanced, 5 = expert). The ratings from the 5-point Likert scale for the agreement items were regrouped into 3 categories: "disagree or strongly disagree," "neither agree nor disagree," and "agree or strongly agree."

Results

Sample Description

A total of 380 psoriasis care providers in Canada and the US participated in this study. Thirty-five HCPs (15 in Canada, 20 in the US) completed the qualitative exploratory phase, and 345 HCPs (122 in Canada, 223 in the US) completed the quantitative phase. (see Table 1). Triangulation of data revealed challenges in 3 major areas: (1) establishing an accurate diagnosis, (2) selecting treatment for psoriasis and monitoring side effects, and (3) communicating and collaborating with other healthcare providers.

Challenges Establishing an Accurate Diagnosis of Psoriasis

On average, 30% of PCP, PA, and NP screen for psoriasis sub-types at diagnosis compared to 88% of Derm and 65% of Rheum. (see Table 2). The absence or the underuse (due to lack of time) of diagnostic tools in primary care settings was identified as a potential explanation for the difference reported. Representative quotes elaborate this finding below.

> *In my particular office we don't have the skin biopsy kit that I had in residency, which would make it very easy because if it's not clear cut-and-dry psoriasis, sometimes it's hard to tell …*
> – PCP, US

> *I've had patients come in for something totally different and I'm like, 'how long have you had that on your elbow?' 'Oh, I've had it forever. I saw the doctor once and they gave me some steroid cream. It kind of worked but it doesn't bother me that much.' It is spreading but gets pushed to the wayside because they are in for other things and we don't get enough time with our patients to really go over everything.*
> – PCP, US

Table 1. Description of Sample by Region, Profession/Specialty, and Data Collection Phase.

Phase 1 Interviews	Derm (n = 7)	Rheum (n = 7)	PCP (n = 7)	PA (n = 7)	NP (n = 7)	Total (n = 35)
Canada	3	3	3	3	3	15
USA	4	4	4	4	4	20
Years of practice						
3–10 years	1	2	1	3	3	10
11–20 years	5	4	1	1	3	14
21+ years	1	1	5	3	1	11
Setting						
Academic	—	1	—	—	1	2
Community	7	6	7	7	6	33
Location						
Rural	—	—	2	1	2	5
Suburban	3	2	3	5	2	15
Urban	4	5	2	1	3	15
Phase 2 survey	Derm (n = 74)	Rheum (n = 70)	PCP (n = 75)	PA (n = 61)	NP (n = 65)	Total (n = 345)
Canada	30	25	31	16	20	122
USA	44	45	44	45	45	223
Years of practice						
3–10 years	23	25	23	35	24	130
11–20 years	27	26	20	18	22	113
21+ years	24	19	32	8	19	102
Setting						
Academic	2	7	5	6	8	28
Community	72	63	70	55	57	317
Location						
Rural	3	7	14	13	19	56
Suburban	39	25	33	30	24	151
Urban	32	38	28	18	22	138

Derm, dermatologists; Rheum, rheumatologists; PCP, primary care physicians; PA, primary care physician assistant; NP, primary care nurse practitioners.

Table 2. Responses Provided by Healthcare Providers to Agreement Statements.

| Percent of ...... Who Agreed or Strongly Agreed with the Statement | Profession | | | | | | |
	Derm	Rheum	PCP	PA	NP	Total	Sig[a]
A "During diagnosis, I take the time to screen for psoriasis sub-types."	88% (n = 65)	65% (n = 45)	36% (n = 27)	20% (n = 12)	35% (n = 22)	50% (n = 171)	P < .001
B "I believe psoriasis requires immediate referral to a dermatologist."	60% (n = 44)	35% (n = 24)	24% (n = 18)	18% (n = 11)	24% (n = 18)	34% (n = 115)	P < .001

Derm, dermatologists; Rheum, rheumatologists; PCP, primary care physicians; PA, primary care physician assistant; NP, primary care nurse practitioners.
[a]Chi-squared test.

Table 3. Percent of Healthcare Providers who Self-Reported No or Basic Levels of Knowledge or Skills.

| Percent of ...... who reported no or basic... | Profession | | | | | | |
	Derm	Rheum	PCP	PA	NP	Total	Sig[a]
A ..... knowledge of indicators of psoriasis to distinguish the disease from other skin conditions	7% (n = 5)	—	67% (n = 50)	75% (n = 46)	75% (n = 49)	55% (n = 150)	P < .001
B ...knowledge of current guidelines for the management of	12% (n = 9)	—	81% (n = 61)	95% (n = 58)	83% (n = 54)	66% (n = 182)	P < .001
C ...knowledge regarding the impact of psoriasis treatment on patient's existing metabolic conditions like diabetes	42% (n = 31)	—	85% (n = 63)	95% (n = 58)	83% (n = 54)	75% (n = 206)	P < .001
D ...knowledge of impact of psoriasis treatment on patients with suppressed immune systems (eg, cancer, HIV, hepatitis, NASH)	46% (n = 34)	—	85% (n = 64)	92% (n = 56)	86% (n = 56)	76% (n = 210)	P < .001
E ...knowledge of efficacy of available treatments for psoriasis	15% (n = 11)	—	83% (n = 62)	93% (n = 57)	88% (n = 57)	68% (n = 187)	P < .001
F ... skill in assessing the severity of psoriasis with tools such as Body Surface Area (BSA), Physician's Global Assessment (PGA), or PASI	33% (n = 24)	—	89% (n = 64)	98% (n = 60)	94% (n = 59)	77% (n = 207)	P < .001
G ...skill in communicating with specialists in the management of comorbidities associated with psoriasis	41% (n = 30)	36% (n = 25)	55% (n = 41)	72% (n = 43)	66% (n = 42)	53% (n = 181)	P < .001
H ...skill in managing treatment-related adverse events (eg, skin thinning and bruising)	23% (n = 17)	21% (n = 15)	80% (n = 60)	93% (n = 57)	88% (n = 57)	60% (n = 206)	P < .001
I ...skill in determining which information to share with other healthcare professionals co-managing patients	20% (n = 15)	20% (n = 14)	58% (n = 42)	61% (n = 37)	55% (n = 35)	42% (n = 143)	P < .001
J ...skill in managing patient adherence to treatment	25% (n = 18)	36% (n = 25)	77% (n = 58)	85% (n = 50)	78% (n = 51)	59% (n = 202)	P < .001

Derm, dermatologists; Rheum, rheumatologists; PCP, primary care physicians; PA, primary care physician assistant; NP, primary care nurse practitioners; PASI, psoriasis area and severity index.
[a]Chi-squared test.

PCP, PA, and NP also expressed challenges distinguishing psoriasis in different stages of progress and by sub-types. Participants reported guttate and pustular psoriasis sub-types to be particularly challenging to distinguish.

One of the patients that I needed a dermatologist to diagnose, was someone who had guttate psoriasis, and I

didn't recognize it for what it was at that time. [...] the other one that's gotten tricky is pustular psoriasis.

– NP, Canada

Sub-optimal knowledge of the indicators to help distinguish psoriasis from other skin conditions was reported by 67% of PCP and 75% of PA and NP (see Table 3). The majority of PCP

(89%), PA (98%), and NP (94%) also reported lacking skills to assess the severity of psoriasis with tools such as body surface area (BSA), physician's global assessment (PGA), or psoriasis area and severity index (PASI). Reporting the lowest confidence levels recognizing signs and symptoms of psoriasis were PCP (69 ± 17) and PA (67 ± 17) (see Table 4).

Participants reported challenges recognizing symptoms as psoriasis in part due to varying presentations during the progression of the condition and in absence of flare.

> *The challenges are patients sometimes who have very minimal disease and it really isn't tremendously diagnostic or they're not in a flare period or it's not reactive, it can be difficult to diagnose.*
> – Derm, Canada

In addition, establishing a precise diagnosis is more complex when treatment has been initiated and has modified skin presentation.

> *The problem is once you start putting over-the-counter creams on any rash it changes the way the rash looks. That's a problem sometimes in diagnosing psoriasis.*
> – PA, US

Lack of referrals from primary to specialty care was also pointed out as a contextual challenge that might impede an accurate and timely diagnosis.

> *I think it's [psoriasis is] often under-diagnosed so I think it's imperative that as dermatologists we always ask our patients about it, but number two, from the beginning sometimes those patients are managed by family providers, family physicians who might not refer the patient*
> – Derm, Canada

Psoriasis was reported to be a condition that requires immediate referral by 60% of Derm, 35% of Rheum, 24% of PCP, 18% of PA, and 28% of NP (see Table 2).

Challenges Selecting Treatment for Psoriasis and Monitoring Side Effects

The majority of PCP (81%), PA (95%), and NP (83%) reported sub-optimal knowledge of the current clinical guidelines for the management of psoriasis and 88% were unaware of the efficacy of available treatments (see Table 3). Participants indicated that clinical experience is often favored over guidelines, even when these are known, given the variation in individual patient needs, and limited access to recommended treatments.

> *There are published guidelines. I think most dermatologists, by and large, really don't follow guidelines. It's an overall gestalt and sort of experience, and just the art of picking the right therapy for the right patient*
> – Derm, Canada

> *For instance, there are some new guidelines in the United States suggesting the first treatment for somebody with psoriatic arthritis should be a biologic therapy, but there is no access to that. You have to go through a series of conventional therapies like methotrexate, leflunomide, drugs like that before you can get to a biologic or advanced therapy. That's one issue.*
> – Rheum, Canada

Participants reported challenges when selecting treatment for patients with comorbidities, particularly metabolic (eg, diabetes, obesity) and immunosuppressive conditions.

> *Usually being overweight leads to diabetes. Quite a few psoriatic patients have diabetes in my practice. They have hypertension. They have dyslipidemia. They have slowed down their kidney function. For me it's very important that whatever I treat, I don't make it worse [...] If you have patients who are obese diabetic, then you have NASH [non-alcoholic steatohepatitis]. And if you have NASH, you have already an abnormal liver function test. So, if you prescribe methotrexate, you don't know what you're dealing with. You have to worry about the liver.*
> – PCP, US

Table 4. Self-Reported Confidence Levels to Selected Items.

Profession	Mean Confidence Level (Std. Deviation) When	
	Recognizing Signs and Symptoms of Psoriasis	Managing Adverse Events Resulting from Biologic Therapy
Derm	89 (13)	77 (18)
Rheum	75 (19)	82 (15)
PCP	69 (17)	38 (28)
PA	67 (17)	30 (23)
NP	74 (19)	55 (23)
Total	74 (19)	63 (27)
Sig[a]	$P < .001$	$P < .001$

Derm, dermatologists; Rheum, rheumatologists; PCP, primary care physicians; PA, primary care physician assistant; NP, primary care nurse practitioners.
[a]Kruskal-Wallis H test.

"If they have some sort of hepatitis B in conjunction with psoriatic arthritis, then that becomes a real challenge. Because to find the right medication that would not trigger the hepatitis B to flare up, that's the challenge because you are immune suppressing them."

– Rheum, US

In the survey, many HCPs reported a knowledge gap regarding the impact of psoriasis treatment on patient's existing metabolic conditions (42% of Derm, 85% of PCP, 95% of PA, and 83% of NP), as well as on patients with suppressed immune systems (46% of Derm, 85% of PCP, 92% of PA, and 86% of NP) (see Table 3). Differences between countries were also observed for the latter knowledge gap: reported by 84% of HCPs practicing in Canada and 72% of those practicing in the US. When it comes to communicating with specialists in the management of comorbidities associated with psoriasis, 55% of PCP, 72% of PA, and 66% of NP reported a skill gap. This was also true of specialists, but to a lesser extent: 41% of Derm and 36% of Rheum (see Table 3).

Seventy-seven percent of PCP, 85% of PA, and 78% of NP reported a skill gap in managing patient adherence to treatment (see Table 3). Qualitative data clarified the difficulties HCPs face selecting an injectable vs oral treatment route, considering patients' phobias, ability to self-administer an injection, digestive sensitivity, and adherence to the treatment schedule.

Patients' tolerance of things is different across the board. People say: "[…] I'll just take another pill every day, that's no big deal". Other people can't remember to take a pill to save their life and they're okay with an injection. […] 10-15% of the population has a needle phobia so how are you going to get them to do an injectable?

– PA, US

Finally, once treatment is selected and administered, HCPs contend with managing adverse events. This issue is pronounced with biologic agents, which was reported as challenging, as infection is a high-risk adverse event that may need hospitalization due to blood, skin, and/or urinary tract infections.

Patients have had problems with recurrent infections such as urinary tract infections while on the biologics. And so, in those cases, those biologics have to be stopped. And it can be tricky because you can't always get them on a different biologic. The patient doesn't want to or is scared to get on a different biologic for fear of the same sort of side effects happening.

– Rheum, Canada

Participants from all 3 primary care provider professions reported sub-optimal confidence (below 60 on the 0–100 scale) in managing adverse events from biologic therapy

(see Table 4). Among PCP, 80% reported sub-optimal skills in this area, as did 93% of PA and 88% of NP (see Table 3).

Challenges Communicating and Collaborating with Other Healthcare Providers

Given the nature of psoriasis and its comorbidities, patients are often co-managed with other HCPs. Of PCP, 58% reported difficulty determining which information to share with other healthcare professionals when co-managing patients (see Table 3). Qualitative data indicated that inconsistent or unclear norms of communication may impede transfer.

I think family physicians are generally frustrated by the communication between specialists and GP's, especially for chronic conditions because we rarely, rarely, they rarely send anything to us after maybe an initial consultation.

– PCP, Canada

More respondents from the US (66%) than Canada (48%) reported that differences in electronic health record (EHR) systems between practices are a significant barrier.

Educational Needs Stated by Healthcare Providers

Derm, PCP, PA, and NP overwhelmingly identified (average 30–50%) treatment algorithms and the safety and efficacy of treatments as the most important topics for further education. Derm and Rheum also indicated the need for education on resources to support patient adherence to treatment, comorbidities associated with psoriasis and psoriatic arthritis, and the mechanisms of actions of new treatments for these conditions. Several Rheum, PCP, PA, and NP (all around 17%) requested training on tools and technologies to communicate with other specialists involved in psoriasis and psoriatic arthritis care. PA and NP requested tools to assess patient response to treatment and resources to support patience adherence.

Discussion

Results of this mixed-methods investigation indicate a need to improve psoriasis care practices, particularly those of clinicians in primary care settings. Results show challenges establishing an accurate diagnosis of psoriasis, as there is a lack of screening for sub-types, as well as a lack of PCP knowledge and skills to distinguish psoriasis from other conditions.

Further clarifying Doshi et al.'s[5] findings regarding psoriasis undertreatment and patient dissatisfaction, this study indicated that pressures of time and lack of knowledge to adequately screen and use diagnostic tools in the primary care setting ultimately impede timely referrals of patients to speciality settings. We can infer that this may prevent psoriasis patients from receiving the proper treatment according to sub-

type and severity if they remain in the sole care of primary care providers. Patients may also receive improper treatment if management by a specialist is significantly delayed. Specialists and primary care participants had misaligned perceptions regarding the urgency of referrals for psoriasis.

Challenges selecting treatments for psoriasis and monitoring for side effects accentuate the differences between primary care and specialist professions regarding reluctance to treat patients with biologic therapies.[3,5] Primary care providers in particular lacked knowledge of psoriasis and the efficacy of treatments. The difficulty in selecting the treatment is compounded by the sheer number of options, patient preferences, and comorbidities. These gaps are important to address as some traditional agents used for psoriasis have effects which may exacerbate comorbidities, such as hypertension, or impact hepatic and renal function.[3] Although knowledge gaps related to comorbidities were more prominent for primary care providers, more than 40% of dermatologists reported gaps in this area, and therefore may also benefit from education on the impact of psoriasis treatments on metabolic conditions and immunosuppression. Although this data was collected before the COVID-19 pandemic, supportive guidance, such as those published by the National Psoriasis Foundation,[15] is recommended to further improve and adapt care in this context. For instance, some biologic agents for psoriasis inhibit pro-inflammatory cytokines and may potentially increase risk of infection, which further complicates treatment decisions during the COVID-19 pandemic.[16]

Finally, communicating and collaborating on patient co-management emerged as a challenge. This finding is particularly salient due to the complexity of distinguishing psoriasis symptoms from other diseases, the nature of symptoms presented to primary care, and the variety of treatments and their side effects, which often requires the involvement of specialists. This study also sheds light on gaps that can impede coordination of care: lack of skill from primary care providers in determining which information to share with specialists, incompatibilities of EHR systems, and lack of confidence among primary care providers to manage adverse events from biologic therapy. These areas merit further exploration to understand their compounding effects. In the meantime, specialists should collaborate with primary care providers to become more aware of their psoriasis educational needs.

Future educational interventions should aim to improve PCP knowledge of the characteristics of psoriasis that call for timely referrals to specialists. Education efforts should also foster effective primary care and specialist collaboration throughout the continuum of care to ensure the best outcomes for patients. Psoriasis can have an effect on patient psychological and social well-being due to symptoms and the visibility of the affected area.[17,18] Addressing individual, team, and systemic gaps could provide psoriasis patients with more coherent, patient-centered care and thus reduce the impact of the disease on their quality of life. Although the current study revealed collaborative gaps between primary care providers, dermatologists, and rheumatologists, it would be beneficial for optimal patient care to ensure HCPs collaborate strategically and effectively with mental health professionals in educational interventions. As highlighted by Young et al (2017),[19] psoriasis can lead to psychological burden, which in turn increases the likelihood of anxiety, depression, and substance abuse.

Limitations

The results from this study come from self-reported evaluation rather than objective observation, prompting our use of triangulation[9] to minimize self-reporting bias. Although purposive sampling[20] was used to reduce the risks of selection bias (the sample included participants from various practice settings with various years of experience), caution should be exercised when generalizing the findings to a national scale. For locally tailored educational interventions, shorter, location-specific needs assessments should first be conducted to ensure the relevance of interventions for targeted learners.

Conclusion

As evidence-based continuing medical education is increasingly required,[21] the findings from this study should guide targeted educational interventions in psoriasis care. These include (1) online modules and lectures to improve the knowledge of primary care providers of the critical features of psoriasis as well as when to refer to specialists, and (2) interdisciplinary simulation and case-based learning activities to bridge collaboration gaps. Finally, we hope that the findings from this study provide an opportunity for practicing clinicians to reflect on their own practice and educational gaps.

Author Contributions

Co-authors SM, SP, and PL contributed to developing the methodology (with the help of co-authors JC, MJG, AK, VC, PPD, and CF) and analyzing the data. All co-authors contributed to the interpretation of data. All co-authors have contributed sufficiently to this article to be considered as authors, as per the authorship requirements detailed by the International Committee of Medical Journal Editors (ICMJE). All authors read and approved the final manuscript.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Ms. Murray is CEO and Founder of AXDEV Group Inc.,

Availability of Data and Material

Aggregate data from this data are available upon reasonable request.

Ethics Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by VERITAS IRB, an international independent ethical review board.

Consent to Participate

Informed consent was obtained from all individual participants included in the study.

Consent to Publish

The authors affirm that human research participants provided informed consent for publication of this aggregated data included in this article, as they were explained that any references to their identity would be removed or disguised prior to the preparation of the research reports.

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