Psoriasis: towards a timely and accurate diagnosis

A thesis submitted to The University of Manchester for the degree of Doctor of Philosophy in the Faculty of Biology, Medicine and Health

2022

Maha Abo-Tabik

School of Biological Sciences

Division of Musculoskeletal & Dermatological Sciences

Contents

Word count: 28297

List of Tables

List of Figures

Chapter 2

Chapter 4

Chapter 5

Chapter 6

List of Abbreviations

IPC	International Psoriasis Council
BSA	Body surface area
UVR	Ultraviolet radiation
APC	Antigen presenting cell
DM	Diabetes mellitus
CVD	Cardiovascular diseases
BID	Inflammatory bowel disease
GWAS	Genome wide association studies
PsA	Psoriatic arthritis
QoL	Quality of life
WHO	World health organisation
CLCI	Cumulative life course impairment
PASI	Psoriasis Area and Severity Index
DQLI	Dermatology Quality of Life Index
SPI	Simplified Psoriasis Index
NICE	National Institute for Health and Care Excellence
SIGN	Scottish Intercollegiate Guidelines Network
PUVA	Psoralen and UV-A
UV-B	Ultraviolet-B
TNF	Tumour necrosis factor
IL	Interleukin
Th	T-helper cell
BADBIR	British Association of Dermatologists Biologic Interventions Register
MTX	Methotrexate

FDA	Food and Drug Administration
CPRD	Clinical Practice Research Datalink
EHR	Electronic health record
NHS	National Health Service
NIHR	National Institute for Health Research
MHRA	Medicines and Healthcare products Regulatory Agency
HES	Hospital Episode Statistics
ONS	Office for National Statistics
IMD	Index of Multiple Deprivation
ISAC	Independent Scientific Advisory Committee
BNF	British National Formulary
IQR	Interquartile range
IR	Incidence rates
CI	Confidence interval
IRR	Incidence rate ratio
GP	General practitioner
E-Delphi	Electronic-Delphi
UREC	University of Manchester Research ethics committee
HRA	Health Regulatory Authority
CRN	Clinical Research Network
PIC	Participants identification centre
ANCOVA	Analysis of covariance
SD	Standard deviation

Abstract

Aim: This thesis aimed to understand the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK; develop expert-agreed diagnostic criteria for chronic psoriasis (chronic plaque psoriasis); subsequently applying these criteria to develop a training tool to improve psoriasis diagnosis by non-dermatologists.

Methods: Two case-control studies were undertaken involving participants from a large primary care electronic health record database, the Clinical Practice Research Datalink. Individuals with a record of psoriasis within the study window (01/01/2010–29/12/2017) were matched to comparison patients with no previous record of psoriasis based on age, sex, and general practice. Healthcare events including differential diagnoses, clinical features and prescribed medications were examined and their annual incidence rate (IR) and incidence rate ratio (IRR) with 95% confidence interval (95% CI) for ten years before the index date (date of psoriasis diagnosis for cases) were compared between cases and controls. The frequency of GP consultations was also compared between both groups. To improve psoriasis diagnosis, an international panel of 50 dermatology experts took part in three rounds of data collection to establish a clinical diagnostic tool for chronic plaque psoriasis in adults using consensus methods (e-Delphi survey). Subsequently, a training tool based on the findings from the e-Delphi exercise was developed to improve psoriasis diagnosis by non-dermatologists. A before-and-after exploratory investigation of the online training was undertaken with 60 primary care professionals to investigate the impact of training on improving diagnostic skills for psoriasis.

Results: 17,320 psoriasis cases and 99,320 controls were included from CPRD GOLD, and 11,442 cases and 65,840 controls were extracted from CPRD Aurum. Data from CPRD GOLD showed that people with psoriasis were up to eight-times more likely to be diagnosed with pityriasis rosea at six months (IRR 7.82 (95%CI 4.09-14.95)) before the index date than controls. Cases were twice as likely to be diagnosed with eczema 1.90 (1.76 -2.05), or tinea corporis 1.99 (1.74-2.27) one year before diagnosis. Cases were also more likely to report certain clinical features suggestive of psoriasis (including dry skin, rash, skin texture changes and itching) than controls up to five years before index date. The most frequently reported clinical feature was rash with IRR of 2.71 (2.53-2.92) at one year before diagnosis. Psoriasis cases were prescribed topical corticosteroids 1.97 (1.88-2.07) or topical antifungals 1.92

(1.78-2.07) in the year before diagnosis twice as often as controls. Data from CPRD Aurum showed similar results to CPRD GOLD.

The international e-Delphi exercise yielded two main outcomes: (1) a definition of chronic plaque psoriasis; and (2) nine clinical diagnostic criteria to be used together when making a diagnosis of chronic plaque psoriasis. Diagnostic criteria were further categorised as one essential and eight supportive criteria. Panel ratings indicated that at least four supportive criteria must be present, together with the essential criterion to make a diagnosis of chronic plaque psoriasis in adults.

For the training tool study, a convenience sample of 60 primary healthcare professional (GPs, nurses and pharmacists) completed the training. Findings suggest that the newly developed e-learning tool for psoriasis improved the diagnostic ability of primary care practitioners, and that the diagnostic ability of GPs was on average, higher than nurses and pharmacists. After training, participants reported being more confident in making a diagnosis of psoriasis.

Conclusions: Potential opportunities for the earlier diagnosis of psoriasis were identified from the medical records of patients with the disease. Earlier diagnosis of psoriasis may be achieved by following consensus agreed clinical diagnostic criteria for psoriasis. The training tool to improve psoriasis diagnosis may help non-dermatologists to implement the consensus agreed diagnostic criteria for chronic plaque psoriasis in their clinical practice, thereby avoiding a potentially detrimental delay in establishing an appropriate treatment regimen. Future work should aim to explore the applicability of findings from this thesis in resource poor settings such as lower- and middle-income countries to improve psoriasis diagnosis in areas with limited access to specialist dermatology care and standardise case definition in epidemiological field studies for psoriasis.

Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Copyright

I. The author of this thesis (including any appendices and/or schedules to this thesis) owns certain copyright or related rights in it (the "Copyright") and she has given the University of Manchester certain rights to use such Copyright, including for administrative purposes.

II. Copies of this thesis, either in full or in extracts and whether in hard or electronic copy, may be made only in accordance with the Copyright, Designs and Patents Act 1988 (as amended) and regulations issued under it or, where appropriate, in accordance with licensing agreements which the University has from time to time. This page must form part of any such copies made.

III. The ownership of certain Copyright, patents, designs, trademarks, and other intellectual property (the "Intellectual Property") and any reproductions of copyright works in the thesis, for example graphs and tables ("Reproductions"), which may be described in this thesis, may not be owned by the author and may be owned by third parties. Such Intellectual Property and Reproductions cannot and must not be made available for use without the prior written permission of the owner(s) of the relevant Intellectual Property and/or Reproductions.

IV. Further information on the conditions under which disclosure, publication and commercialisation of this thesis, the Copyright and any Intellectual Property and/or Reproductions described in it may take place is available in the University IP Policy (see http://documents.manchester.ac.uk/DocuInfo.aspx?DocID=24420), in any relevant Thesis

restriction declarations deposited in the University Library, the University Library's

regulations (see http://www.library.manchester.ac.uk/about/regulations/) and in the

University's policy on Presentation of Theses.

Acknowledgments

Preface

Maha Abo-Tabik graduated from university of Baghdad, college of medicine with MBChB in 2012. After graduation Maha practiced medicine in her home country (Iraq) for three years. In 2015, Maha was awarded the Chevening scholarship to undertake a master's degree, which sparked her interest in dermatology research especially psoriasis. She graduated from the University of Hertfordshire in the UK, with a master's degree with distinction in clinical dermatology in 2016.

Maha started her PhD programme at the Centre for Dermatology Research, Division of Musculoskeletal & Dermatological, Faculty of Biology, Medicine and Health, the University of Manchester in 2017. Her research focused on improving the diagnosis of psoriasis in non-specialist dermatology settings by developing and piloting clinical examination based diagnostic criteria for psoriasis and subsequently applying them to educate healthcare professionals about psoriasis diagnosis.

Publications

<u>Published papers</u>

     I.   Abo-Tabik M, Parisi R, Willis S, Griffiths CEM, Ashcroft DM, on behalf of the Global psoriasis atlas . Development of clinical diagnostic criteria for chronic plaque psoriasis: an international e-Delphi study. Br J Dermatol. 2021; 185(2):455-6. doi: 10.1111/bjd.20096.

    II.   Abo-Tabik M , Parisi R , Morgan C , Willis SC , Griffiths CEM , DM Ashcroft, on behalf of the Global psoriasis atlas Mapping opportunities for the earlier diagnosis of psoriasis in primary care settings in the UK: results from two matched case–control studies. Br. J. Gen. Pract.2022; 72(723). doi: https://doi.org/10.3399/BJGP.2022.0137.

<u>Conference abstracts</u>

I.   Abo-Tabik M, Parisi R, Willis S, Griffiths C, Ashcroft D. Developing clinical examination-based diagnostic criteria for psoriasis in adults (age 18 years and above). [poster]. In Postgraduate Summer Research Showcase; 2019 June 12; Manchester. Abstract No. 85.

II.   Abo-Tabik M, Parisi R, Willis S, Griffiths C, Ashcroft D. Clinical examination–based diagnostic criteria for chronic plaque psoriasis in adults: A Delphi consensus of international experts. [poster]. In: 100th Annual Meeting British Association of Dermatologists; 2020 July 7-9; Manchester. Abstract No. P044.

III.   M Abo-Tabik , R Parisi , C Morgan , SC Willis , CEM Griffiths , DM Ashcroft. Mapping opportunities for the earlier diagnosis of psoriasis in primary care: a large retrospective analysis of general practice electronic health records in the

United Kingdom. [poster]. In: 6th World Psoriasis & Psoriatic Arthritis Conference; 2021 July 30- July 3; Stockholm. Abstract No. 35164.

IV.   M Abo-Tabik , R Parisi ,M Hann, R Tucker, SC Willis , DM Ashcroft, CEM Griffiths. Development and evaluation of an online training tool to aid the diagnosis of psoriasis.In: 31st EADV Congress; 2022 Sept 7-10; Milan. . Abstract No. 3018. Submitted.

Chapter 1 - Overview of thesis structure

This chapter covers the overall structure of the thesis, with a brief outline of the work included in each chapter.

1.1. Overview of thesis structure

In my PhD I have taken the critical steps to appraise the literature and current understanding about the pathogenesis and practice of psoriasis, before answering the research question. The starting point for this research is a genuine belief that many people suffer needlessly from psoriasis and are not receiving the best medical care. More specifically, earlier diagnosis helps to improve both patient care and use of the medical resources.

My thesis presents an evolving project, where each chapter's research question builds on the findings from the previous chapter. This integrated work is shown progressively through the thesis. The following is a summary of each chapter content:

Chapter 1 – Overview of thesis structure.

Chapter 2 – A general overview of psoriasis.

This chapter consists of two main parts:

 Part 1 provides contextual information about psoriasis, its pathogenesis, clinical spectrum, disease severity measures, associated health conditions, management plan and treatment options.

Part 2 includes background information about psoriasis diagnosis and previous attempts to define clinical diagnostic criteria.

Chapter 3 – Aims and objectives

Chapter 4 – Mapping opportunities for the earlier diagnosis of psoriasis in primary care settings in the UK.

Presents the approach and outcome of a matched case-control to understand the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK using the UK largest primary care electronic records; the clinical practice research data link (CPRD).

Chapter 5 – Development of clinical examination based diagnostic criteria for chronic plaque psoriasis in adults: An international e-Delphi study.

Describes the process of developing expert agreed set of clinical diagnostic criteria for chronic plaque psoriasis in adults.

Chapter 6 – Development and evaluation of an online training tool to improve the diagnosis of psoriasis.

Describes the development and evaluation of a new training tool for primary care professionals to improve their diagnostic skills for psoriasis.

Chapter 7 – Discussion.

Discusses the findings and implications of each one of the three conducted studies and provide information on the implications of the findings for policy and practice, and potential future work.

Chapter 2-A general overview of psoriasis

The aim of this chapter is to provide contextual information about psoriasis with detailed information about the current practice for the clinical diagnosis of psoriasis and the previous attempts to develop diagnostic criteria for psoriasis.

2.1. Part 1: key concepts in psoriasis

Part 1 provides an initial introduction to the pathogenesis, clinical spectrum, and subtypes of psoriasis, means for psoriasis severity assessment which is then followed by a summary of current approaches in psoriasis management and treatment.

2.1.1. Background

Psoriasis is a chronic, complex, inflammatory skin disease with a frequent relapsing, remitting course. The global prevalence of psoriasis varies globally and estimated to range from less than 0.3% in Taiwan to 8.5% in Norway (1).

In the United Kingdom, psoriasis affects approximately 0.5 to 1.9 of the overall population and 1.92 % of the adults (1). The incidence is approximately 129.0 per 100,000 person-years (2). There are different clinical subtypes of psoriasis, the most common phenotype is chronic plaque psoriasis. Psoriasis affect usually extends beyond the skin and greatly impacts the quality of the life and socioeconomic status of patients and their caregivers (3).

Different genetic, environmental and lifestyle risk factors contribute to the pathogenesis of psoriasis, and for this reason is considered a multifactorial disorder (4). Due to its long course and associated comorbidities such as cardiovascular disease and psoriatic arthritis, psoriasis requires regular follow-ups with assessment of the disease severity and response to treatment.

Currently, there is no definitive cure for psoriasis and existing management approaches are mainly used to control symptoms and monitoring for comorbidities.

Personalised, stratified medicine (5-7) and preventative strategies are both progressive areas for current psoriasis practice and research (8).

The diagnosis of psoriasis is usually based on a comprehensive skin evaluation, especially when a patient has lesions with classic topographic features (9-11). Although a skin biopsy is not routinely taken, it may be indicated if there is diagnostic uncertainty.

In most cases, dermatologists are able to diagnose psoriasis. However, since psoriasis can look like other skin conditions such as eczema and tinea corporis, diagnosing it can sometimes be difficult even for the trained eye. For non-dermatologists, recognising earlier presentations of the disease particularly in childhood can be a challenging task.

Several factors may contribute to the delayed diagnosis of psoriasis in non-specialist dermatology settings such as in primary care settings or in those parts of the world where access to specialist dermatology setting is restricted such as in lower-middle income countries. Such factors include the absence of well-defined and validated diagnostic criteria for psoriasis (12) and the limited dermatology knowledge and training of primary care professionals (13). On the other hand, many studies on the incidence and prevalence of psoriasis reported inconsistencies in the epidemiological data due to the non-standardised psoriasis case definition (1, 2).

To address these problems, detailed investigation of the pre-diagnostic period and the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK were required. Developing a standardised approach for psoriasis diagnosis to be used in clinical and research settings could play a vital role in improving care for psoriasis patients and producing more reliable epidemiological data. Additionally, since non-dermatologists such as primary care professionals are the first point of contact for psoriasis patients in many countries including the United Kingdom, it is important for them to be able to diagnosis the disease and to differentiate between psoriasis and other skin conditions mimicking psoriasis in its clinical presentation.

2.1.2. Clinical spectrum

Psoriasis is a chronic, relapsing skin disorder. It can occur at any age, However, epidemiological studies conducted in western Europe and the United States suggested that psoriasis has two peaks of presentation at around 30–39 and 60–69 years of age. The pattern usually corresponds to whether psoriasis first presented before (type 1) or after (type 2) the age of 40 years and is regarded as either 'early onset' or 'late onset' respectively (14). In early-onset psoriasis (type 1), females are more likely to be affected than males; however, in late-onset psoriasis (type 2) less difference is observed between genders (2). Type 1 psoriasis is associated with positive family history, HLA-Cw6 and HLA-DR7, whereas type 2 psoriasis shows a negative correlation with family history and lacks an HLA association (15).

The onset of psoriasis can be sudden or can progress gradually over time (16).

The typical presentation of a psoriasis lesion usually manifests as a red or pink plaque that is covered with silvery/white scales on white skin (8, 17). However, on darker skin colour, psoriasis lesion may appear grey in colour and may give rise to marked post-inflammatory hyperpigmentation (17, 18). The disease tends to affect the extensor surfaces of the limbs, lower back, and trunk. This presentation is most common and accounts for more than 90% of all cases (8, 19). Sometimes plaques develop at the site of a previous trauma (isomorphic or Koebner phenomenon), which is usually noticed within 10 days to a few weeks of the injury occurring. A linear psoriasis plaque suggests prior excoriation (20). In addition, gentle scraping of the overlying scales will reveal fine spots of bleeding (Auspitz sign). Lesions usually affect the extensor surfaces and scalp. The scalp is frequently the first and most common anatomical site affected by psoriasis (21). Flexural involvement may also occur, and a fissure may be observed at the skin crease.

Nail changes such as pitting, yellowish discolouration, paronychia, onycholysis and subungual hyperkeratosis are observed in about 20% of patients with psoriasis and may be associated with scalp and joint involvement (16).

Sometimes, clinical psoriasis signs can be subtle, such as localized genital lesions, flexural erythema alone or mild scaling of the scalp. In such circumstances, careful physical examination might reveal additional symptoms elsewhere (17).

In children, the clinical presentation of psoriasis may be more subtle than in adults with thinner, less hyperkeratotic plaques. The distribution often involves the flexures, face and skin covered by clothing and hair, which can be easily missed if these areas are not specifically asked about and examined. Psoriasis in children and younger adults (age less than 18 years) may also mimic other skin conditions such as atopic dermatitis, irritant or allergic contact dermatitis, pityriasis rosea and seborrheic dermatitis. Similar to adults, psoriasis in children may also be confused with some infectious skin conditions, such as tinea and candida infections. Features of juvenile psoriasis have been reported in previous literature, including an increased rate of guttate psoriasis characterized by an abrupt onset and erythematous exanthema of numerous small (tear drop or rain drop) lesions that have a centripetal distribution over the body. The extremities and the face may also be affected (21). Each lesion measures less than 1 cm in diameter and lesions tend to distribute in a centripetal fashion (24). If left untreated, guttate psoriasis can be self-limiting or may develop into chronic plaque psoriasis (23). Like adults, psoriasis in children is also under-recognised in primary and secondary care. Reasons for this may include a lack of awareness that psoriasis can develop from infancy onwards

2.1.3. Clinical subtypes

Clinically, the classification of psoriasis subtypes can be challenging. Within one subtype the features of psoriasis can differ depending on the anatomical site, for example chronic plaque psoriasis on the scalp is often hyperkeratotic (thick scale) compared to the thin erythematous lesions seen in flexural psoriasis. Another challenge is that the presentation of psoriasis can change between subtypes. Psoriasis can initially present as guttate disease and then develop into chronic plaque psoriasis, or it is possible to develop a guttate flare of chronic plaque psoriasis (23). Similarly, chronic plaque psoriasis can become unstable and change into generalised pustular psoriasis.

In 2005, the International Psoriasis Council (IPC) proposed a clearer classification system for psoriasis subtypes based on their clinical appearance (21). Four main subtypes were defined: chronic plaque psoriasis (psoriasis vulgaris), guttate psoriasis, pustular psoriasis and erythrodermic psoriasis. Nail psoriasis may occur within the four subtypes, or as an isolated type of psoriasis.

2.1.3.1. Chronic plaque psoriasis

Chronic plaque psoriasis (psoriasis vulgaris) is the predominant type, affecting about 90% of all patients (4). No matter which psoriasis phenotype a patient has, they could develop chronic plaque psoriasis later in life. This psoriasis phenotype usually begins as well-demarcated (clear separation between affected and unaffected skin) erythematous macules or papules that extend peripherally and then coalesce to form plaques (24). Lesions may vary in size from 0.5 cm in diameter to large confluent areas several centimetres across.

Lesions can also vary in number from single to multiple; however, they are usually monomorphic and symmetrically distributed over the extensor surface of the limbs, lower back, trunk and scalp.

There are a number of chronic plaque psoriasis subcategories classified according to the anatomical location, distribution and morphology (thickness and size of the plaque). These phenotypes include flexural psoriasis, seborrhoeic psoriasis, scalp psoriasis, palm, sole and non-pustular psoriasis (21). In flexural psoriasis, lesions affect skin folds and intertriginous areas such as axilla, the sub-mammary area (the crease under the breasts) and groin. Scales might not be seen because of the occlusion and friction effect, and erythema and fissuring may result (25). Figure 2.1a demonstrates typical well-demarcated red/pink psoriasis plaques covered with white scales on lightly pigmented skin. Figure 2.1b demonstrates grey psoriasis plaque covered by silvery scales on dark pigmented skin.

Psoriasis affecting the palms and soles (acral psoriasis) can present as confluent erythema and scale, discrete plaques or ill-defined scaly/fissured areas. Scalp psoriasis can vary from discrete plaques to complete scalp involvement, diffuse change to thick adherent scale. Frequently affected sites include the hairline, post-auricular and the occiput. Scalp psoriasis can lead to non-scarring alopecia (hair loss).

A

B

C

D

Figure 2. 1. Chronic plaque psoriasis

Note:

A. Chronic plaque psoriasis on lightly pigmented skin. Reproduced with permission from https://www.psoriasiscouncil.org/
B. Chronic plaque psoriasis on dark skin colour. Reproduced with permission from http://www.atlasdermatologico.com.br/
C. Chronic plaque psoriasis on extensor surface of the lower limb. Reproduced with permission from Dr Tatajana Maul.
D. Chronic plaque psoriasis on the back and sacrum. Reproduced with permission from Dr Tatajana Maul.

2.1.3.2. Guttate Psoriasis

Guttate psoriasis is characterized by an abrupt onset and erythematous exanthema of numerous small (tear drop or rain drop) lesions that have a centripetal distribution over the body. The extremities and the face may also be affected (21). Each lesion measures less than 1 cm in diameter and lesions tend to distribute in a centripetal fashion (24).

This psoriasis variant is most commonly triggered by streptococcal infection (in two-third of the patients). The association between streptococcal infections and acute guttate psoriasis has been known for many years. Previous literature suggested a high incidence of streptococcal infections and raised serum antistreptococcal M6 protein in blood samples (26). One case-controlled study indicated a strong association between guttate psoriasis and both a family history of psoriasis and stressful life events (27). The skin rash usually develops over a month (28). Guttate psoriasis most commonly affects children and young adults. If left untreated, guttate psoriasis can be self-limiting or may develop into chronic plaque psoriasis (23). Figure 2.2 shows the lesion shape and distribution of guttate psoriasis.

Figure 2. 2. Guttate psoriasis

Note:

Guttate psoriasis on the back of 9 years old girl. Adapted from https://commons.wikimedia.org/wiki/File:Psoriasis_en_gouttes_enfant_2.jpg

2.1.3.3. Erythrodermic Psoriasis

Erythrodermic psoriasis is a confluent type of psoriasis affecting more than 90% of the body surface area (BSA) (21). It may progress from any type of psoriasis to cause a generalized form of the disease all over the body. Common trigger factors include abrupt withdrawal of systemic corticosteroids, and to a lesser extent, sudden discontinuation of systemic methotrexate treatment, following phototherapy burns, or concomitant infection (21). Erythrodermic psoriasis is the most refractory to treatment (29). Erythroderma can be easily diagnosed in patients with pre-existing psoriasis; however, it is a life-threatening condition that requires urgent medical care (i.e. emergency treatment) (24). Erythroderma of psoriasis is not significantly different from other causes of erythroderma (16).

2.1.3.4. Pustular psoriasis

Pustular psoriasis refers to a set of severe inflammatory skin conditions that are characterised by the repeated eruptions of painful neutrophil filled pustules (30, 31). The condition could present with an abrupt onset accompanied by a systemic upset (generalised pustular psoriasis) or present as a chronic pustular eruption that affect the palms and soles (palmoplantar pustulosis) or the tips of fingers and toes (acrodermatitis continua of Hallopeau) (30). It is worth mentioning that although pustular psoriasis is currently grouped with chronic plaque psoriasis, the skin disorder is phenotypically different from chronic plaque psoriasis. Pustular psoriasis also responds differently to treatment and have a distinct genetic characteristic (32). Figure 2.3 shows an example of pustular pustulosis.

A

 B

Figure 2. 3. Pustular psoriasis

Note:

A. Plantar pustulosis. Adapted from https://dermnetnz.org/

B. Palmar pustulosis. Adapted from https://dermnetnz.org/

2.1.3.5. Nail psoriasis

Nail psoriasis is common and occurs in 50-56% of psoriasis cases (33). In rare cases, nail psoriasis can also occur independently of the cutaneous disease. In psoriatic nail disease four main nail signs may be seen: nail pitting (small indentations in the nail plate) onycholysis (lifting of the nail plate from the nail bed), oil drops (light brown translucent patches under the nail plate) and subungual hyperkeratosis (thickening of the nail plate and bed).

Other clinical signs of psoriatic nail disease include Beau's lines and onychorrhexis which manifest as transverse ridges and longitudinal ridges with splitting, respectively (34). A significant correlation between nail psoriasis and psoriatic arthritis has been established. Griffiths et al (21) argued that nail changes could be predictors of psoriatic arthritis, especially for the associated interphalangeal joint. People with cutaneous manifestation of psoriasis showed a rate of nail involvement of approximately 40%, while the rate of nail psoriasis in those with psoriatic arthritis is up to 80% (34-36). Hence, previous literature suggested that nail psoriasis could be a predictor of arthritis and may present a few years before joint symptoms (14, 37). Figure 2.4 presents photographs of nail psoriasis.

A

B

C

D

Figure 2. 4. Nail psoriasis

Note:

A. Nail pitting. Reproduced with permission from https://www.psoriasiscouncil.org/.

B. Nail pitting. Reproduced with permission from miss Michelle Nyasha.

C. Onycholysis with oil drop sign. Reproduced with permission from https://www.psoriasiscouncil.org/.

D. Subungual hyperkeratosis. Reproduced with permission from https://www.psoriasiscouncil.org/.

2.1.4. Differential diagnoses of psoriasis

The diagnosis of psoriasis relies on the identification of clinical features, which are incorporated into clinical diagnostic criteria (137). However, its variable clinical presentation and resemblance to other skin conditions such as eczema, tinea corporis and pityriasis rosea make it difficult to recognise (8), especially in those populations where access to specialist dermatology care is restricted which may result in missed or delayed diagnosis.

Atopic dermatitis is a common chronic, inflammatory, and pruritic skin condition. Which often starts early, in infancy. However, it also affects older children and adults. Atopic dermatitis cause itchy skin lesions and it may be distinguishable from psoriasis due to lack of sharp margination of the erythematous skin lesions (i.e., lack of well-demarcated lesion of chronic plaque psoriasis). Atopic dermatitis may mimic flexural psoriasis, as scales in flexural psoriasis might not be seen because of the occlusion and friction effect. On the other hand, seborrhoeic dermatitis may mimic facial or scalp psoriasis, with the presence of greasy, yellowish scales which is more diffuse and less well-defined than in psoriasis. Seborrhoeic dermatitis may co-exist with psoriasis (so-called 'sebo-psoriasis'). Figure 2.5 and 2.6 show features of atopic dermatitis and seborrhoeic dermatitis respectively. Tinea corporis (figure 2.7) is another skin condition that could mimic psoriasis. It may initially present as a single round erythematous patch with a raised rim. Gradually, tinea corporis lesion spreads out from the centre hence forming a ring-shape with central clearance/ hypopigmentation with a peripheral scaly edge. With time, multiple lesions may coalesce to form a polycyclic pattern. The distribution of tinea corporis lesions is typically asymmetrical.

Pityriasis rosea (figure 2.8) which starts as an abrupt, papulosquamous eruption can also mimic psoriasis. It is a self-limiting disease that may last for 6-8 weeks. This may help to distinguish psoriasis from pityriasis rosea as psoriasis is chronic skin disorder that last for many years. See figure 2.7.

Other differential diagnosis of psoriasis may include lichen planus which may present with mucosal and nail involvement, scarring alopecia and severe itching. Similarly lichen simplex chronicus may present as localised areas of lichenification due to repeated scratching and rubbing of itchy skin lesion. Other less common skin condition that may resemble psoriasis is

cutaneous T-cell lymphoma which presents with itchy, red, scaly patches however, unlike psoriasis, there is colour variation among the patches.

Figure 2. 5 Atopic dermatitis

Note: Reproduced with permission from https://www.atlasdermatologico.com.br/

Figure 2. 6 Seborroiec dermatitis

Note: Reproduced with permission from https://www.atlasdermatologico.com.br/

Figure 2. 7 Tinea corporis

Note: Reproduced with permission from https://www.atlasdermatologico.com.br/

Figure 2. 8 Pityriasis rosea

Note: Reproduced with permission from https://www.atlasdermatologico.com.br/

2.1.5. Pathogenesis

Our understanding of the pathogenesis of psoriasis is evolving. In this context, clinical and basic science observations have explained the pathogenesis of psoriasis as the interplay between genetic, environmental and risk factors. Indeed, since the epidermis is the main physical barrier of the human body against the external environmental insults (e.g. trauma, ultraviolet light, exposure to chemicals), epidermal keratinocytes were thought to be the primary culprit through hyperproliferation and abnormal cell differentiation.

A major breakthrough to our understanding happened when ciclosporin, an immunosuppressive agent, induced psoriasis clearance. It was then clear that the immune system is responsible for psoriasis pathogenesis (4).

Trigger factors such as ultraviolet radiation (UVR), chemical irritants, microbial infection, lifestyle habits (e.g. smoking or alcohol consumption) and stress can promote an immune response in genetically susceptible individuals. This immune response includes T-cell

activation by antigen presenting cells (APCs), such as Langerhans cells of the epidermis. APCs also release specific inflammatory cytokines such as interleukin-12 (IL-12) and IL-23, which further promote the differentiation of activated T -cells into T-helper cell (Th) 1 and Th-17 cells (Figure 2.9).

Subsequently, activated T-cells migrate towards the skin and continue to produce cytokines that interact with epidermal and dermal cells and alter keratinocyte proliferation and epidermal thickness (38).

Specifically speaking, the Th-17 cytokine pathway plays a predominance role in the pathogenesis of psoriasis. External triggers activating the release of IL-23 which in turn provokes an inflammatory response leading to the release of cytokines including the IL-23. IL-23 then regulates the differentiation and proliferation of Th-17 cells. The proliferated Th-17 cells then migrate to the epidermal layer of the skin to induce a pro-inflammatory cytokine response through mediators such as IL-17A, IL-17F, IL-22 and the tumour necrosis factor-alpha (TNF-α). This will result in the characteristic pathological abnormalities associated with psoriasis which include epidermal hyperproliferation, inflammatory infiltrate to the dermis/epidermis and increased angiogenesis. Other cell types, including mast cells and neutrophils can also be identified in high numbers in a psoriasis lesion, such cells are further responsible in secreting mediators such as IL-17A that drive the Th-17 pathway.
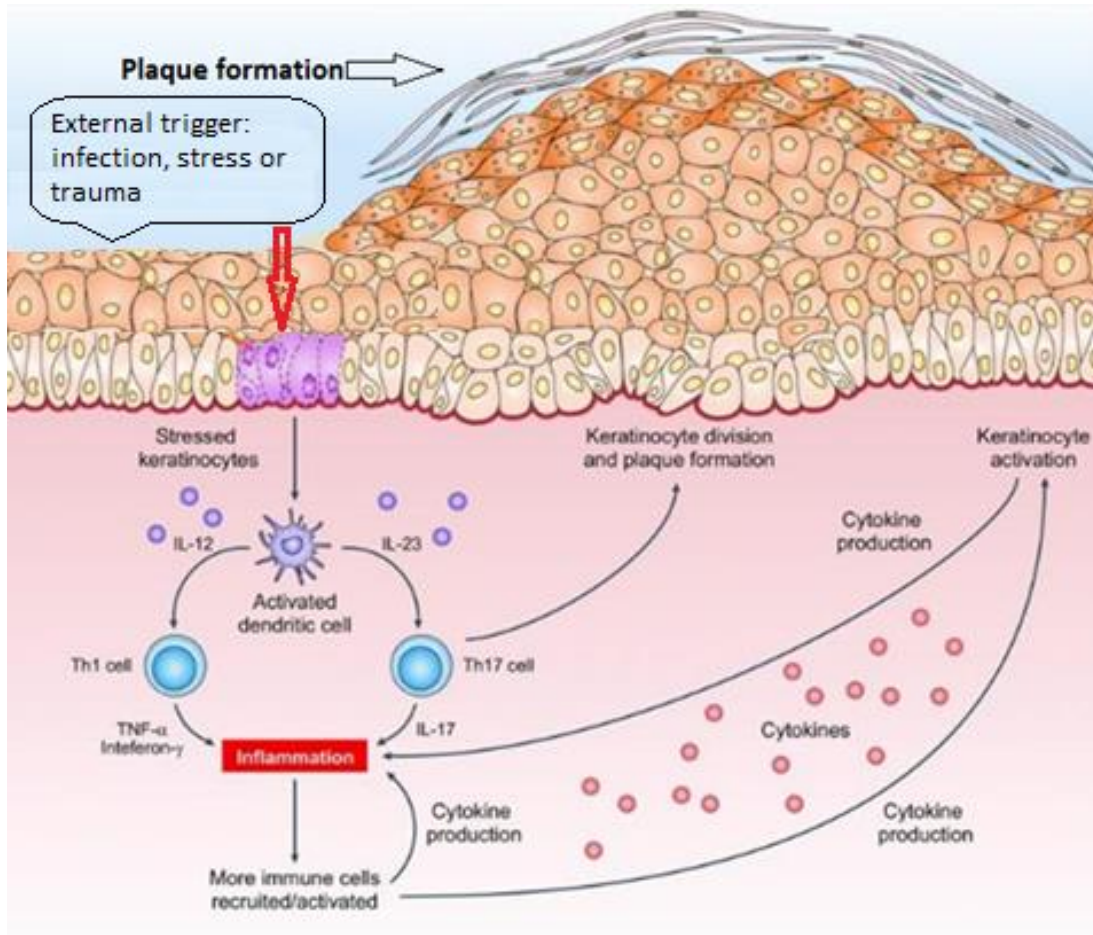
Figure 2. 9. Pathophysiology of psoriasis

Note:

Source: adapted and reproduced from Young et al, 2017 (13)

As illustrated in figure 2.9, the triggered immune response (cycle of inflammation) leads to keratinocytes hyper-production and hence thickening of the epidermis and the appearance of the characteristic psoriasis plaque. Unveiling the role of the immune system and involved cytokines played an important role in the recent advancement in therapeutic goals, specifically with the use of biologic therapies.

2.1.6. Comorbidities

Psoriasis is associated with several comorbidities including diabetes mellitus (DM), hypertension, obesity, dyslipidaemia, cardiovascular diseases (CVD), non-alcoholic fatty liver disease and psoriatic arthritis (39). On occasion, patients with psoriasis may also develop uveitis and inflammatory bowel disease. Studies have shown that mortality rates due to myocardial infarction or stroke in patients with psoriasis (with a history of early or frequent hospitalization) are 2.6 times higher than in the general population. In line with this, few studies have emerged suggesting that individuals with psoriasis have a greater risk to develop CVD compared to the general population (40), raising the question whether psoriasis is an independent risk factor for major cardiovascular events or not.

On this topic, a study conducted by Parisi et al (41) who used clinical data collected from general practices in England between 1994 and 2009, found that, after adjusting for the major risk factors for CVD such as diabetes, hypertension, hyperlipidaemia and smoking status, although people with psoriasis have an increased prevalence of comorbidities associated with CVD, nevertheless, the diseases was not an independent risk factor for major cardiovascular events including myocardial infraction, unstable angina, acute coronary syndrome and stroke. Study authors also reported that co-existence of inflammatory arthritis in people with psoriasis might independently associated with CVD (41). Indeed, future studies with larger sample size and longer follow-up periods are required to confirm these findings.

Other conditions are associated with psoriasis, such as the metabolic syndrome, which encapsulates number of conditions including hypertension, dyslipidaemia, diabetes, and obesity. The presence of metabolic syndrome is associated with higher risk of developing CVD and subsequently an elevated mortality risk compared to the general population (42). Given

this, the association between psoriasis and metabolic syndrome has received significant attention. Indeed, a 2013 systematic review and meta-analysis identified 12 studies with 41,853 psoriasis patients from more than 1.4 million total participants investigating the risk of metabolic syndrome in psoriasis (42). Results of this meta-analysis suggested higher prevalence of metabolic syndrome among patients with psoriasis compared to the general population and a direct relationship between psoriasis severity and the prevalence of metabolic syndrome (42).

Some studies have reported a strong link between psoriasis and inflammatory bowel disease (IBD). IBD represent a group of conditions characterised by chronic inflammation which result in damage to the gastrointestinal tract. IBD most common forms include Crohn's disease and ulcerative colitis (43). The association between psoriasis and IBD has been explained by the overlapping genetic and immune-pathogenic aspects (44). Genome wide association studies (GWAS) have identified 7 loci that confer risk for both IBD and psoriasis (44). Additionally, Th-17, IL-23 and IL-17 that are key mediators of the pathogenic process in psoriasis, are similarly implicated in the pathogenesis of IBD (45).

On the other hand, psoriatic arthritis (PsA), which is an inflammatory disease primarily affecting the joints is closely linked to psoriasis (46). There are various manifestations of psoriatic arthritis including enthesitis, spondylitis, dactylitis and peripheral arthritis, often resulting in considerable impact on physical functioning as well as social and work life (47). PsA affects almost 30% of people with psoriasis with a minimum of 20% of those who are affected have sever manifestation of PsA (46). Both psoriasis and PsA are autoimmune and inflammatory diseases, where both innate and adaptive immunity appears to be dysregulated. However, whilst psoriasis is a disease with mainly cutaneous manifestation, the

epidermis is the primary site of inflammation where as in PsA, the synovial tissue appears to be the targeted site for inflammation (46).

Due to its significant impact on QoL, psoriasis is also associated with psychological impairment. Patients with psoriasis often experience embarrassment, low self-esteem, anxiety and increased prevalence of depression; episodes of anger or hopelessness are reported by patients with psoriasis (48). It is therefore essential to assess for depression when evaluating disease severity and when escalating treatment. Psoriasis is also associated with various other comorbidities including nephritic disease (49) and malignancies (50). It is clear that patients may experience health-related issues beyond psoriasis and therefore a holistic and complete approach to healthcare is vital.

2.1.7. Impact on quality of life

As discussed earlier, psoriasis is a chronic, debilitating disease that has a substantial impact on the quality of life (QoL) of patients and their family members (3). Even if a relatively limited body BSA is affected, a high psychosocial impact on patient QoL can be observed. Furthermore, psoriasis at some body sites can have a greater QoL impact than others. Patients suffering from nail psoriasis report poorer QoL, are more likely to be admitted to hospital and have a higher risk of developing arthritis (20).

In 2016, the world health organisation (WHO) stated that chronic skin diseases with high stigmatisation are perceived significantly more negatively by the patients themselves than their peers (51).

Patients with psoriasis have fewer employment opportunities and lower incomes than their healthy peers (24). Furthermore, psoriasis has a significant impact on the healthcare system

because of the social impact and long-term treatment requirements. In the UK, it is estimated that psoriasis cost the health care system £1.4 billion per annum.

Finlay et al (52) found that patients with psoriasis had comparable disability to those with hypertension and diabetes. Similarly, many other studies showed that the effect of psoriasis on health-related quality of life corresponds to that observed in other medical and psychiatric conditions, such as cancer, arthritis, hypertension, heart disease, diabetes, and depression (53-56). In recent years, mental wellbeing of people with psoriasis received a particular attention. In this context, multiple studies discussed the association between psoriasis and psychological comorbidities. Recently, the IPC held a roundtable event to discuss the latest evidence regarding the role of neuroinflammation in psoriasis pathology and the impact of psoriasis on psychological wellbeing. The outcome of this discussion came to support the relationship between psoriasis and higher risk of having depression. However, no association was suggested between psoriasis and suicidal attempts. (55)

These studies were critical evidence to change society's perceptions of psoriasis from a cosmetic disease to one exerting physical and psychological disability (55, 56).

An important concept being applied in psoriasis is the failure to achieve full life potential. Previous studies coined the term "cumulative life course impairment; CLCI". This concept reflects the significant physical, social and psychological burden of psoriasis on a patient's life (57, 58).

This concept aims to capture the impairment psoriasis has over an individual's lifetime, influencing the choices made and outcomes experienced, rather than assessing health related quality of life impairment at single points in time. For example, psoriasis can negatively affect relationships, work attendance and prospects, income and social activity (59). CLCI supports the rationale to identify opportunities for early diagnosis and intervention for the prevention

of long-term harm in patients with psoriasis. Opportunities may exist to reduce the burden of psoriasis earlier, enabling people to make positive decisions and fulfil their potential.

2.1.8. Measuring psoriasis severity and impact on quality of life

Assessing disease severity and impact on quality of life are major elements for both new and follow-up psoriasis patients' consultations. Most importantly, documenting the outcome of this assessment is an essential measure to inform treatment decisions, and evaluate response to treatment.

Psoriasis severity is based on the percentage of body surface area involved but also includes other activity parameters (e.g. redness and plaque thickness), the site involved (high impact or difficult to treat sites such as nails, face, scalp, palms and soles), the impact on patient quality of life and systemic symptoms such as malaise and fever, which are common in erythrodermic and generalised pustular psoriasis.

Two of the most traditional tools to assess the clinical severity of psoriasis and response to treatment is the BSA and Psoriasis Area and Severity Index (PASI) (60). BSA measures the proportion of the body surface area affected by psoriasis. BSA roughly consider the size of the palm "handprint" as an estimate of 1% coverage (61). In contrast, the PASI, uses an arithmetic formula which is calculated by grading three components of a psoriasis lesion (redness, thickness and desquamation) on a 0-4 scale, weighted by the percentage of affected body surface area. Here the affected body area being divided into four parts: head and neck, trunk, upper limbs, and lower limbs (61).

Although both tools have been widely used before, their validity have been questioned (62). BSA and PASI are objective measures that may underestimate disease severity if lower

degrees of skin involvement (e.g. BSA <10%) are recorded while ignoring disease involvement of "special areas" (e.g. face, palms, soles, genitalia, scalp), prior treatment history, the impact of psoriasis on quality of life, or a combination of these (63). Additionally, both BSA and PASI are notoriously prone to intra and inter-observer variability (62). More importantly, PASI has never been validate for use in children, and BSA may not reflect accurate disease severity when used in children because of different consideration to the affected body parts (i.e. head in young children makes up more than 10% BSA).

Other limitations that hinder PASI widespread adoption is that its components have never been clearly defined, to simplify this, desquamation applies to scale shedding however, the term has been interpreted as a measure for plaque thickness (62). More importantly, it has been reported that the outcome of assessing the impact of disease burden of psoriasis using the PASI does not match with the actual impact on quality of life as reported by patients (62).

To assess the impact of psoriasis on patient QoL, clinicians use the Dermatology Quality of Life Index (DQLI) questionnaire (64). Although the DLQI is not specifically designed to assess the impact of the disease on the quality of life of patients with psoriasis only, it has been widely used for this purpose (62). The DLQI questionnaire consists of 10 questions covering different aspects of life (symptoms, self-esteem, social activities, personal relationships, daily activities, work, study and treatment compliance) (65). A score of 0-30 is calculated based on the results, with a lower score indicating a lower effect on QoL.

More recently, a more holistic measure to assess psoriasis severity and its impact on well-being has been developed and tested for validity and reliability, this is the Simplified Psoriasis Index (SPI) (62). The SPI is a summary measure of psoriasis with separate components for current severity (SPI-s), psychosocial impact (SPI-p), and past history and interventions (SPI-

i). It derives from the Salford Psoriasis Index (66) and replaces PASI and BSA by giving more attention to those parts of the body where psoriasis is more likely to affect the psychological and physiological wellbeing of the affected individual (62). To assess severity of psoriasis using the SPI, body surface area is divided into 10 unequal body areas, users of the tool are asked to evaluate the extent of psoriasis in each of these parts separately. This was specifically intended to reflect the impact of psoriasis affecting functionally or psychosocially important body sites. Hence, psoriasis affecting functionally and psychologically important body sites including scalp, face, hands, feet, nails and anogenital area are allotted 50% of the total possible extent score. See figure 2.10 below which illustrates the 10 distinct body areas suggested by the SPI.
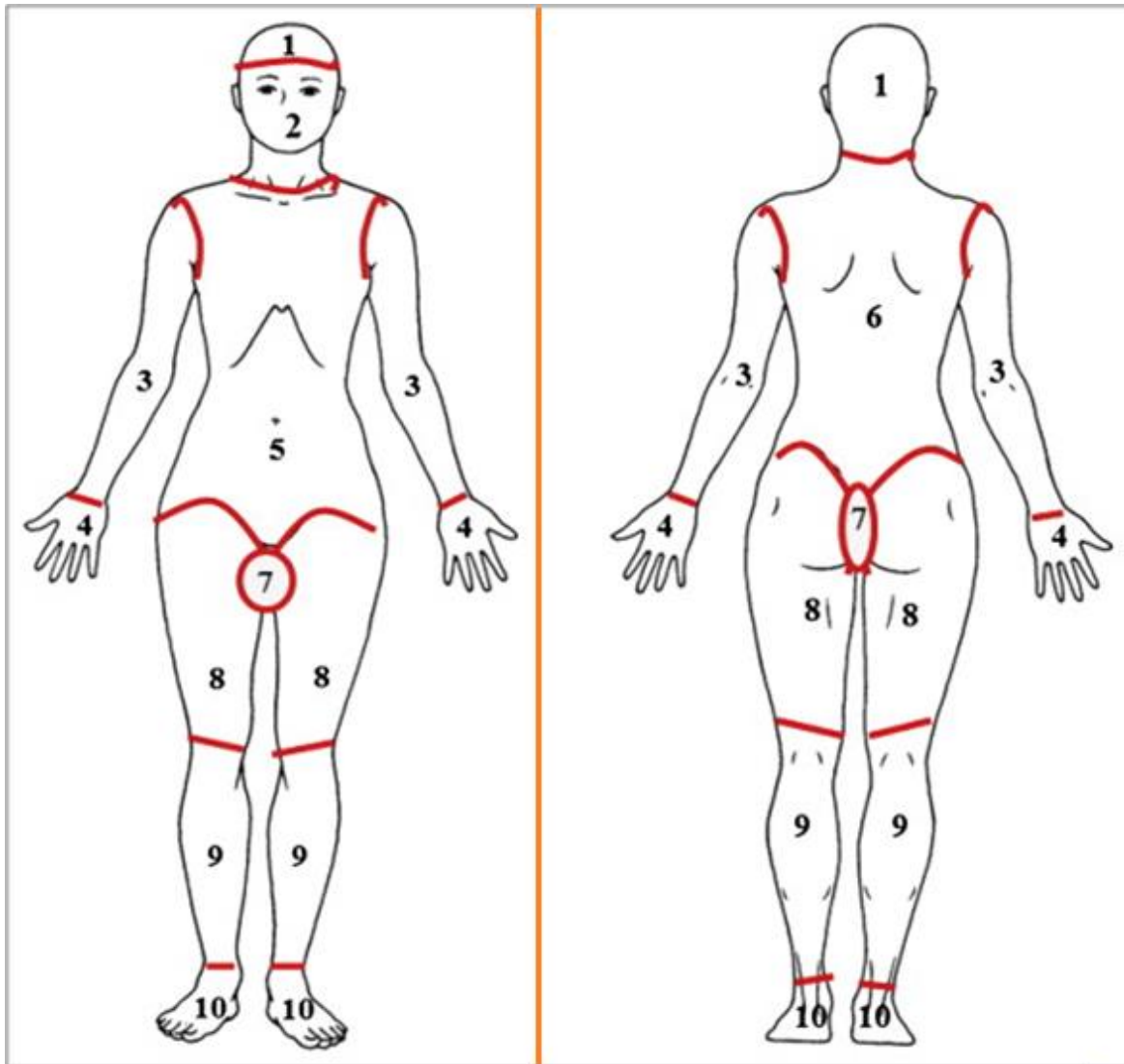
Figure 2. 10. Simplified psoriasis index body sites.

Note: Adapted and reproduced from Chularojanamontri et al (62).

A cohort study of 100 patients with psoriasis found that the severity component of SPI is strongly corelated to PASI and able to capture the change on minimal clinical thresholds. The construct validity of the SPI was demonstrated with close relationship to the DLQI (67). SPI tool was developed in two versions: The first one is intended for use by health professionals (proSPI) and the other version is intended for self-assessment by patients (saSPI).

2.1.9. Management

Although no definitive cure for psoriasis is currently available, there are several treatment options which aims to achieve better disease control and improve patients' QoL. In the early days of Hippocrates, tar and topical arsenic were the treatments of choice for psoriasis. However, with the advancements in clinical and basic science research, more treatments options have been developed.

Several guidelines have been published on the treatment of psoriasis such as the National Institute for Health and Care Excellence (NICE) psoriasis guidelines; which are followed in England and Wales; the NICE guideline for psoriasis management became available in 2012 and were updated in 2017 (28). Other guidelines include the Scottish Intercollegiate Guidelines Network (SIGN) (68) which provide the management approach of psoriasis and psoriatic arthritis in adults; international guidelines, the European S3-Guideline, for the systemic treatment of psoriasis vulgaris (15). Of note, treatment and management of psoriasis occurs in the knowledge that psoriasis cannot be cured. Psoriasis is a lifelong health condition and over time people can experience flares and remission in their disease. The treatment approach which is adapted from NICE guidelines (28) is summarised below and in Figure 2.11. For many patients this follows a stepwise plan depending on whether the disease is mild, moderate, or severe. The overarching aim for treatment is to improve health outcomes but minimise negative long-term sequelae from both the disease and treatment.
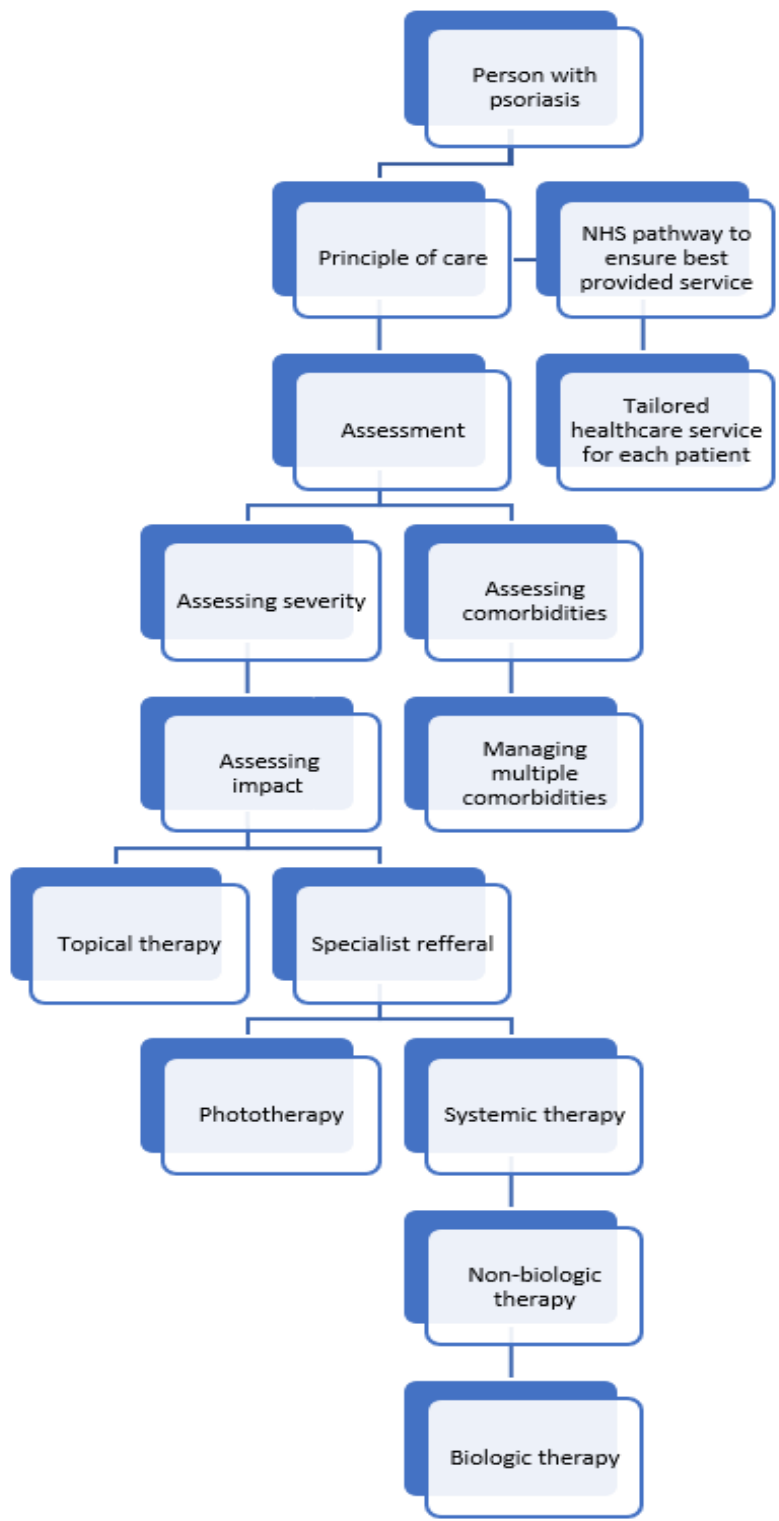
Figure 2. 11. Overview of the psoriasis treatment pathway as suggested by NICE.

Note: Adapted and reproduced from NICE (2012) (28).

2.1.9.1. Mild psoriasis

The first line of treatment involves traditional topical agents including corticosteroids, vitamin D analogues, keratolytics, coal tar, retinoids and dithranol. Topical corticosteroids (ranging from mild such as 1% hydrocortisone) to very potent strengths (e.g. clobetasol propionate) are the most commonly used topical medications as they are usually effective for mild or localised disease and generally well tolerated (69). Topical corticosteroids work by reducing inflammation, decreasing cell proliferation and inhibiting immune cell function (70). In a systematic review by Mason et al (71), the most potent forms of corticosteroids were found to be more efficacious than other forms of topical therapy including vitamin D analogues and coal tar. However, potent topical steroids should not be used long-term due to the risks of numerous side-effects such as epidermal thinning, bruising, ulceration and striae (72).

Today, combinations of steroids and vitamin D analogues are often used (70). However, similarly to topical corticosteroids, long-term use of vitamin D analogues is not recommended due to their potential adverse effects such as skin irritation (69). Other treatment options for patients with localised psoriasis include targeted phototherapy. An example of targeted phototherapy is excimer light therapy, which emits high-intensity UV-B (308 nm). Unlike full body surrounded phototherapy, excimer light therapy has very low carcinogenic potential (69). Salicylic acid is particularly helpful for thick scales and may have a keratolytic effect (73).

2.1.9.2. Moderate-to-severe psoriasis

Systemic treatments (including oral medications, phototherapy and biologics) are the mainstay of treatment for patients with moderate to severe Psoriasis. Often treatment is offered as a stepwise escalation. Drivers for the escalation of treatment may also include psoriasis affecting 'difficult-to-treat sites' such as the face, flexures, genitalia, scalp, palms and soles. Psoriasis affecting these sites has an especially high impact, may result in functional impairment, requires particular care when prescribing topical therapy and can be resistant to treatment.

2.1.9.3. Phototherapy

Phototherapy is a relatively safe and widely used treatment for moderate to severe psoriasis. It works by modulating the immune system by multiple mechanisms, one of which is by altering cytokine profiles and causing apoptosis (74). In general, the main types of phototherapies used to treat psoriasis include narrowband ultraviolet-B (UV-B), broadband UV-B, or psoralen and UV-A (PUVA). The narrowband UV-B is preferred over the broadband UV-B and PUVA because it has a lower risk profile (i.e., less risk of developing melanoma) (69).

2.1.9.4. Systemic therapy

Conventional systemic therapies including methotrexate, ciclosporin, acitretin and phosphodiesterase inhibitors (apremilast) are usually offered for patients with moderate to severe psoriasis (28). These medications could also be offered to treat patients with less severe form of the disease, yet topical therapies and phototherapy are not providing

adequate response. Systemic treatment is guided by patient's needs and requirements. Clinicians managing patients with psoriasis need to consider certain aspects such as patient age, disease severity, impact on QoL, medical history and conception plans when introducing the systemic therapies.

Methotrexate is usually offered as the first choice of oral medications for people with moderate to severe psoriasis. Although methotrexate proved to be an effective treatment option (75), there are certain drawbacks to its use. The adverse drug reaction for methotrexate ranges from nausea, fatigue, and headache to more serious health events including hepatotoxicity, myelosuppression, and pulmonary fibrosis (76).

Ciclosporin is an immunosuppressant agent that is usually prescribed for a short period (average of 12 weeks duration) (77), when rapid treatment response is required (e.g. psoriasis flare). Other specific indications for ciclosporin include palmoplantar psoriasis and when the patient is considering conception (28).

Similar to methotrexate, ciclosporin use comes with a range of potential side effects. These include minor side effects such as headache, increased unwanted hair growth and gingival hyperplasia. More severe side effects include renal impairment and hypertension. Indeed, ciclosporin is an immunosuppressant agent which may lead to an increased risk of infections thereby should be avoided in people with impaired immunity such as people with malignant or premalignant conditions (78).

Acitretin, on the other hand, which is a retinoid (vitamin A derivative) is less frequently prescribed than the previous (methotrexate and ciclosporin). Because acitretin is not an immunosuppressant agent, it might be preferred for those with impaired immunity (such as patients with the human immunodeficiency virus; HIV) and those prone to cancer (78).

However, acitretin is a teratogenic agent that should be avoided by females at childbearing age (78).

Likewise, apremilast is a less likely prescribed systemic therapy for psoriasis. It is usually offered as an alternative option when other systemic medications and phototherapy fail to provide disease control. However, apremilast is usually well tolerated by patients and the most common side effects associated with its use include nausea and vomiting (28). However, a full risk benefit appraisal discussion with the patient should be conducted before prescribing the treatment.

2.1.9.5. Biologics

Biologics used to treat moderate to severe chronic plaque psoriasis represent one of the most significant therapeutic advancements in the field of dermatology. There are four classes of biologics that are currently used for the treatment of psoriasis. These include the TNF inhibitors, IL-12/23 inhibitors, IL-17 inhibitors, and IL-23 inhibitors.

All biologics used to treat psoriasis are administered subcutaneously except infliximab (TNF-a inhibitor) which is given by intravenous infusion. A meta-analysis showed that biologic therapies are significantly more effective than conventional systemics (79). Similarly, some biologic therapies including TNF-α, p40, IL-12/23, and IL-17 are recommended for the treatment of psoriatic arthritis by the Food and Drug Administration (FDA).

Biologic medications work by blocking a specific immune pathway, thus, the main safety concern associated with their use is increased risk of infection and malignancies (80). To address this concern, a large prospective cohort study of 9,038 adults that was conducted using data from the British Association of Dermatologists Biologic Interventions Register

(BADBIR), indicated that biologic therapies have a much better safety profile than non-biologic systemic agents. Nevertheless, common side-effects may include lower respiratory tract, skin, soft tissues, and urinary tract infections. Data analysis of this study showed that the risk of serious infection does not appear to be statistically higher in individuals treated with biologics, compared to those treated with conventional systemic therapies (81).

Various factors may influence the choice of biologic: patient's demographics (age and body mass index), patient preference, comorbidities such as the coexistence of psoriatic arthritis PsA, family planning, cost, and baseline psoriasis severity (82).

2.1.9.6.   Assessing for comorbidities.

As discussed in the previous sections, psoriasis is associated with health-related issues beyond the cutaneous manifestation of the disease and therefore a holistic and complete approach to healthcare is vital.

Within this, particular consideration is given to PsA and cardiovascular disease screening (28). Annual screening for PsA is recommended for people with psoriasis of any severity degree. And assessment for cardiovascular risk is indicated at first presentation with follow-up every five years or less as indicated for people with severe psoriasis (28). A cross-sectional study of 287 people with psoriasis attending primary care suggested that screening for CVD risk factors such as hypertension, hypercholesterolaemia, diabetes and chronic kidney disease helps to identify high number of patients with potentially modifiable and under treated CVD risk factors (83). Other aspects of the holistic approach for psoriasis management include providing advice regarding lifestyle risk factors. Lifestyle changes such as regular physical activity weight loss, reducing alcohol intake and smoking cessation have been suggested as possible favourable psoriasis disease course-modifiers (50, 84, 85).

2.2.   Part 2: Psoriasis diagnosis

This section provides an overview on the clinical diagnosis of psoriasis and previous attempts to develop diagnostic guidelines for psoriasis then summarises the rationale for the work presented in this thesis.

2.2.1. Diagnosis

Psoriasis diagnosis is currently based on clinical history and examination. Pattern recognition of psoriasis lesions is the basis for its clinical diagnosis and involves healthcare professionals looking at the lesion morphology, distribution, and configuration (12). In most cases, dermatologists are able to diagnose psoriasis. However, diagnosing it can sometimes be difficult even for the trained eye. For non-dermatologists, recognising earlier presentations of the disease particularly in childhood can be a challenging task. One of the challenges is due to the lack of standardised diagnostic criteria. In addition, patients sometimes present with an atypical morphology that can be difficult to differentiate from other skin lesions such as eczema, tinea corporis, pityriasis rosea, or even certain malignant skin growths (e.g. cutaneous T cell lymphoma) (86).

Studies have shown that the majority of patients are more likely to seek their initial evaluation and management in a primary care setting (87). Additionally, in many parts of the world such as low- and middle-income countries, access to specialist dermatology care is restricted which further highlights the need for validated diagnostic criteria.

A systemic review of literature was conducted by Burden-Teh et al (12) to identify published literature on valid psoriasis diagnostic criteria in adults and children. The authors reported twenty-three studies that have proposed diagnostic criteria for psoriasis (12). No valid clinical

examination-based diagnostic tools were identified. However, the included studies suggested other diagnostic methods for psoriasis. These diagnostic tools include genetic and molecular tests, histopathology, skin imaging (using dermoscopy or videodermoscopy), computer or questionnaire-based tests and traditional Chinese medicine diagnostic criteria.

The diagnostic accuracy of these criteria varied widely across different categories. High sensitivity and specificity scores were achieved by the questionnaire-based diagnostic criteria, 98% and 95%, respectively. However, this score mostly relied on one specific statement 'I have been diagnosed with psoriasis by a dermatologist'. Exclusion of this statement reduced the sensitivity and specificity to 35% and 50%, respectively. Thus, self–report diagnostic tools are not accurate when used in areas with limited access to specialist dermatologists.

The risk of bias also varied across different studies but was mostly related to scarce details about study populations. Most of the diagnostic criteria have limited applicability in clinical and research settings because of the cost and skills required to adopt them. For example, genetic and molecular diagnostic criteria require specific lab work to identify genetic and biological markers that best predict psoriasis. In addition, histopathological diagnostic criteria involve invasive procedures (skin biopsy) that can only be performed in specialist settings. The feasibility of skin imaging diagnostic criteria is also limited by the availability of equipment and trained personnel.

The systematic review did not include information from a report by Kruger and Duvic (88) which suggested six criteria combining the clinical features of different psoriasis phenotypes in an attempt to standardise the diagnosis. Kruger and Duvic diagnostic criteria are listed in table 2.1.

Table 2. 1. Diagnostic criteria for psoriasis developed by Kruger and Duvic (88).

Diagnostic criteria
1. Similar response obtained from certain medications, becoming worse with lithium or withdrawal of systematic corticosteroids; however, improves with ultraviolet light and Methotrexate (MTX).
2. Similar elements in the natural history such as the Koebner phenomenon where a psoriatic lesion develops at the site of skin trauma.
3. Genetic linkage to components of the major histocompatibility antigens, mainly HLA-Cw6 and HLA-DR7, which are similar for these different phenotypes.
4. Similar profile of associated clinical features, such as nail changes and arthritis.
5. Uniform histological features.
6. Regardless of which psoriasis phenotype the patient has, chronic plaque psoriasis can develop at any time.

Even though Kruger and Duvic's (88) diagnostic criteria could be a comprehensive diagnostic tool in clinical settings, they would not be a useful tool for epidemiological studies due to the associated costs and time required (88). More importantly, the sensitivity and specificity for the diagnostic criteria developed by Krueger and Duvic were not defined (89).

The Krueger and Duvic's (88) criteria were not tested against physician's diagnosis which represents the current gold standard approach for psoriasis diagnosis. These criteria also seem unpractical in terms of diagnosing new psoriasis case, for example, related to MTX, steroid and lithium exposure.

Similarly, Johnson and Armstrong (2013) suggested diagnostic guidelines to help non-dermatologists diagnose psoriasis (20). Their approach includes clinical examination and

history components. In the clinical examination, physicians should look at the characteristic morphology of erythema, scaling, and induration, and specific body site involvement such as nails, scalp and skin folds. The history should include information regarding family history of psoriasis; the first time a lesion was noticed, associated symptoms (such as itching, discomfort, soreness, or irritation), possible trigger factors and lifestyle questions about smoking and alcohol.

Table 2.2 illustrates psoriasis diagnostic guidelines developed by Johnson and Armstrong (20). Even though these diagnostic guidelines are a broad attempt to standardise the approach to the clinical diagnosis of psoriasis, their development did not follow a rigorously conducted study for this purpose such as the formal consensus methods (e.g. Delphi method and RAND/UCLA appropriateness method). Formal consensus methods have been developed to organise subjective judgments of group of experts and to synthesise these judgements with the available evidence (90). Indeed, the diagnostic accuracy of these criteria has not been tested, making their validity questionable.

Table 2. 2. Diagnostic guidelines for psoriasis by Johnson and Armstrong (20).

Aspect	Suggested diagnostic criteria
Lesion Morphology	• Characteristic morphology of erythema, scaling and induration. • Presence of Koebner phenomenon. • Presence of Auspitz phenomenon.
Scalp Involvement	• Scale usually thick and silvery. • Scale should not be yellow and greasy.
Nail Involvement	• Pitting. • Onycholysis. • Hyperkeratosis. • Oil spots (yellowish-brown discoloration).
Intertriginous Involvement	Involvement of the body folds including: • Groin. • Axilla. • Intergluteal fold. • Umbilicus. • Intramammary folds. • Genitalia.
Clinical history	• Gradual onset of skin lesions over the course of weeks to months • Age of onset between 20-30 years or 50-60 years • Presence of psoriasis in first-degree relatives • Improvement with UV exposure or exacerbation with lack of UV exposure

Note: Adapted and reproduced from Johnson and Armstrong (20).

More recently, the Nottingham dermatology research team developed clinical examination-based diagnostic criteria for chronic plaque psoriasis in children. The diagnostic criteria were developed through an international consensus study with the help of a panel of 41 expert dermatologists. The study yielded 16 potential diagnostic criteria (3 major and 13 minor) (91). Table 2.3 summarise the diagnostic criteria of Burden-Teh et al (91).

Table 2. 3. Clinical diagnostic criteria for chronic plaque psoriasis in children by Burden-Teh et al (91).

Major criteria
Scaly erythematous plaques on the extensor surfaces of the elbows and knees.
Scaly erythematous plaques on the trunk triggered by a sore throat or other infection.
Raindrop plaques typical of guttate disease on the trunk or limbs.
Minor criteria
Scale and erythema in the scalp involving the hairline.
Retro-auricular erythema (including behind the earlobes).
Scaly erythema inside the external auditory meatus.
Persistent well-demarcated erythematous scaly rash anywhere on the body.
Fine scaly patches involving the upper thighs and buttocks.
Well-demarcated erythematous rash in the napkin area involving the crural folds.
Persistent erythema in the umbilicus.
Nail pitting.
Onycholysis of the nail(s).
Subungual hyperkeratosis of the nail(s).
Positive family history of psoriasis.
Koebner phenomenon.
Fusiform swelling of a toe or a finger suggestive of dactylitis.

Note: Adapted and reproduced from Burden-Teh et al (91).

The diagnostic criteria developed by Burden-Teh et al (91) focus on the clinical diagnosis of chronic plaque psoriasis in children. Furthermore, the diagnostic criteria did not involve specific recommendations for the diagnosis of chronic plaque psoriasis on skin of colour. Hence, it was appropriate to revisit this question to propose a set of diagnostic criteria for psoriasis in adults that could be applied on patients from varying ethnic backgrounds. Additionally, the suggested diagnostic criteria need to be tested for repeatability in different settings (i.e., primary care setting and/or epidemiological field research setting). Standardised diagnostic criteria for psoriasis would be a helpful tool in comparing data from different centres and countries to further support future research into the epidemiology of psoriasis.

A uniform approach for the diagnosis of psoriasis can also help to choose the best therapeutic option available. After suggesting a valid clinical examination based diagnostic criteria for chronic plaque psoriasis in adults, the research into the epidemiology of psoriasis could involve an international collaborative approach and thus more data about the disease determinants, classification, treatment and prognosis can be gathered.

Chapter 3 - Aims and Objectives

This chapter provides an outline of the research questions, aims and objectives for the work included in this thesis.

This thesis had a number of hypotheses related to the early and accurate diagnosis of psoriasis:

1.   Opportunities for earlier diagnosis of psoriasis can be identified from primary care records of people with psoriasis in the UK.

2.   Consensus can be reached on discriminatory diagnostic features important for the diagnosis of chronic plaque psoriasis by expert dermatologists.

3.   An online training course can improve diagnostic skills of non-dermatologists for chronic plaque psoriasis.

3.1. Aims and objectives

In this thesis, I conducted three separate studies with different methodologies. The aims and objectives for each one of the three research studies are outlined below:

Chapter 4

Aim:

- To understand the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK.

Objectives:

- To track trends of healthcare events prior to psoriasis diagnosis (index date).
- To compare healthcare activities between cases (psoriasis patients) and their matched controls (non-psoriasis patients) retrospectively for ten years before index date (i.e. date of psoriasis diagnosis).

Chapter 5

Aim:

- To agree a list of discriminatory diagnostic features important for the diagnosis of psoriasis.

Objectives:

- To agree a list of discriminatory diagnostic features important for the diagnosis of psoriasis.

Chapter 6

Aim:

- To develop an online training tool to improve psoriasis diagnosis by non-dermatologists.

- To evaluate the impact of training on the diagnostic abilities of non-dermatologists (e.g. primary care- professionals) for psoriasis.

Objective:

- To pilot the newly developed training tool using primary care professionals that can test the effectiveness of the teaching material and provide feedback.

Chapter 4 - Mapping opportunities for the earlier diagnosis of psoriasis in primary care settings in the UK: A population-based case-control study

This chapter covers the approach and outcome of a matched case-control study to identify potential opportunities for accurate and timely diagnosis of psoriasis using primary care electronic health records; delineated from the Clinical Practice Research Datalink (CPRD).

4.1. Introduction

 In chapter 2 of this thesis, evidence suggesting that psoriasis commonly affects people early in their adulthood have been presented (2). This means for a fairly long period of their life, many people with psoriasis live with a chronic, disabling and potentially stigmatising condition (92). Furthermore, studies presented in chapter 2 provided information on how increasing efforts are being made to trial the impact of early intervention for psoriasis which may improve control of cutaneous symptoms and may also modify disease course and burden (93).

The majority of patients with psoriasis seek medical advice first from their general practitioners. The diagnosis of psoriasis in primary care setting is usually based on the clinical appearance of the skin lesions plus medical history information such as family history of psoriasis.

Once the severity and impact of psoriasis has been assessed the physician can formulate a clinical management plan in conjunction with the patient's needs and preferences.

According to NICE Clinical Guideline (28) approximately 90% of people with psoriasis will be managed using topical therapy. Therefore, topical therapy is an appropriate first-line treatment along with practical advice and support in the application and use of the topical treatment. However, topical therapy alone may not provide satisfactory disease control and, a stepwise plan depending on whether the disease is mild, moderate, or severe will be required. The overarching aim for treatment is to improve health outcomes but minimise negative long-term sequelae from both the disease and treatment. Therefore, making an early and accurate diagnosis of psoriasis in primary care (i.e., first point of contact for most patients with psoriasis) is paramount. As discussed in the previous sections of this thesis,

psoriasis may be associated with health-related issues beyond the cutaneous manifestation of the disease and therefore a more holistic approach to healthcare is vital. This holistic management plan can be made by the general practitioner (152).

Within this, consideration is given to PsA and cardiovascular disease screening (28). Annual screening for PsA is recommended for people with psoriasis of any severity degree. Assessment of cardiovascular risk is also indicated at first presentation with follow-up every five years or less as indicated for people with severe psoriasis (28). Other aspects of the holistic approach for psoriasis management that can be advised by the general practitioner include providing advice regarding lifestyle risk factors. Lifestyle changes such as regular physical activity weight loss, reducing alcohol intake and smoking cessation have been suggested as possible favourable psoriasis disease course-modifiers (50, 84, 85).

Thus, psoriasis cases need to be recognised early. To date, very few studies are available on the clinical diagnosis of psoriasis (12) and to the best of our knowledge, no studies on the pre-diagnostic period of psoriasis are present.

Electronic health records (EHRs) offer an opportunity to provide evidence for patient groups and situations where clinical trial data do not exist (94).

Currently, retrospective research in psoriasis is limited by knowledge gaps that exist in commonly used data sources (i.e., clinical trial data), Hence, EHRs may help address this problem.

EHRs represent real-time longitudinal data that are collected as part of patients' routine care and stored in electronic format (95).

The primary purpose of the EHR is to support clinical workflow, nevertheless, researchers have used EHR to conduct epidemiologic and observational research such as incidence and prevalence studies (56, 96), hypothesis generating studies (41, 84), risk factor identification (50, 84) and surveillance reports (97).

Key benefits of using EHR in research include the feasibility of including large number of people and/or events and generalisability of study outcome across wide ethnic backgrounds, age groups, socioeconomic status and geographical distribution. Hence, enhancing the precision of findings and promoting a wide array of novel research studies (95).

Additionally, research using EHRs is cost-effective and require much less time than traditional manual methods of data collection (98).

It is important to highlight that primary care settings in the UK have been largely paperless for more than 20 years, offering a valuable opportunity to interrogate EHR when answering research questions with limited availability of traditional clinical data (99). Additionally, primary care is central to the provision of health care in many developed health systems, including the National Health Service (NHS) and primary care physicians are likely to be the first to recognise or be consulted about psoriasis symptoms (100). The aim of the work presented in this chapter was therefore to understand the pre-diagnostic period and the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK.

4.2. Methods

4.2.1. Data source

4.2.1.1. The Clinical Practice Research Datalink; CPRD

The data for this chapter were obtained from the Clinical Practice Research Datalink (CPRD GOLD and CPRD Aurum, described later). The CPRD is not-for-profit service and is jointly funded by the National Institute for Health Research (NIHR) and the Medicines and Healthcare products Regulatory Agency (MHRA) (101).

The CPRD has been used in over 2,900 scientific publications investigating health care delivery, effectiveness of health policy, drug safety, use of medicines and disease risk factors (101).

Due to its wide geographic coverage (England, Wales, Scotland and Northern Ireland) and ongoing data collection since 1987, CPRD is one of the largest primary care EHR datasets of longitudinal medical records in the world with 13- and 8-years follow-up duration on average for CPRD GOLD and CPRD Aurum respectively (95, 101).

Currently, CPRD consists of two separate datasets namely, CPRD GOLD and CPRD Aurum based on the software used at practice level. CPRD GOLD includes data from practices which use Vision software (95), whereas CPRD Aurum includes data from practices using EMIS-Web electronic patient record software (102).

The CPRD collates anonymised information that include demographic, lifestyle (e.g. smoking status), clinical, referral, immunisation, test results and therapy data. A subset of participating English practices (approximately 75% and 95% of the practices from CPRD GOLD and CPRD Aurum respectively) are eligible to contribute data to the CPRD linkage scheme (95).

Currently available linkages include Hospital Episode Statistics (HES), Office for National Statistics (ONS) and Index of Multiple Deprivation (IMD).

By February 2022, CPRD GOLD provided primary care data from practices across England, Wales, Scotland and Northern Ireland which covers around 20,82 million patients from 984 practices in the UK (95). Whilst CPRD Aurum collected primary care data from general practices in England only which cover 40,9 million patients from 1,489 practices in England. Both GOLD and Aurum are considered to be representative of the UK general population in terms of age, gender and ethnicity (95, 102).

4.2.2. Study design and population

A case-control study design was used to understand the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK. Two independent analyses were conducted using data from CPRD GOLD and CPRD Aurum (i.e., CPRD GOLD as the main database and CPRD Aurum as the replication database).

The validity of electronic health records as a source to conduct epidemiological studies to understand the natural history of psoriasis in primary care setting has been established previously in The Health Improvement Network (THIN). The study by Seminara et. al (151) to investigate the validity of THIN for identifying psoriasis patients suggested that THIN and the General practice research datalink (GPRD; earlier version of CPRD) cover similar populations and have similar methods for capturing electronic medical data. Hence, it is likely that the results of the aforementioned study generalize to the CPRD cohort of the present study (discussed in chapter 4 of this thesis). Reflecting on these findings, the CPRD represent a reliable resource to conduct longitudinal study to understand the natural history of psoriasis in primary care setting in the UK.

Furthermore, I followed the same method (i.e. code list identification process) used to identify psoriasis cases using electronic health records followed by previously conducted cohort studies (78, 28, 50). Search terms for psoriasis were identified by Read codes. A list of Read codes was compiled by searching the description field of the Read code using a list of key words and synonyms and excluding irrelevant codes (103, 104). The code lists were cross-referenced with published code lists available at an online clinical repository (105). The final list of clinical events was reviewed by an expert dermatologist (CEMG) to make sure of its clinical relevance to the aim and objective of the study.

Cases were defined as individuals aged 18 years or above who received an incident (first documented) diagnosis of psoriasis anytime between 1 January 2010 and 29 December 2017. The date was psoriasis diagnosed clinically in primary care was defined as the index date.

Each individual with psoriasis (i.e., case) was matched with six eligible individuals without a prior diagnosis pf psoriasis. The matching criteria were the year of birth, gender and general practice. Controls were identified using incident density sampling allowing for controls to be selected as cases later. The selection of patients with and without psoriasis from the same population at risk and identifying them from the same general practices and during the same time window was implemented to ensure avoiding potential selection bias.

Cases and controls were required to have 'up to standard' records for at least 12 months prior to study entry and were followed retrospectively for ten years before index date. ''Up to standard' is a general data quality measure used by CPRD that is not related to precision of dermatological diagnoses. It is a practice-based quality metric based on the continuity of recording and the number of recorded deaths. It is recommended by the team managing CPRD to use 'up to standard' data as a first step for any CPRD-based studies to ensure selecting research quality patients and periods of quality data recording (95).

The study was approved by the Independent Scientific Advisory Committee (ISAC) for Medicines and Healthcare products Regulatory Agency database research (ISAC approval 18_308R) in the UK.

Throughout this chapter I will refer mainly to data from CPRD GOLD (main cohort) first and then I will review the data from CPRD Aurum (replication cohort).

4.2.3. Code lists

In order to identify possible pre-diagnostic presentation of psoriasis, an extensive literature search was conducted using Web of Science, Medline, EMBASE, EBSCO and using three search strategies:

1.   "pre-diagnostic" OR "prodromal" OR "antecedent" OR "precedent" AND "psoriasis"),

2.   "psoriasis" AND ("diagnosis" OR "detection") AND ("delay" OR "missed" OR "error"),

3.   "predictor" AND "psoriasis".

Articles that described pivotal insights in psoriasis diagnosis and pre-diagnostic presentation were selected. Additional studies were found using bibliography of selected articles. Search restrictions included studies reporting on human only and reported in English language. An a priori list of clinical events that could potentially be related to earlier diagnosis of psoriasis in primary care settings was identified. Clinical events of interest were grouped into three categories: Differential diagnosis for psoriasis, clinical features and prescribed medications. Table 4.1 illustrates clinical events categories and items.

Table 4. 1: Clinical events categories and explanations

Clinical event	Category	Items
Differential Diagnosis	Pityriasis rosea	
	Seborrhoeic dermatitis	
	Eczema.	Contact dermatitis Atopic dermatitis Neurodermatitis Asteotic eczema Discoid eczema Hand eczema
	Tinea corporis	
	Candida skin infections	Candida infections caused by candida species.
Clinical features	Skin rash	Rash, erythema, redness and induration.
	Dry skin	
	Skin texture changes	Desquamation of skin Scaling of skin Skin plaque Skin crust
	Itching	Itching Pruritus Skin irritation
Prescribed medication	Topical corticosteroids	
	Topical antifungal medications.	

Diagnoses and clinical features of interest were identified by Read codes. A list of Read codes for each differential diagnosis or clinical feature was compiled by searching the description field of the Read code using a list of key words and synonyms and excluding irrelevant codes (103, 104). Medications were identified by product codes and were possible, the code lists were cross-referenced with published code lists available at an online clinical repository (105). The final list of clinical events was reviewed by an expert dermatologist (CEMG) to make sure of its clinical relevance to the aim and objective of the study. Figure 4.1 describe the process for code list development.

Review of literature

↓

Define clinical events of interest

↓

Create a list of key words, inclusion and exclusion terms

↓

Search Read code Dictionarries

↓

Assemble two seperate candidate code lists for CPRD GOLD and CPRD Aurum

↓

Compare and match CPRD GOLD and CPRD Aurum code lists

↓

Review by research team members with clinical experience

↓

Compile final code lists
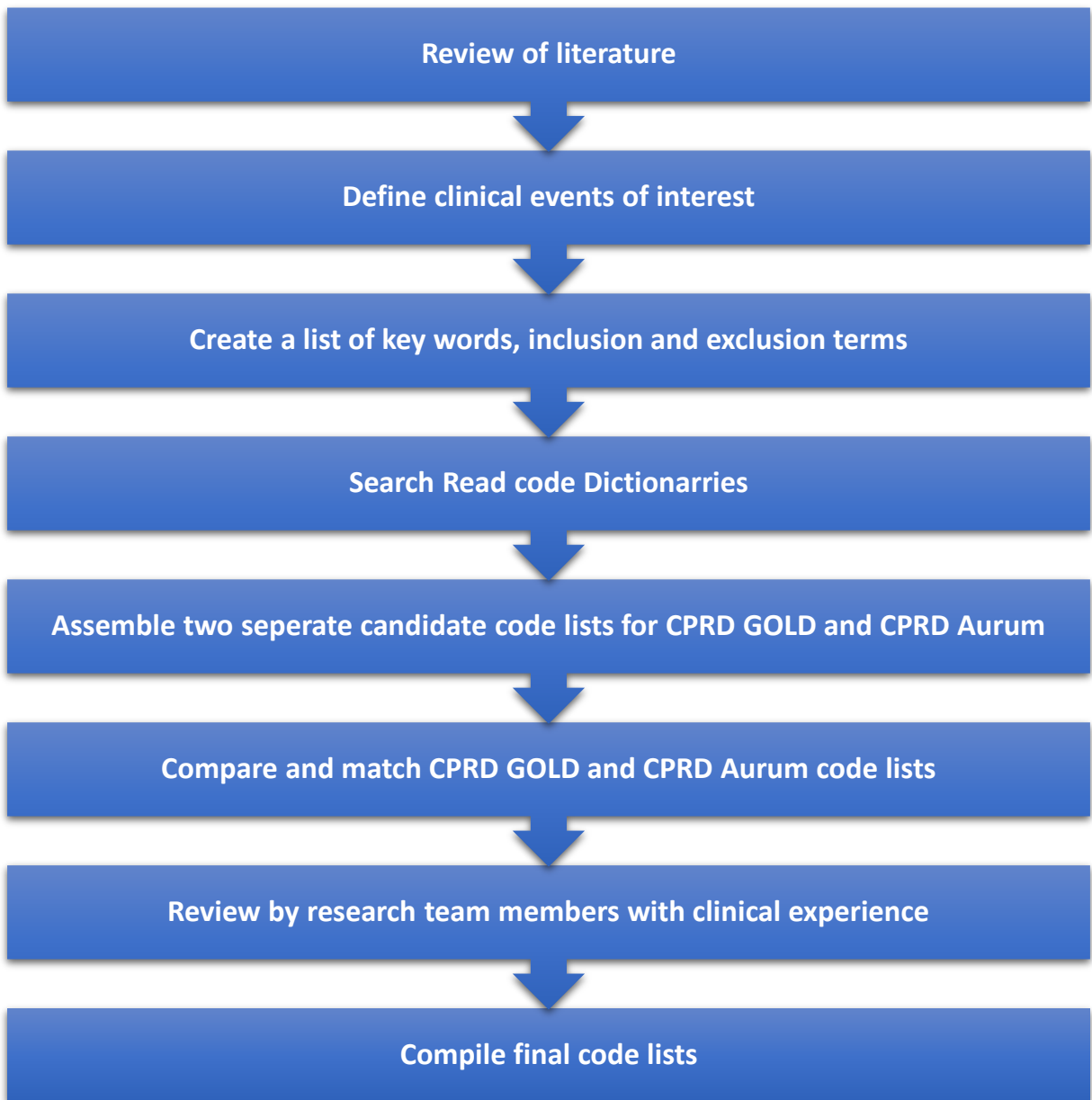
Figure 4. 1. Process for code list development

4.2.4. Clinical events of interest

4.2.4.1.   Differential diagnosis

Differential diagnoses of interest included seborrheic dermatitis, other eczema (including contact dermatitis, atopic dermatitis, neurodermatitis, discoid eczema, asteatotic eczema and hand dermatitis), tinea corporis, candida skin infections, and pityriasis rosea.

4.2.4.2.   Clinical features

the number of times cases and controls consulted their general practitioner (GP) with clinical features that were considered suggestive of psoriasis were counted. The list of clinical features suggestive of psoriasis were identified after an extensive literature search. The list of proposed clinical features was reviewed by experienced dermatologist CEMG to ensure its relevance to the purpose of the present study. Clinical features that may precede a diagnosis of psoriasis included itching, dry skin, rash and skin texture changes (scale, plaque and crust). We only included clinical features with recoded Read codes.

4.2.4.3.   Prescribed medications

Two groups of medications that are often prescribed to people with eczema, tinea corporis, candida dermatosis and pityriasis rosea were identified. These include topical corticosteroids from section 13.4 British National Formulary (BNF) and topical antifungal treatments from section 13.10.2 BNF (105). Data analysis showed that the most commonly prescribed corticosteroid topical preparations according to their potency were hydrocortisone 1% cream (mild corticosteroid) followed by Eumovate cream or ointment (clobetasone butyrate 0.05%), Betnovate RD (betamethasone 0.025%) (moderate corticosteroids), Betnovate 0.1% ointment and scalp application (potent corticosteroid) and Dermovate cream (clobetasol propionate 0.05%) (very potent corticosteroids).

4.2.5. Statistical Analysis

4.2.5.1.   Demographic and socio-demographic characteristics

Demographic characteristics of interest included age at index date, gender, geographical region at the general practice level and socioeconomic status. The socioeconomic status was based on the IMD as a measure of socioeconomic deprivation of residential neighbourhood (106-108) which was linked at general practice level.

At the practice level, the geographical region was recorded by CPRD as 1 of 13 regions in the UK (95, 102). In this study, these regions were further summarised into London, South England (Southwest, South Central, Southeast Coast), Midlands and East England (East Midlands, West Midlands, East of England), North England (Northeast, Northwest, Yorkshire and the Humber). Descriptive statistics were used to calculate the median and interquartile range (IQR) for demographic characteristics.

4.2.5.2.   Frequency of GP consultation

The frequency of GP consultations before the index date was compared between cases and controls. A clinical consultation of the GP was defined as a day on which Read code record was made by the GP. Where there were multiple Read codes recorded on the same day, only one was included in the consultation rate analysis in order to reduce the chance of duplicates. Descriptive statistics (median and (IRQ)) were used to report the annual frequency of GP consultations from five years before index date.

4.2.5.3.   Clinical events of interest

Incidence rates (IR) per 1000 person-years and 95% confidence intervals (95% CIs) for each clinical event (differential diagnosis, clinical features and prescribed medication) were calculated for each year within 10 years before the index date for individuals with and without psoriasis. The incidence rate ratio (IRR) and 95% CIs for each clinical event at 6 months, 1 year, 3 years and 5 years before index date for cases and controls was also calculated.

4.3. Results

4.3.1. Main cohort: CPRD GOLD dataset

4.3.1.1. Demographic characteristics

The study population was extracted from 796 participating GP practices. 17,320 individuals with incident diagnosis of psoriasis were identified from CPRD GOLD and matched to 99,320 individuals without a psoriasis diagnosis. The baseline demographic characteristics are described in Table 4.2. Median (IQR) age at index date was 51 (36-64) and 50 (36-64) for cases and controls, respectively; 52% were female and 48% were male for both groups.

Table 4. 2: Baseline demographic characteristics of the study population (CPRD GOLD)

Total		Psoriasis case (n= 17,320)	Control (n= 99,320)
Sex n (%)	Male	8,282 (47.82)	47,491(47.82)
	Female	9,038 (52.18)	51,829 (52.18)
Age at index Median (IQR)		51 (36-64)	50 (36-64)
Region n (%)	London	2,457 (14.19)	14,023 (14.12)
	South England	7,227 (41.73)	41,626 (41.92)
	Midlands and east England	3,831 (22.12)	21,924 (22.07)
	North England	3,805 (21.97)	21,747 (21.89)
Number of GP consultations before index date Median (IQR)	4–5 years prior to index date	7 (2-13)	5 (2-12)
	3–4 years prior to index date	8 (3-15)	6 (2-12)
	2–3 years prior to index date	8 (3-16)	6 (2-13)
	1–2 years prior to index date	10 (5-18)	8 (4-15)
	0–1 year prior to index date	11 (5-19)	8 (4-15)
Socioeconomic status IMD quintile n (%)	1 (least deprived)	4,020 (23.21)	23,997 (24.16)
	2	3,830 (22.11)	22,405 (22.56)
	3	3,422 (19.76)	19,553 (19.69)
	4	3,343 (19.30)	18,775 (18.90)
	5 (most deprived)	2,695 (15.56)	14,533 (14.63)

4.3.1.2.   Frequency of GP consultations

Overall, individuals with psoriasis were more likely to visit their GP than those without psoriasis. Visits to the GP practices for individuals with psoriasis increased during the 5-year period before the index date by almost 60%, from a median (IQR) of 7 (2-13) per year at five years before index date to 11 (5-19) visits per year at one year before index date. Whereas the frequency of GP consultations for those without psoriasis showed a less noticeable increase from 5 (2-12) to 8 (4-15) over the same 5-year period before index date.

4.3.1.3.   Differential diagnosis

Psoriasis cases were more likely to receive a diagnosis of another skin condition including pityriasis rosea, eczema, seborrhoeic dermatitis, tinea corporis and candida skin infection than those in the comparator group from five years before index date.

The incidence rates of being diagnosed with one of the aforementioned skin conditions were markedly higher for the psoriasis group than those without psoriasis in the final year before index date, as shown in Table 4.3.

Individuals with psoriasis were almost eight times more likely to be diagnosed with pityriasis rosea (Figure 4.2 a) and two times more likely to be diagnosed with eczema (Figure 4.2 d) and seborrhoeic dermatitis (Figure 4.2 b) within the last year before index date than those in the comparator group. In addition, individuals with psoriasis were 2.5 times more likely to be diagnosed with tinea corporis (Figure 4.2 c) and 1.5 times more likely to be diagnosed with candida skin infection (Figure 4.2 e) in the final year before index date than those without psoriasis.

The incidence of recorded pityriasis rosea increased from (IR 11.9 per 1000 person-years, 95% CI 5.7-25.1) at ten years before index date to 99.2 per 1000 person-years (76.7-128.4) at one year before the index date for those with psoriasis compared to a less noticeable increase from 18.8 per 1000 person-years (14.8-24) to 21.4 per 1000 person-years (17.7-26.9) over the same period of time for the matched individuals without psoriasis.

The incidence rate of receiving a diagnosis of eczema (including atopic dermatitis, contact dermatitis, neurodermatitis, asteatotic eczema, discoid eczema and hand eczema) for those who ended up with psoriasis diagnosis increased from 21.3 per 1000 person-years (19.5-23.1) in ten years before index date to 76.8 per 1000 person-years (73.4-80.2) in one year before index date for psoriasis group, compared to a rate of 22.5 per 1000 person-years (21.5-23.6) at ten years before index date to 28.8 per 1000 person-years (27.6-28.9) in one year before index date in comparator group (Figure 4.2).

Similarly, the incidence of recorded seborrhoeic dermatitis diagnosis followed an increasing trend from a rate of 16.6 per 1000 person-years (13.8-19.9) in ten years before index date to 83.7 per 1000 person-years (77.1-90.7) in one year before index date for individuals with psoriasis compared to a less noticeable increase from only 18.9 per 1000 person-years (16.6-21.5) in ten years before index date to 25.4 per 1000 person-years (22.8-28.4) in one year before index date for comparators. These rates reflect double the chances for individuals with psoriasis to receive a diagnosis of seborrhoeic dermatitis than the comparator group in the final year before index date, as shown in Figure 4.2.

Individuals who were eventually diagnosed with psoriasis had a higher incidence rate of diagnosis of tinea corporis from ten years before index date 15.3 per 1000 person-years (13.2-17.6) to 68.6 per 1000 person-years (64.1-73.4) within one year before diagnosis,

whereas those without psoriasis showed a less noticeable increase in diagnosis of tinea corporis from 18.7 per 1000 person-years (21.2-19.9) in ten years before diagnosis to 28.74 per 1000 person-years (27.3-30.2) in one year before diagnosis. The incidence rate of recorded candida skin infections increased markedly from ten years before index date 13.4 per 1000 person-years (11.2-16) towards the final year before index date 65.3 per 1000 person-years (60.2-70.9) in cases compared to a less marked increase from ten years 17.5 per 1000 person-years (16.3-18.9) to 29.8 per 1000 person-years (28-31.6) in one year before index date in controls.

Despite inconsistent trends of the IR for diagnosing pityriasis rosea in people with psoriasis, there was a sharp increase from 12 per 1000 person-years (5.7-25.1) in ten years before index date to 99.2 per 1000 person-years (76.7-128.4) in one year before the index date compared to individuals without psoriasis within the same study period, from 18.8 per 1000 person-years (14.8-24) to 21.4 per 1000 person-years (17.7-26.9).
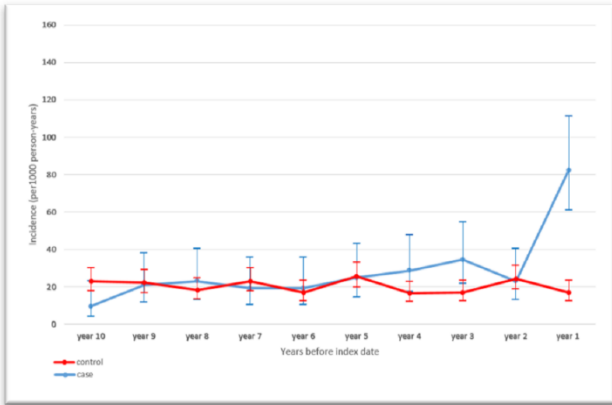
a. Pityriasis rosea.
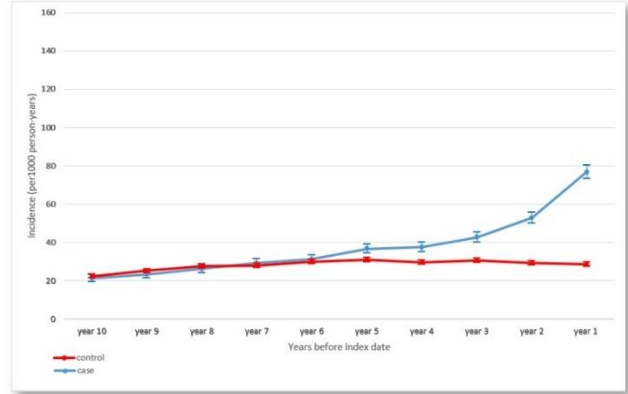
b. Seborrheic dermatitis.

C. Tinea corporis

d. Eczema .
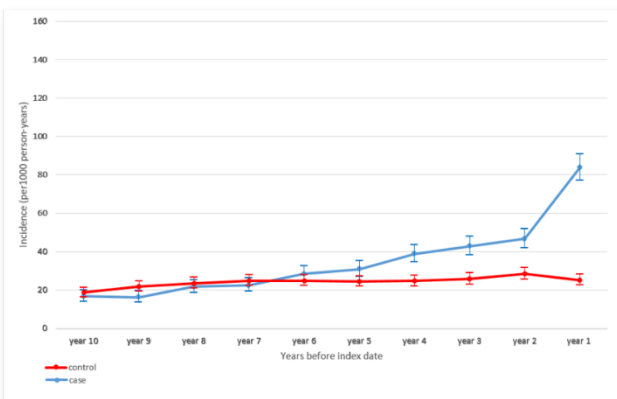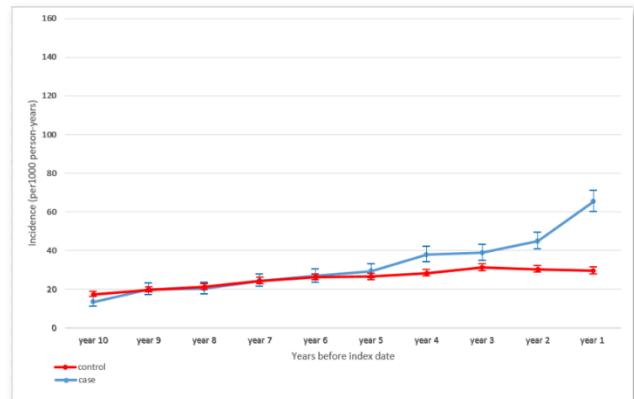
e. Candida skin infection.
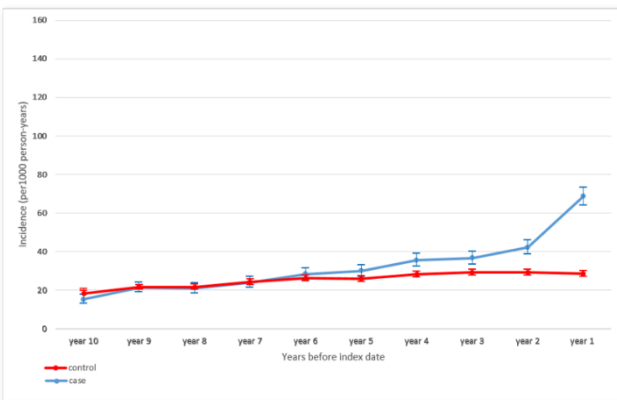
Figure 4. 2. Annual incidence rate per 1000 person-years of other differential diagnoses from 10 years prior to index date. Bars are 95% CIs (CPRD GOLD).

4.3.1.4.   Clinical features

Individuals with psoriasis more frequently reported skin rash, dry skin, skin texture changes (including scales, plaque and crust) than individuals without psoriasis diagnosis before index date.

The most frequently reported clinical feature was skin rash. Those who ended up with a psoriasis diagnosis were four times more likely to report skin rash at the final year before index date than the comparator group (Figure 4.3 a). The incidence rate of recorded skin rash increased from 15.5 per 1000 person-years (14.1-17) to 120.5 per 1000 person-years (116.5-129.7) from ten to one year before index date respectively in those with psoriasis diagnosis compared to a significantly lower incidence rate from 19.4 per 1000 person-years (18.6-20.3) to 31.1per 1000 person-years (30-32.2) from ten to one year before index date in those without psoriasis diagnosis.

Individuals with psoriasis were twice more likely to report dry skin (Figure 4.3 b) and skin texture changes (Figure 4.3 c) at the final year before index date than controls.

the IR of recorded dry skin increased from 13.7 per 1000 person-years (10.9-17.2) in ten years before index date to 77.9 per 1000 person-years (70.9- 85.7) in one year before index date in individuals who eventually developed psoriasis, compared to an IR of 14.9 per 1000 person-years (13.3-16.8) in ten years before index date to 32.6 per 1000 person-years (30.1-35.3) in one year before index date for individuals without psoriasis.

Similarly, the incidence rate of reported skin texture changes increased from 14.8 per 1000 person-years (12.7-17.3) in ten years before diagnosis 74.7 per 1000 person-years (69.7-80) in one year before diagnosis. Whereas IR for the same clinical feature showed a less

significant increase from 15.7 per 1000 person-years (14.7-16.8) in ten years before index date to 40.2 per 1000 person-years (38.5-42) in one year before index date in controls.

The IR for itching in the psoriasis group had less noticeable increase from 17 per 1000 person-years (14-20.9) in ten years before index date to 49.6 per 1000 person-years (44-55.9) in the final year before index date, compared to IR for itching in the non-psoriasis group which only increased from 17.7 per 1000 person-years (16-19.5) in ten years before index date to 32.36 per 1000 person-years (30 -34.4) in the final year before index date (Figure 4.3 d).
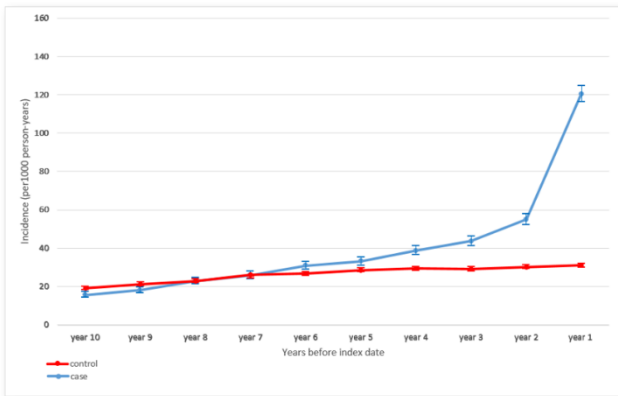
a. Rash
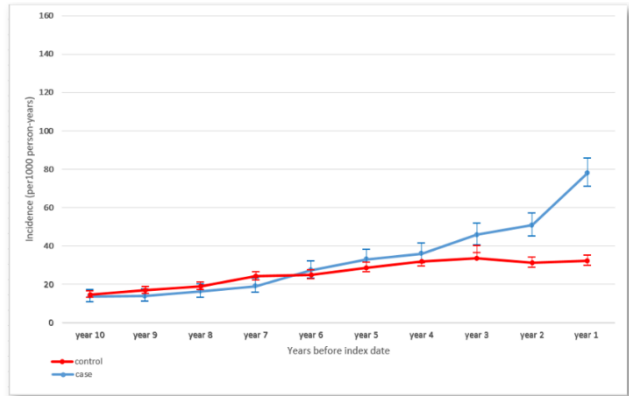
b. Dry skin
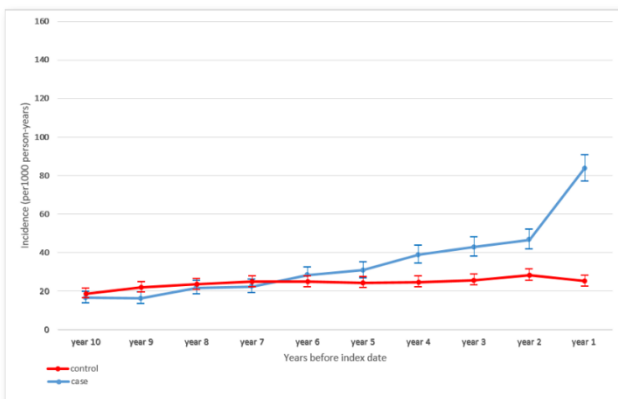
c. Skin texture changes

d. Itching

Figure 4. 3. Annual incidence rate per 1000 person-years of recording clinical features suggestive of psoriasis from 10 years prior to index date. Bars are 95% CIs (CPRD GOLD).

4.3.1.5. Prescribed medications

There was an increasing likelihood of an individual being prescribed topical corticosteroids or topical antifungal medication closer to diagnosis compared to the comparator patients. Individuals in the psoriasis group were twice as likely to be prescribed topical corticosteroids or topical antifungal medication within the final year before the index date than those in the comparator group (Figure 4.4).

The incidence rate for prescribing topical corticosteroids increased from 27.4 (25.9-29) in ten years before index date to 111.9 per 1000 person-years (108.9-115.1) in one year before index date for cases compared to a rate of 26.9 per 1000 person-years (26.1-27.8) in ten years before index date and 44.2 per 1000 person-years (43.1-45.3) in one year before index date for controls.

The incidence rate for prescribing topical antifungal medication increased from 19.9 per 1000 person-years (18.3-21.6) in ten years before index date to 88.8 per 1000 person-years (82.5-89.3) in one year before index date for cases compared to a rate of 23.4 per 1000 person-years (22.5-24.3) in ten years before index date and 38 per 1000 person-years (36.9-39.2) in one year before index date for controls.

The IRRs for all investigated clinical events at 6 months, 1 year, 3 years and 5 years before index date is shown in Table 4.3.
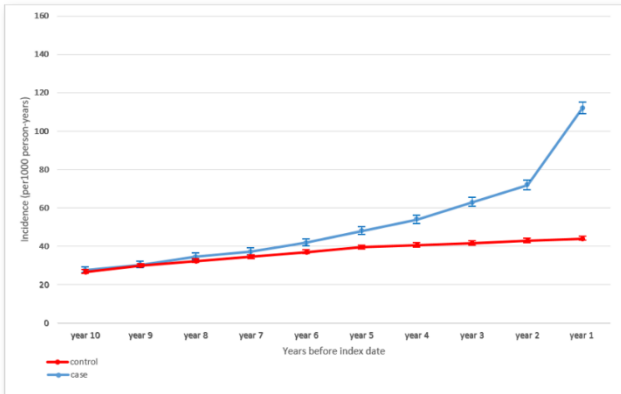
a. Topical corticosteroids
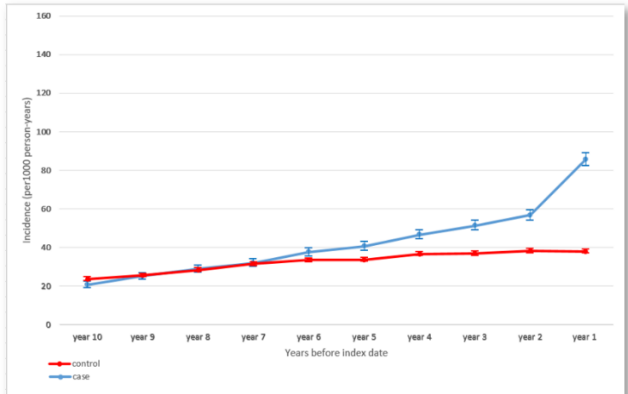
b. Topical antifungals

Figure 4. 4. Annual incidence rate per 1000 person-years of prescribing topical corticosteroids and topical antifungals from 10 years prior to index date. Bars are 95% CIs (CPRD GOLD).

Table 4. 3: Incidence rate ratios of clinical events recorded 6 months, 1, 3 and 5 years before index date (CPRD GOLD).

Clinical events	IRR (95% CIs) 6 months	IRR (95% CIs) 1 Year	IRR (95% CIs) 3 Year	IRR (95% CIs) 5 Year
Seborrhoeic dermatitis	2.34 (1.82-3.00)	1.97(1.65-2.35)	1.49(1.33-1.66)	1.27(1.33-1.38)
Eczema.	2.23 (1.99- 2.50)	1.90(1.76 -2.05)	1.41(1.35-1.48)	1.23(1.18-1.28)
Tinea corporis	2.52(2.09-3.03)	1.99(1.74-2.27)	1.43(1.32-1.56)	1.25(1.17-1.34)
Candida skin infections	1.46 (1.32-1.74)	1.44(1.29 -1.61)	1.28(1.20 -1.37)	1.15(1.08-1.21)
Pityriasis rosea	7.82 (4.09-14.95)	3.24 (2.24-5.27)	1.71(1.28-2.27)	1.38 (1.09 -1.75)
Dry skin	2.05 (1.54 -2.72)	1.52 (1.24-1.86)	1.38 (1.22 -1.57)	1.8 (1.06-1.30)
Rash	4 (3.62 -4.41)	2.71 (2.53-2.92)	1.63 (1.55 -1.71)	1.32 (1.27 -1.38)
Skin texture changes	2.17 (1.69-2.29)	1.55 (1.39 -1.37)	1.23 (1.14-1.31)	1.13 (1.06 -1.20)
Itching	1.39 (1.00 -1.93)	1.54 (1.22 -1.94)	1.26 (1.10-1.45)	1.18 (1.05 -1.32)
Topical corticosteroids	2.58 (2.39-2.79)	1.97 (1.88 -2.07)	1.46 (1.42 -1.50)	1.24 (1.21 -1.27)
Topical antifungal treatment	2.32 (2.08-2.59)	1.92 (1.78 -2.07)	1.43 (1.36-1.49)	1.24(1.20-1.29)

4.3.2. Replication cohort: CPRD Aurum

Data from CPRD Aurum showed similar findings to CPRD GOLD. 11,442 individuals with incident psoriasis diagnosis (cases) and 65,840 without psoriasis (controls) were included in this study.

The baseline demographic characteristics of the study cohort are shown in table 4.4. The median (IQR) was 50 (35-64) years for both cases and controls.

Study population consisted of52% female and 48% male patients. Study population was extracted from 176 GP practices contributing to the CPRD Aurum database.

The frequency of GP consultations increased steadily from 7 visits in five years before index date to 12 visits in the final year before index date, as shown in table 4.4.

Trends for incidence rates for the examined clinical events (differential diagnosis, clinical features and prescribed medication) were all similar to the findings from CPRD GOLD. Annual incidence rate for the investigated clinical events of interest is shown in figures 4.5-4.7. The incidence rate ratios are shown in table 4.5.

Table 4. 4: Baseline demographic characteristics of the study population (CPRD Aurum).

Total		Case (n= 11,442)	Control (n= 65,840)
Sex n (%)	Male	5,516 (48.21)	31,735 (48.20)
	Female	5,925 (51.79)	34,105 (51.80)
Age at index Median (IQR)		50 (35-64)	50 (35-63)
Region n (%)	London	1,520 (13.28)	8,693 (13.20)
	South England	4,721(41.27)	27,267 (41.41)
	Midlands and east England	3,210 (28.06)	18,509 (28.12)
	North England	1,991 (17.4)	11,371 (17.27)
Number of GP consultations in 5 years before index date Median (IQR).	4–5 years prior to index date	7 (3-14)	6 (2-12)
	3–4 years prior to index date	8 (4-16)	6 (2-13)
	2–3 years prior to index date	9 (4-17)	7 (2-14)
	1–2 years prior to index date	10 (5-19)	8 (4-15)
	0–1 year prior to index date	12 (6-20)	8 (4-16)
Socioeconomic status IMD score n (%)	1 (least deprived)	2,726 (23.82)	16,097 (24.45
	2	2,452 (21.43)	14,492 (22.01)
	3	2,269 (19.83)	12,509 (19.00)
	4	2,200 (19.23)	12,523 (19.02)
	5 (most deprived)	1,789 (15.64)	10,202 (15.50)
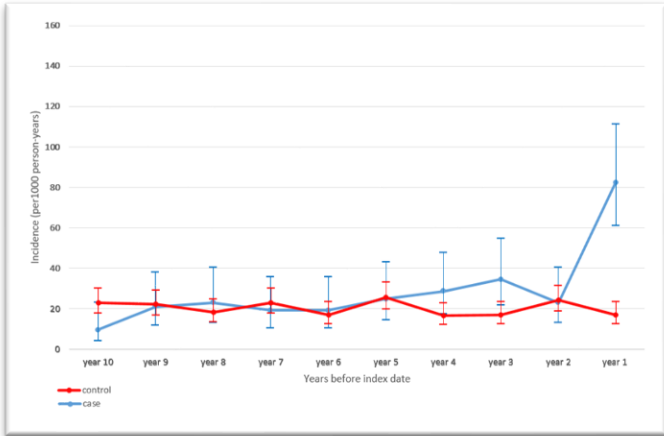
a. Pityriasis rosea.
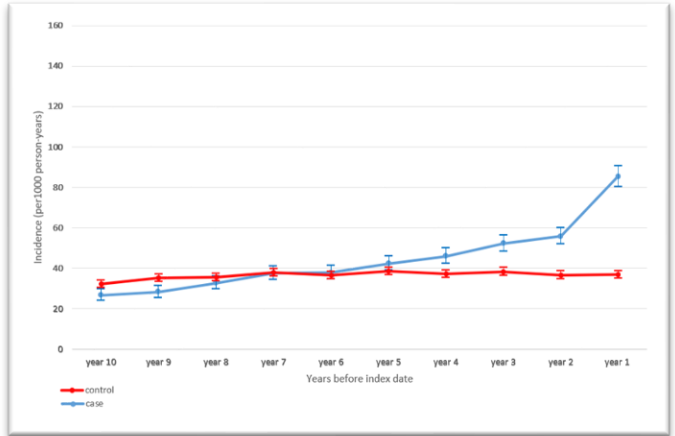
b. Seborrheic dermatitis.

c. Tinea corporis.

d. Eczema.
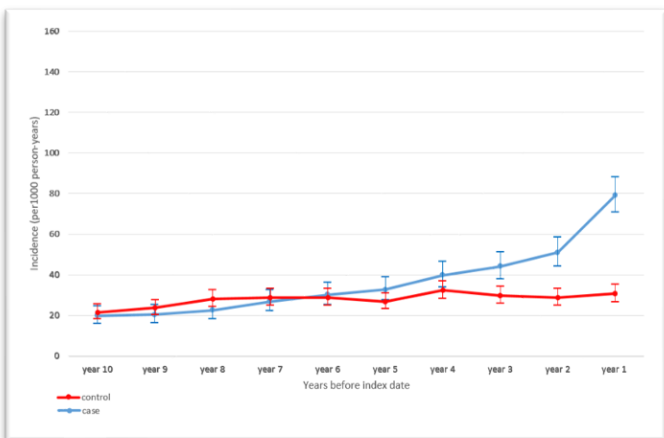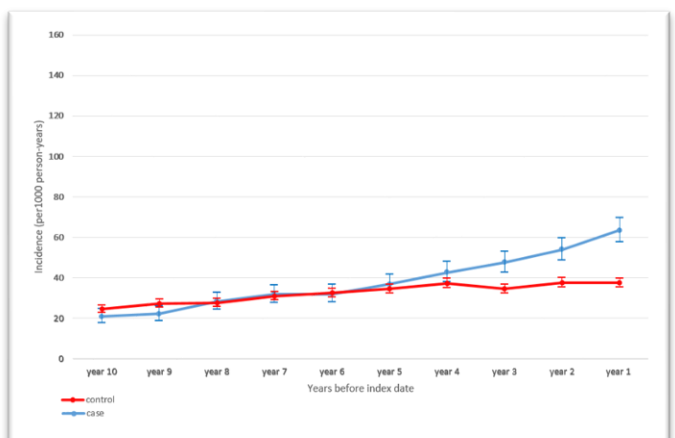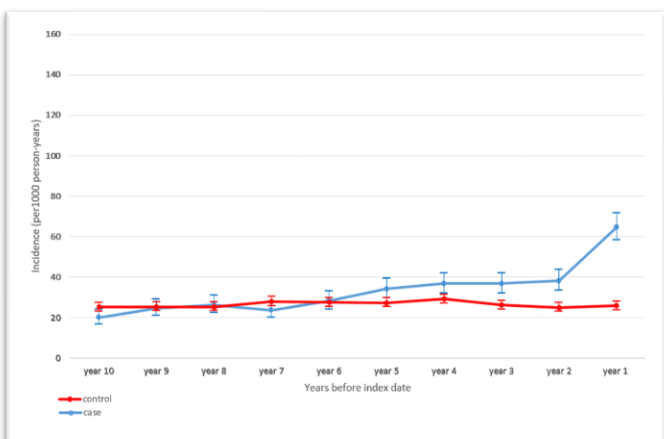
e. Candida skin infections.

Figure 4. 5. Annual incidence rate per 1000 person-years of other differential diagnoses from 10 years prior to index date. Bars are 95% CIs (CPRD Aurum).
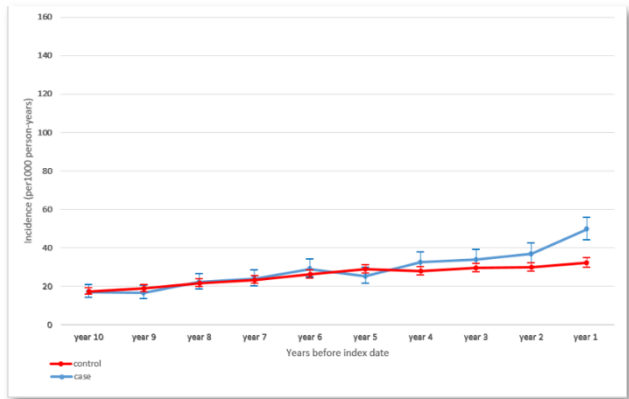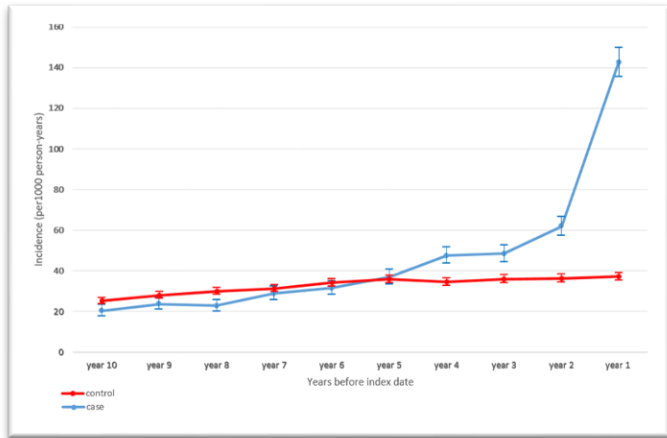
a. Rash
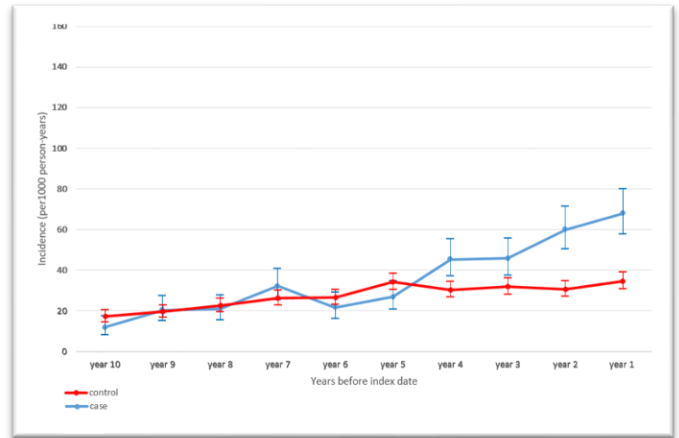
b. Dry skin
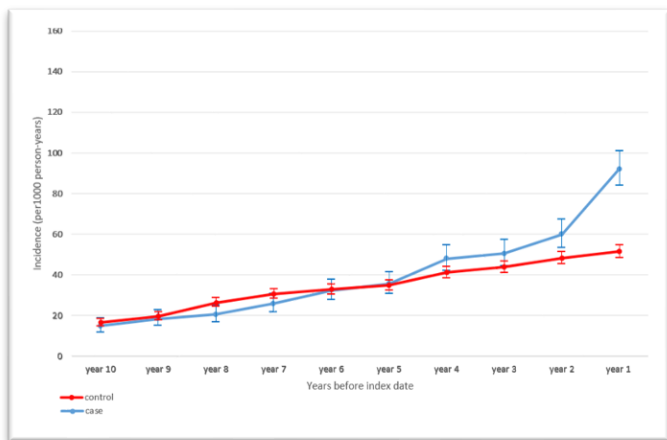
c. Skin texture changes
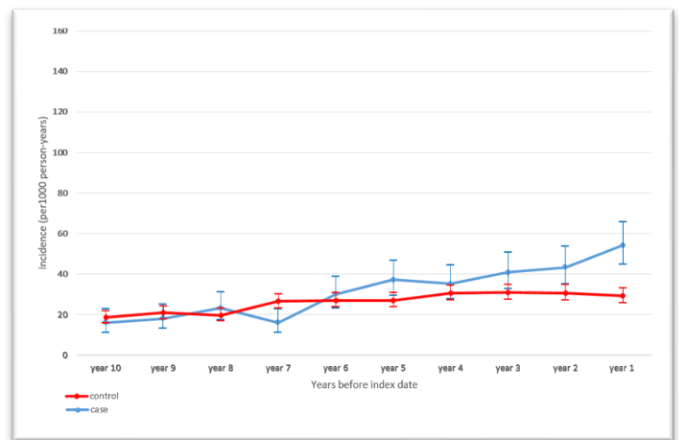
d. Itching

Figure 4. 6. Annual incidence rate per 1000 person-years of recording clinical features suggestive of psoriasis from 10 years prior to index date. Bars are 95% CIs (CPRD Aurum).
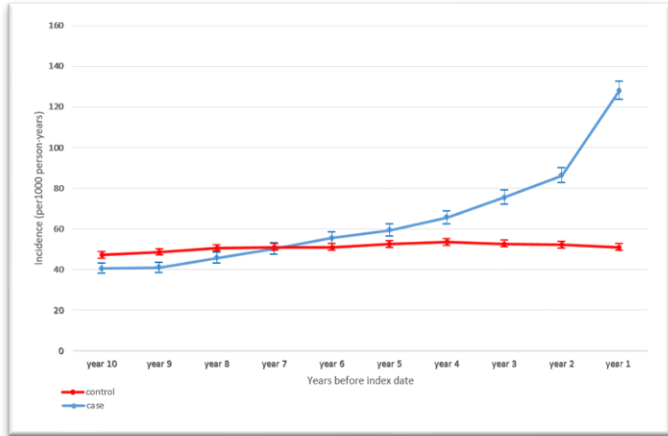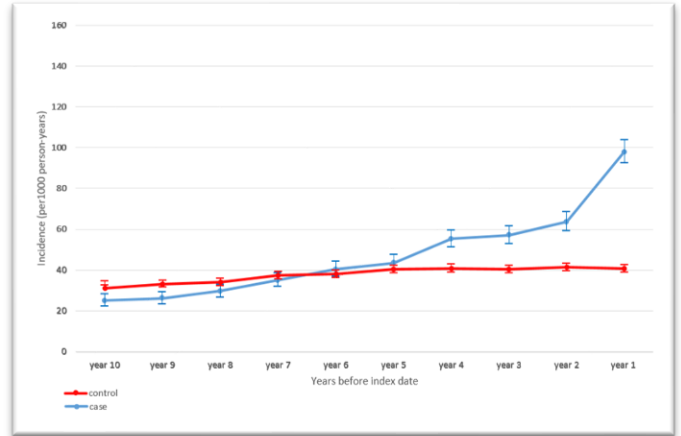
a. Topical corticosteroids   b. Topical antifungals

Figure 4. 7. Annual incidence rate per 1000 person-years of prescribing topical corticosteroids and topical antifungals from 10 years prior to index date. Bars are 95% CIs (CPRD Aurum).

Table 4. 5: Incidence rate ratios (IRR) of clinical events recorded 6 months, 1, 3 and 5 years before index date (CPRD Aurum).

Clinical events	IRR (95% CI) 6 months	IRR (95% CI) 1 Year	IRR (95% CI) 3 Year	IRR (95% CI) 5 Year
Seborrhoeic dermatitis	2.72 (2.23-3.33)	2.31(2.01-2.65)	1.52 (1.39-1.65)	1.31 (1.22-1.41)
Eczema	2.17 (1.99- 2.36)	2 (1.88 -2.12)	1.45 (1.40-1.51)	1.23 (1.19-1.27)
Tinea corporis	2.13 (1.89-2.39)	1.90 (1.74-2.07)	1.33 (1.26-1.41)	1.18 (1.13- 1.24)
Candida skin infections	1.92 (1.67-2.21)	1.75 (1.59-1.94)	1.29 (1.21-1.38)	1.17 (1.11-1.23)
Pityriasis rosea	4.56 (2.95-7.04)	3.24 (2.30-4.57)	1.71 (1.34-2.18)	1.35 (1.10 -1.66)
Dry skin	2.15 (1.81-2.55)	1.86 (1.64-2.10)	1.38 (1.28 -1.50)	1.19 (1.11-1.27)
Rash	3.41 (3.20 -3.64)	2.54 (2.42-2.66)	1.58 (1.53 -1.63)	1.28 (1.24 -1.31)
Skin texture changes	1.97 (1.67-2.09)	1.56 (1.44 -1.69)	1.28 (1.21-1.35)	1.14 (1.09 -1.19)
Itching	1.51 (1.24 -1.84)	1.37 (1.19 -1.58)	1.17 (1.07-1.28)	1.07 (0.99 -1.15)
Topical corticosteroids	2.09 (1.97-2.21)	1.80 (1.74 -1.87)	1.36 (1.33 -1.39)	1.18 (1.16 -1.21)
Topical antifungal treatment	2.02 (1.87-2.15)	1.72 (1.64 -1.81)	1.31 (1.27-1.35)	1.17(1.14-1.20)

4.4.   Discussion

To the best of my knowledge, this study represents the first attempt to examine EHRs of people with and without psoriasis prior to a documented diagnosis of psoriasis and retrospectively analyse data to understand the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK.

The study population was extracted from 796 participating GP practices. 17,320 individuals with incident diagnosis of psoriasis were identified from CPRD GOLD and matched to 99,320 individuals without a psoriasis diagnosis. The baseline demographic characteristics were described in Table 4.2. The median (IQR) age at index date was 51 (36-64) and 50 (36-64) for cases and controls, respectively; 52% were female and 48% were male for both groups. Previous epidemiological studies conducted in western Europe and the United States suggested that psoriasis has two peaks of presentation at around 30–39 and 60–69 years of age. The pattern usually corresponds to whether psoriasis first presented before (type 1) or after (type 2) the age of 40 years and is regarded as either 'early onset' or 'late onset' respectively (14). Findings from the present study suggest that half of the sample have type II psoriasis (i.e. the median of age for cases is 51 years). The median age of the study cohort was consistent with findings from other cohort studies using data extracted from the CPRD investigating EHR of individuals aged 18 years or above with psoriasis diagnosis. (78, 28, 50).

A list of premonitory clinical events has been identified; It has been hypothesized that these clinical events could possibly be related to a diagnosis of psoriasis before it is made.

The results of this epidemiological investigation suggest that individuals who were diagnosed with psoriasis more frequently visited general practices than those without psoriasis within five years prior to their diagnosis.

The findings from the CPRD study suggest that individuals who ended up with psoriasis diagnosis more frequently reported rash, dry skin, skin texture changes and itching and they were diagnosed with pityriasis rosea, eczema and/ or fungal infections prior to the index date than those in the comparator group. Hence, they were prescribed topical corticosteroid and/ or topical antifungal medication before a documented diagnosis of psoriasis more often than were those without psoriasis. The frequent use of these medications could mask signs and symptoms of psoriasis and contribute to potential delay in diagnosis. The findings from the present study did not suggest that the preceding diagnoses were incorrect. However, it suggested that certain skin conditions including pityriasis rosea, eczema and tinea corporis are more frequently documented for cases than controls before the index date (i.e., date of psoriasis diagnosis for cases). Furthermore, since these skin conditions (i.e. pityriasis rosea, eczema and tinea corporis) could mimic psoriasis and their incidence rate per 1000 person-years for cases increased steadily from 5 years before index date compared to their incidence rate per 1000 person-years for controls as shown in figures (4.2-4.7), these clinical events may represent potential opportunities for earlier diagnosis of psoriasis. This can lead general practitioners to suspect psoriasis when reviewing patients, investigate more thoroughly themselves, or refer patients to an experienced dermatologist if deemed important.

Pityriasis rosea and tinea corporis can look very similar to psoriasis. However, they have very different causes and treatments. The courses of the two skin conditions are also different

from that of psoriasis. Both tinea corporis and pityriasis rosea are short term diseases that may last for few weeks. In contrast, Psoriasis is a chronic skin conditions with frequent relapsing and remitting periods.

Eczema on the other hand may be distinguishable from psoriasis due to lack of sharp margination. May mimic flexural or chronic plaque psoriasis, as skin can become lichenified. Chronic hand eczema can present as ill-defined psoriasiform plaques on the palms and soles (28)

The outcome of this study may help to alert general practitioners to consider psoriasis among other differential diagnosis when the patient present multiple times with skin problems that were previously diagnosed as eczema, tinea corporis or pityriasis rosea. The findings did not suggest that the preceding diagnosis were incorrect. However, it suggested that, following data analysis it was noticed that certain skin conditions including Pityriasis Rosea, eczema and tinea corporis are more frequently documented for cases than controls before the index date (i.e., date of psoriasis diagnosis for cases). Further data analysis suggested that since these skin conditions (i.e. Pityriasis Rosea, eczema and Tinea corporis) could mimic psoriasis and the incidence rate per 1000 person-years increased steadily from 5 years before index date compared to incidence rate per 1000 person-years for controls as shown in as shown in figures (4.2-4.7), these clinical events differential diagnosis) may represent potential opportunities for earlier diagnosis of psoriasis. This can lead general practitioners to suspect psoriasis in appropriate cases, investigate more thoroughly themselves, or refer patients to an experienced dermatologist if deemed important.

Retrospective analysis of the EHR shows that potential opportunities for an earlier diagnosis of psoriasis present from five years prior to psoriasis diagnosis for some people. Hence,

suggesting possible delays in psoriasis diagnosis of up to five years for some individuals. The outcome of this study suggests the need to explore further whether opportunities for early and accurate diagnosis of psoriasis could be established by following consensus-agreed diagnostic criteria for psoriasis. Previous studies reported that primary healthcare professionals have low confidence in managing psoriasis and highlighted the disproportionately low level of dermatology teaching in medical schools in relation to the significant amount of skin disease seen by physicians (109, 110). Therefore, further studies investigating the impact of additional training on improving the diagnostic skills of primary care professionals for psoriasis might be required.

Chapter 5 - Development of clinical examination-based diagnostic criteria for chronic plaque psoriasis in adults: an international e-Delphi study

This chapter describes the process of developing a set of clinical diagnostic criteria for

chronic plaque psoriasis in adults using consensus method. It also considers the implications

of the expert agreed diagnostic criteria in clinical and research settings.

5.1. Introduction

As discussed previously in chapter 2 of this thesis, psoriasis is a long-term skin disease that impacts on the quality of life of patients and their caregivers and on health care systems. However, few diagnostic criteria have been proposed and no validated clinical examination guidelines exist for psoriasis in adults (age 18 years and above).

Literature review in chapter 2 of this thesis identified the knowledge gap existing with psoriasis diagnosis. Despite psoriasis being a common disease, surprisingly little guidance on the process for reaching a diagnosis of psoriasis is available in the literature (12). Its variable presentation and clinical overlap with other skin disorders such as eczema, fungal infections and certain neoplastic conditions (e.g. cutaneous T cell lymphoma) (86) make the diagnosis of psoriasis a challenging task, particularly for non-dermatologists.

The current approach to diagnosing psoriasis is based on the morphology and pattern of lesions (i.e., shape of the lesion(s)) which is dependent on a physician's clinical experience.

The approach to diagnose psoriasis in adults has never been standardised and may result in misdiagnosis of cases particularly among non-dermatologists. Only recently, a research team at the University of Nottingham undertaken an international consensus exercise to standardise psoriasis case definition in children (91, 111). The outcome of this consensus exercise was then validated to develop the best predictive diagnostic model for chronic plaque psoriasis in children (111). Due to the fact that psoriasis in adults often has a different distribution and appearance than in children, it was then appropriate to revisit this research question and develop standardises clinical diagnostic criteria for chronic plaque psoriasis in adults.

Noteworthy, in many parts of the world especially in low- and middle-income countries, there is limited access to specialist dermatology services and patients often initially receive care from other healthcare providers such as nurses, pharmacists and other healthcare advisors. Such healthcare professionals are likely to require additional support to make an accurate diagnosis of psoriasis. Moreover, developing diagnostic criteria could also support the training of non-dermatologists, improving their ability to diagnose psoriasis.

Given this, the aim of the study was to establish a set of clinical examination-based diagnostic criteria to support practitioners when diagnosing psoriasis in adults.

5.2. Methods

5.2.1. Study type

This study was conducted as a three-stage, international electronic-Delphi (e-Delphi) exercise. The Delphi technique is a consensus method that has been widely used to identify the collective opinion of experts about a particular subject (112). The Delphi technique is widely used in clinical and health services research. (113) It is an iterative process based upon the scoring of a series of structured statements which are revised and repeated until consensus has been reached amongst a panel of expert participants (114). It is a method that has been used for establishing diagnostic criteria for other skin conditions such as ulcerative lichen planus (115) and ulcerative Pyoderma Gangrenosum (116). The present study consisted of three successive rounds of data collection facilitated by an online survey methodology. The study took place between August 2018 and August 2019. A formal feedback process was undertaken and results generated from the process were circulated to participants for comments. All communication occurred electronically via e-mail and an online survey platform (Select Survey V4.033.002) was used to administer the questionnaire.

An e-Delphi study was chosen from the possible methods of group process because of its inherent feasibility. The absence of a need by the panellists to meet in person removed any constraint on the geographic location of the panel members. More importantly, involving experts from wide geographical distribution helped to capture experience in diagnosing psoriasis in people with darker skin colour. In addition, the anonymous nature of the Delphi technique was thought to be a key factor in avoiding a result that might be skewed by one or more persuasive panellists.

The study was performed in two different stages: Stage I involved a literature review, item

generation and construction of the questionnaire; and Stage II involved three rounds of data

collection and analysis. Figure 5.1 summarises the study design and procedure.
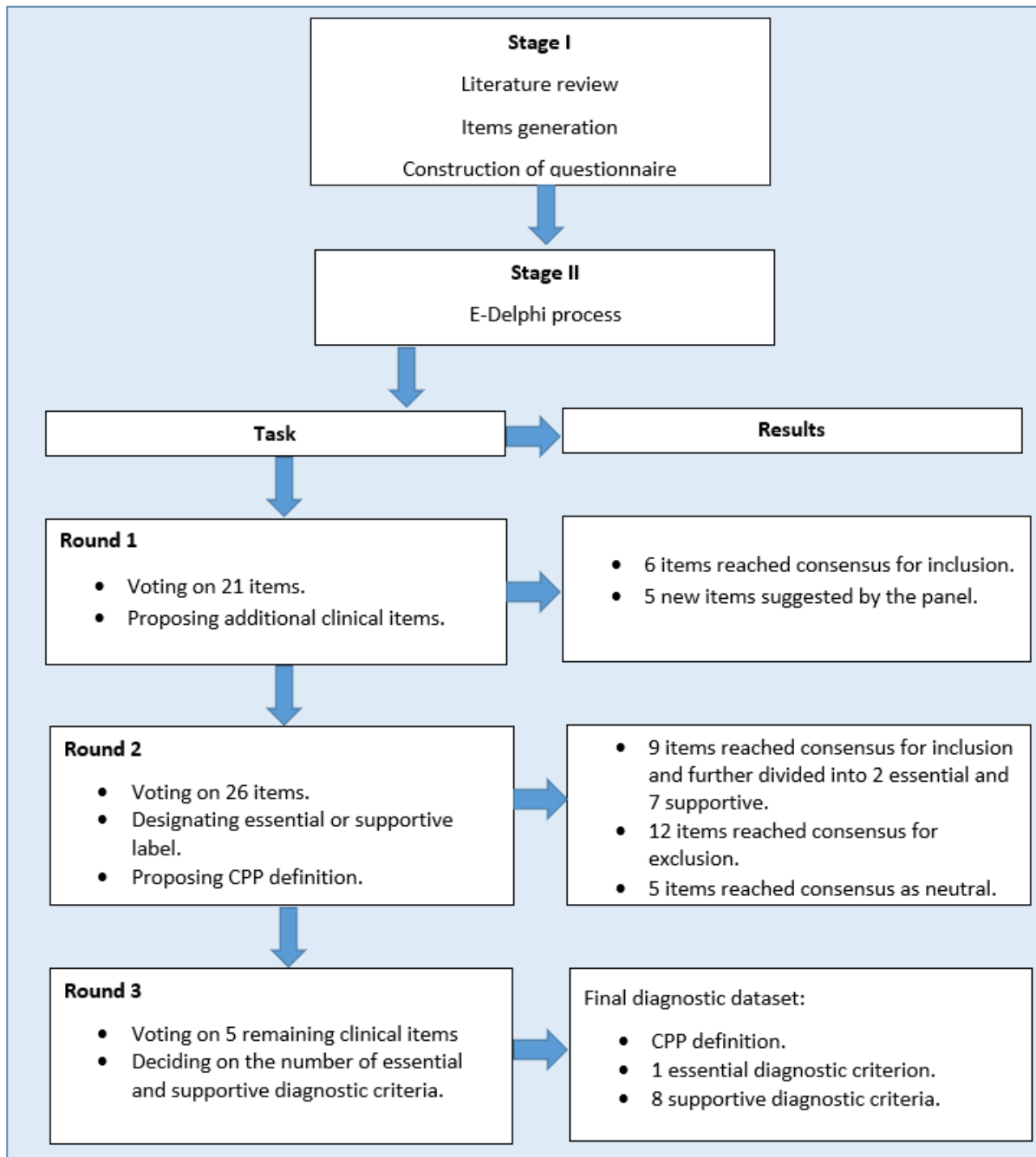
Figure 5. 1. Flow diagram of three rounds e-Delphi exercise to develop clinical examination-based diagnostic criteria for chronic plaque psoriasis in adults

During Stage (I), potential diagnostic items were identified following an extensive electronic database search of Web of Science, Medline, EMBASE, EBSCO, Scopus and the Cochrane Library of Systematic Reviews undertaken from February 2018 to June 2018 using the following search terms: 'psoriasis', 'diagnosis', 'classification', 'clinical criteria', 'diagnostic criteria' and 'cutaneous features.

Inclusion criteria were for studies that reported on the diagnosis of psoriasis and that are in English language only (due to limited availability of resources e.g. translators). Potential diagnostic items were extracted from the literature (n=21) and included in a questionnaire divided into five sections covering: lesion morphology; distribution; physical signs; clinical history; and associated features. The list of proposed diagnostic items in the first round of the e-Delphi study is shown in Table 5.1.

Table 5. 1: List of clinical diagnostic items of chronic plaque psoriasis proposed for rating in the first round of the e-Delphi exercise

Lesion morphology
Well-demarcated lesion(s).
Lesion(s) are pink to red in colour.
In deeply pigmented skin, lesions are grey in colour.
Patient's lesions vary in size.
Lesions are covered by silvery/white scales.
Palpable lesion(s).
Distribution
Symmetrically distributed lesion(s).
Lesions affecting the scalp are asymmetrical.
Lesions affecting palms and soles are asymmetrical.
Physical signs
Presence of Woronoff's ring.
Positive Auspitz sign.
Positive Koebner phenomenon.
Scaling can be induced by light scratching.
History
Family history of psoriasis in first degree relatives.
Preceded by group A streptococcal pharyngitis or tonsillitis.
Associated symptoms
Overall dry skin or cracking.
Itching.
Sore/painful skin.
Oozing and/or bleeding from the lesions.
Nail involvement.
Joint pain and/or stiffness.

Stage II of the study started with the first round of the Delphi process, with those completing the questionnaire asked to rank the importance of each item using a nine-point Likert scale (117, 118). The scale ranged from extremely unimportant to extremely important with a midpoint of 5, corresponding to "Not sure".

5.2.2. Participants

During the recruitment process, invitation letters were sent by e-mail explaining the study procedure to 100 councillors of the IPC. The IPC is an international community of dermatology experts working to improve the health of people with psoriasis around the world. The IPC has more than 100 members (councillors) who work include educating other physicians (internationally) on a range of topics related to psoriasis management. All of IPC board members and IPC councillors, are recognised as key opinion leaders in the field of psoriasis. Additionally, IPC conducts research in areas critical to improving psoriasis care overall.

There is a lack of agreement around the minimum e-Delphi sample size (i.e. number of experts) and no criteria against which a sample size choice could be judged. For the present study I followed recommendations by Akins et al. (147) for which the e-Delphi aimed to include a minimum of 20 expert participants. The same recommendations were followed by a recent e-Delphi study to develop clinical diagnostic criteria for chronic plaque psoriasis in children (91).

A record of consent was captured prior to participants taking part in the study. Participants were encouraged to take part in all three rounds of the study.

5.2.3. Study procedures

5.2.3.1. First round

At the first round of data collection, participants answered demographic questions to establish a clear understanding of the composition of the study population. Panel members were then asked to rate potential diagnostic items for chronic plaque psoriasis according to their perceived importance on a nine points Likert scale. Members of the panel were also asked to nominate other diagnostic items that they incorporate into their daily practice when diagnosing psoriasis. In addition, they were invited to comment on the terminology used in the proposed list of items in order to improve clarity of the description of the criteria. Responses to the first-round survey were then used to develop the subsequent round of the questionnaire. First round questionnaire is found in appendix (1).

5.2.3.2. Second round

In addition to the first-round items, the second round included a definition of chronic plaque psoriasis (that was developed following suggestions from panel members in the first-round responses) and additional diagnostic items (that were based on analysis of data extracted from free text comments provided at round one). Changes to wording of diagnostics items were also made based on panel feedback. Changes were incorporated into the next round questionnaire after review by the research team.

In the second round, each participant received a personalised questionnaire where five new items had been added (Table 5.2). The second-round questionnaire is found in appendix (2).

Table 5. 2: Proposed items suggested by panel members in the first round that were incorporated in the second-round questionnaire

Additional items suggested by panel members.
Preceded by group A streptococcal pharyngitis or tonsillitis.
Persistent dandruff.
Frequent skin infections.
Frequent topical corticosteroids use.
Exposure to stressful life events.

Panel members were asked to state if they agreed, disagreed or were not sure about the proposed definition of chronic plaque psoriasis and to suggest relevant modifications. In this round, panel members were further asked to review a summary of individualised feedback they were given where first-round responses of all participants were provided alongside

their own original ratings. Participants were asked to consider this feedback and to re-rate the diagnostic criteria accordingly.

In this round, participants were also asked to designate the items that had received a median score of 7 or more as essential or supportive in determining a diagnosis of chronic plaque psoriasis. 'Essential' items were those that must be present to make a clinical diagnosis of psoriasis. 'Supportive' items were those that did not have to be present but whose presence in conjunction with other diagnostic criteria supports a diagnosis of psoriasis.

5.2.3.3. Third round

The third-round questionnaire was developed based on participants' responses to the second-round questionnaire. However, at this point panel members were asked to re-rate only five items deemed to be supportive criteria in the previous rounds but whose importance on the nine-point Likert scale was still equivocal (table 5.5).

In this round, participants were also asked whether they agreed, disagreed, or were unsure about the proposed revised chronic plaque psoriasis definition; and to give their opinions about the number of supportive criteria that need to accompany the essential criteria in the final diagnostic dataset. Finally, participants were asked to specify the number of supportive criteria that need to accompany the essential ones to make the diagnosis of psoriasis. The agreed-upon threshold for the number of supportive items needed to make the diagnosis of chronic plaque psoriasis was 70% or above of participants. The third-round questionnaire is found in appendix (3).

5.2.4. Defining consensus and data analysis

Consensus refers to a generally accepted opinion or view among a defined group of people. When analysing the results, the median score of rating and IQR were calculated to measure the importance of each proposed item.

The achievement of consensus was established a priori and three thresholds for agreement were defined. Consensus for inclusion was defined as the median score being at least seven or more (on a nine-point scale) with an IQR of two points or less. This threshold implied that the experts regarded the item as important and believed it should be included in the final version of the diagnostic tool.

Consensus for exclusion was defined as a median score of three or less. Consensus neutral was defined as the median score of 4-6 resulting in the item being included in further rounds with feedback from the participants to determine whether it could reach inclusion or exclusion thresholds.

5.3. Results

A total of 50 clinicians completed the first-round questionnaire. Panel members were based in 27 countries from six continents. All the panel members were consultant dermatologists; the majority had more than 20 years of clinical experience. Characteristics of participants are shown in Table 5.3.

Table 5. 3: Demographic Characteristics of the panel members

	Round 1	Round 2	Round 3
Number of participants	50	38	40
Gender Male (%) Female (%)	35 (70%) 15 (30%)	26 (68%) 12 (32%)	27 (69%) 12 (31%)
Years of clinical experience More than 20 years 16-20 years 11-15 years 6-10 years	32 (64%) 9 (18%) 8 (16%) 1 (2%)	25 (66%) 7 (18%) 5 (13%) 1 (3%)	26 (67%) 7 (18%) 6 (15%) -
Country of clinical practice			
Argentina	3	2	3
Australia	2	2	1
Belgium	1	1	1
Brazil	1	1	1
Canada	3	3	2
Chile	1	1	1
China	2	1	1
Colombia	1	1	1
Denmark	1	-	1
Egypt	1	1	1
Germany	3	2	1
Iran	1	1	1
Ireland	1	-	-
Israel	1	1	1
Italy	1	1	1
Japan	2	1	1
Malaysia	1	1	1
Netherlands	1	1	1
Philippines	1	1	-
Poland	1	1	1
Portugal	1	1	1
Singapore	1	1	1

South Africa	2	2	2
Spain	2	2	2
Switzerland	1	1	1
United Kingdom (UK)	5	4	4
United States of America (USA)	11	5	8

After the first round of data collection, five new potential clinical diagnostic items were

added based on participants' suggestions. The wording of two statements was amended for

clarity. A summary of the items that achieved a level of consensus during the first-round

survey is shown in Table 5.4.

Table 5. 4: Clinical diagnostic items that reached consensus being important (median>=7) in round 1

Diagnostic item	Median score	Interquartile range (IQR)
Well-demarcated lesion(s).	8	7-9
Lesions are pink to red in colour.	7	7-8
Lesion(s) are covered by silvery/white scales.	8	7-9
Palpable lesion(s).	7	6-8
Symmetrically distributed lesions.	7	6-7
Family history of psoriasis in first degree relatives.	7	6-8

In the second-round survey, responses were received from 38 dermatologists. Twenty-two (58%) of 38 participants agreed on the proposed definition of psoriasis, 8 (21%) disagreed and 8 (21%) were unsure. The definition of chronic plaque psoriasis was then modified according to experts' comments from a general definition of psoriasis to more specifically defining chronic plaque psoriasis and its sites of predilection.

Nine of the 26 items proposed in the second round achieved consensus and were included in the final diagnostic dataset. Two of the original agreed items were designated as 'essential diagnostic criteria' and were combined into a single statement, 'well-demarcated lesion with or without silvery/white scales', as per the group's suggestion (Figure 5.2). The rest of the seven items were labelled as 'supportive diagnostic criteria'. Five other items of the proposed list reached a consensus for being supportive diagnostic criteria but their median score of rating was six points, below the established threshold for items to be considered for inclusion in the final diagnostic tool. These items were included in the third-round questionnaire for re-rating by the panel. The second-round results are shown in tables 5.5 and 5.6.

Table 5. 5: Clinical diagnostic items that reached consensus being important (median ≥7) in round 2

Item	Median	IQR	Definitive (%)	Supportive (%)	Neither (%)
Well demarcated lesion(s).	8	8-8	19 (50)	19 (50)	-
Lesions are pink to red in colour.	8	7-8	15 (39.5)	22 (57.9)	1 (2.6)
Patient's lesions vary in size.	7	7-8	3 (7.9)	23 (60.5)	12 (31.6)
Lesions are covered by silvery white scales.	8	8-8	23 (60.5)	15 (39.5)	-
Palpable lesion(s).	7	7-8	10 (26.3)	24 (63.2)	4 (10.5)
Symmetrically distributed lesions	7	7-8	8 (21)	27 (71)	3 (8)
Family history of psoriasis in first degree relatives.	7	6-8	2 (5.3)	34 (89.5)	2 (5.3)
Nail involvement.	8	7-8	10 (26.3)	27 (71)	1 (2.6)
Joint pain and/ or stiffness.	7	6-7	3 (7.9)	33 (86.9)	2 (5.3)

Table 5. 6: Clinical diagnostic items that reached consensus being supportive with a median score=6 in round 2.

Item	Median	IQR	Definitive (%)	Supportive (%)	Neither (%)
In deeply pigmented skin, lesions may be grey in colour.	6	6-7	3 (7.9)	27 (71.1)	8 (21.1)
Positive Koebner phenomenon.	6	6-8	4 (10.5)	34 (89.5)	-
Preceded by group A streptococcal pharyngitis or tonsillitis.	6	5-7	1 (2.6)	33 (86.8)	4 (10.5)
Persistent dandruff.	6	5-7	-	31 (81.6)	7 (18.4)
Itching.	6	6-7	-	32 (84.2)	6 (15.8)

Note: These items were readministered in round 3 questionnaire

In the third and final round, 40 dermatologists responded. 80% (32 of total 40 participants) of the participants agreed on the proposed definition of chronic plaque psoriasis; a few made minor comments that were incorporated into the final version of the definition. In this round, two further items were recommended as being supportive diagnostic criteria.

The total number of supportive diagnostic criteria at this stage was nine. However, two of the supportive criteria ` Lesions are pink to red in colour' and 'In deeply pigmented skin, lesions may be grey in colour' were subsequently combined into one statement as they relate to the same aspect of the clinical presentation (Figure 5.3).

The final diagnostic tool therefore consists of one essential diagnostic criterion and eight supportive diagnostic criteria. Figures 5.2 and 5.3 illustrates changes in panel ratings across three rounds of the consensus study for the final diagnostic dataset.

When asked about the number of supportive diagnostic criteria that should accompany the essential one to establish a clinical diagnosis of chronic plaque psoriasis, 80% (32 of total 40 participants) of panel members agreed that at least four out of the eight supportive diagnostic criteria must be present together with the essential criterion in order to make the diagnosis. Table 5.7 contains full details of the final diagnostic criteria.
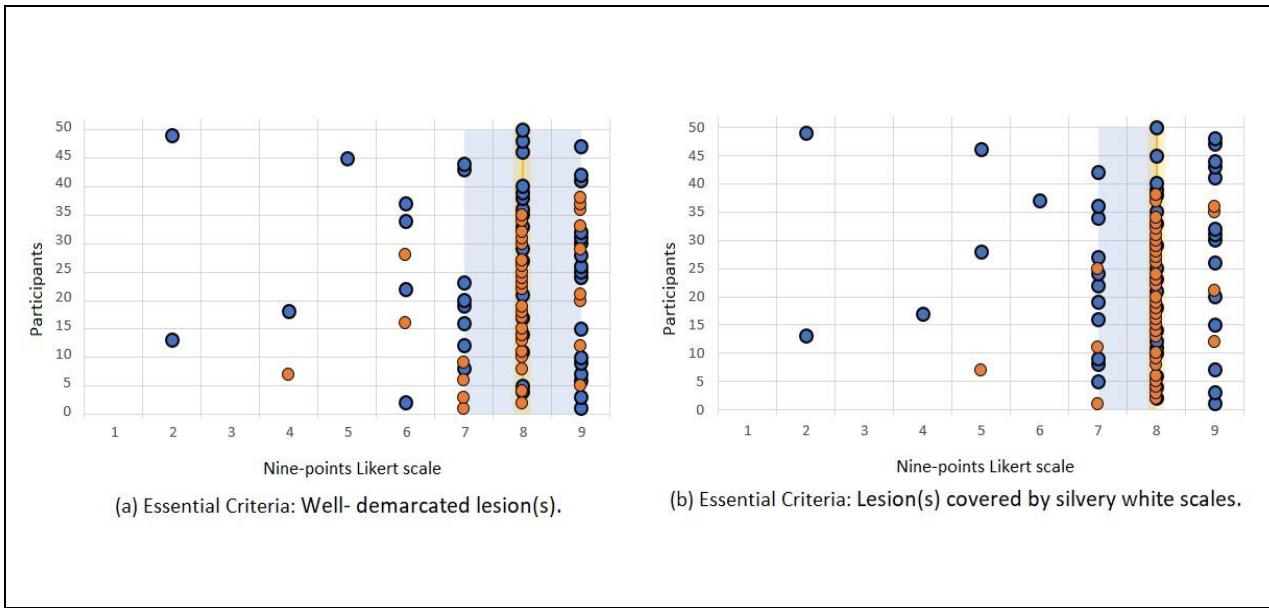
Figure 5. 2. Panel ratings for the essential diagnostic criteria that were combined into single diagnostic criterion in the final diagnostic dataset.

Note: The figure shows movement to more favourable outcome with each subsequent

round and less outliers. The line represents the median and the shaded area is IQR. Each

line/ shaded area corresponds to the same round colour. Grey is overlapping estimate.

Items A and B were combined into a single statement "Well demarcated lesion with or

without silvery/white scales".
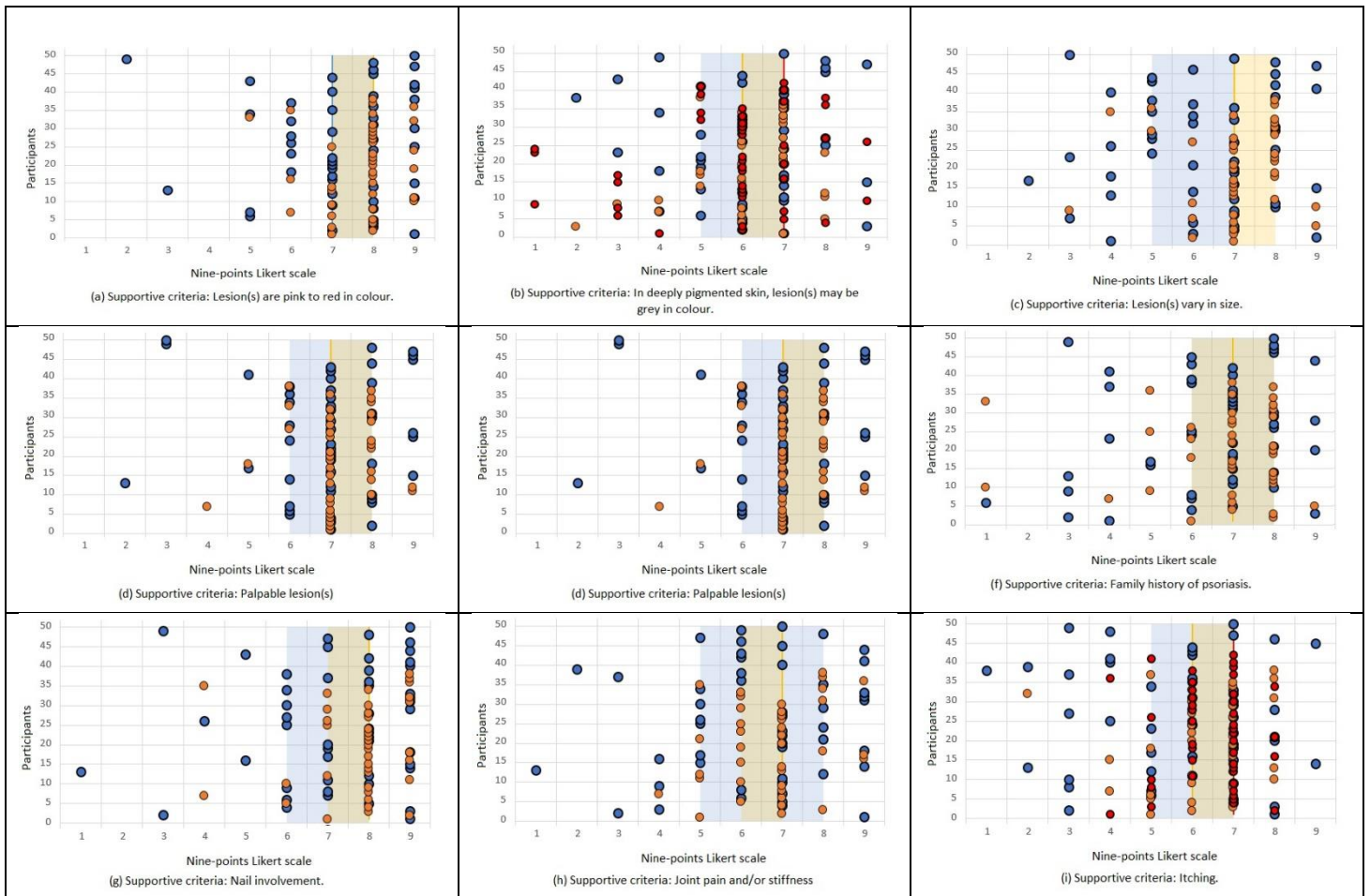
Figure 5. 3. Panel ratings for each supportive clinical diagnostic criterion on the final diagnostic dataset.

Note: Figure showing movement to more favourable outcome with each subsequent round and less outliers. The line represents the median and the shaded area is IQR. Each line/ shaded area corresponds to the same round colour. Grey is the overlapping estimate. Items C and D were combined into a single statement "Lesions are pink to red in colour. In deeply pigmented skin, lesions may be grey in colour".

Table 5. 7: Final diagnostic dataset

Definition: chronic plaque psoriasis is systemic, inflammatory disease that predominately affect the skin. Skin lesions can occur on any part of the body and particularly affects extensor surfaces of the limbs especially elbows and knees. Other common sites for psoriasis to appear include the trunk, the umbilicus, over the lower back (sacrum), on the scalp involving the hairline, skin inside and behind the ears, the palms of the hands, soles of the feet and nails. Skin folds such as armpits, between the buttocks, genitals and under the breast may also be affected.

Clinical diagnosis of chronic plaque psoriasis in adults requires the presence of the essential criterion and at least four out of the eight supportive criteria listed below.

Essential clinical diagnostic criterion: well demarcated lesion with or without silvery/white scales.

Supportive clinical examination diagnostic criteria:

1. Lesions are pink to red in colour. In deeply pigmented skin, lesions may be grey in colour.

2. Lesions vary in size.

3. Lesions are palpable.

4. Lesions are symmetrically distributed.

5. Family history of psoriasis in first degree relatives.

6. Nail involvement (such as pitting, onycholysis and subungual hyperkeratosis of the nails).

7. Joint pain and/or stiffness.

8. Itching.

5.4. Discussion

The results of this study revealed strong consensus that 'well-demarcated lesions with or without silvery-white scales' is a cardinal clinical finding in all adult patients with chronic plaque psoriasis. No other diagnostic criteria were deemed essential and the panel responses did not present extreme outliers for most of the suggested items (Figure 5.2 and 5.3). Eight supportive clinical diagnostic criteria and a definition of chronic plaque psoriasis signposting the most common body sites that could be affected were also identified to aid with psoriasis case ascertainment.

Feedback from panel members across all three rounds suggested including items about the genetic, molecular and/or pathological characteristics of psoriasis lesions; however, items related to these were not included because they were not consistent with the primary aim of the study which was to develop clinical examination–based diagnostic criteria for chronic plaque psoriasis in adults. Other feedback suggested the inclusion of information about associated co-morbid diseases such as cardio-metabolic complications, but these again were beyond the scope of this research project

Recently, Burden-Teh et al (91) conducted a consensus exercise to build a diagnostic tool for chronic plaque psoriasis in children. Although the study produced 16 clinical examination-based diagnostic criteria for chronic plaque psoriasis in children, the applicability to a wider age group has not been determined. Thus, more focused work to develop diagnostic criteria for chronic plaque psoriasis in adults (age 18 years and above) and involving experts with experience in managing psoriasis in patients from wider ethnic background was needed.

The consensus developed criteria are intended to standardise psoriasis case definition for epidemiological field studies. This is especially important to help non-dermatologist

investigators identify psoriasis cases particularly in resource poor settings. Development of a clinical diagnostic tool for the most common type of psoriasis, chronic plaque psoriasis, will also help to provide better medical care in terms of earlier diagnosis and treatment. The diagnostic set of criteria could also serve as a teaching and training tool for healthcare providers involved in psoriasis management (such as nurses, pharmacists and doctors in training); especially in those parts of the world where access to specialist dermatology care is limited.

Chapter 6 - Development and evaluation of an online training tool to improve the diagnosis of psoriasis

This chapter covers the approach and outcome of an exploratory study to evaluate a newly developed training tool for primary care professionals to improve their diagnostic skills for psoriasis.

6.1. Introduction

In most cases, dermatologists are able to diagnose psoriasis. However, since psoriasis can look like other skin conditions such as eczema and tinea corporis, diagnosing it can sometimes be difficult even for the trained eye (12). For non-dermatologists, recognising earlier presentations of the disease particularly in childhood can be challenging.

Findings from the analyses conducted using EHRs of this thesis (chapter 4) suggested that possible opportunities for earlier diagnosis of psoriasis in primary care exist and represent potential factors for the delay in starting appropriate treatment in some individuals.

In general, epidemiological studies report that the prevalence of skin diseases in the UK is relatively high and earlier reports from primary care databases in England and Wales suggested that 15% of all consultations with GP practices are for dermatology related problems (121). Further evidence suggests that 54% of the UK population are affected by a skin disease each year with around 24% (13 million people) visit their GP every year about a skin problem (121).

More specifically, psoriasis is considered one of the most frequently seen skin conditions in primary care (100) and many patients seek initial evaluation and treatment at the primary care level (28, 109, 122). Hence, health workers in primary care are well positioned to provide diagnosis and initiate treatment for psoriasis.

Despite this, dermatology training for health workers in primary care is limited (123, 124). Such inadequate dermatology training at primary care level may contribute to under treatment and increased dermatology outpatient referrals (125). Given this, additional dermatology training for primary care professionals is of particular importance.

In an attempt to improve the early diagnosis of psoriasis by non-dermatologists, a consensus-agreed list of diagnostic criteria for chronic plaque psoriasis in adults has been developed (as presented in chapter 5). The outcome of this e-Delphi study has been used to develop an e-learning resource to improve psoriasis diagnosis by non-dermatologists.

The aim of the work presented in this chapter was therefore to develop a training tool and evaluate the impact of training on improving diagnostic skills for psoriasis, it was hypothesised that following the training, participants would improve clinical skills to identify psoriasis cases.

6.2. Methods

6.2.1. Study design and procedures

Based on the findings from the international e-Delphi study, a training tool has been developed to improve the diagnosis of psoriasis. The training tool consisted of a short demographic questionnaire, training section and feedback survey (appendix 4). Figure 6.1 shows a conceptual framework of the training tool. The first version of the training tool was piloted in a group of 5 participants (a nurse, 2 pharmacists, 2 non-medical research investigators) to test the design, structure and clarity of information presented in the training tool. Feedback was used to revise the training tool and the final product was then launched for the main study.

A before-and-after exploratory investigation of the online training tool that was then conducted between December 2021 and March 2022. The study was conducted online and a specifically designed website hosted the training tool.

Relevant ethical approvals were obtained from the University of Manchester Research ethics committee (UREC) and Health Regulatory Authority (HRA) (reference numbers 2021-12043-21142 and 21/HRA/3150 respectively). The study was also adopted by the NIHR Clinical Research Network (CRN) Portfolio (IRAS ID: 293734).
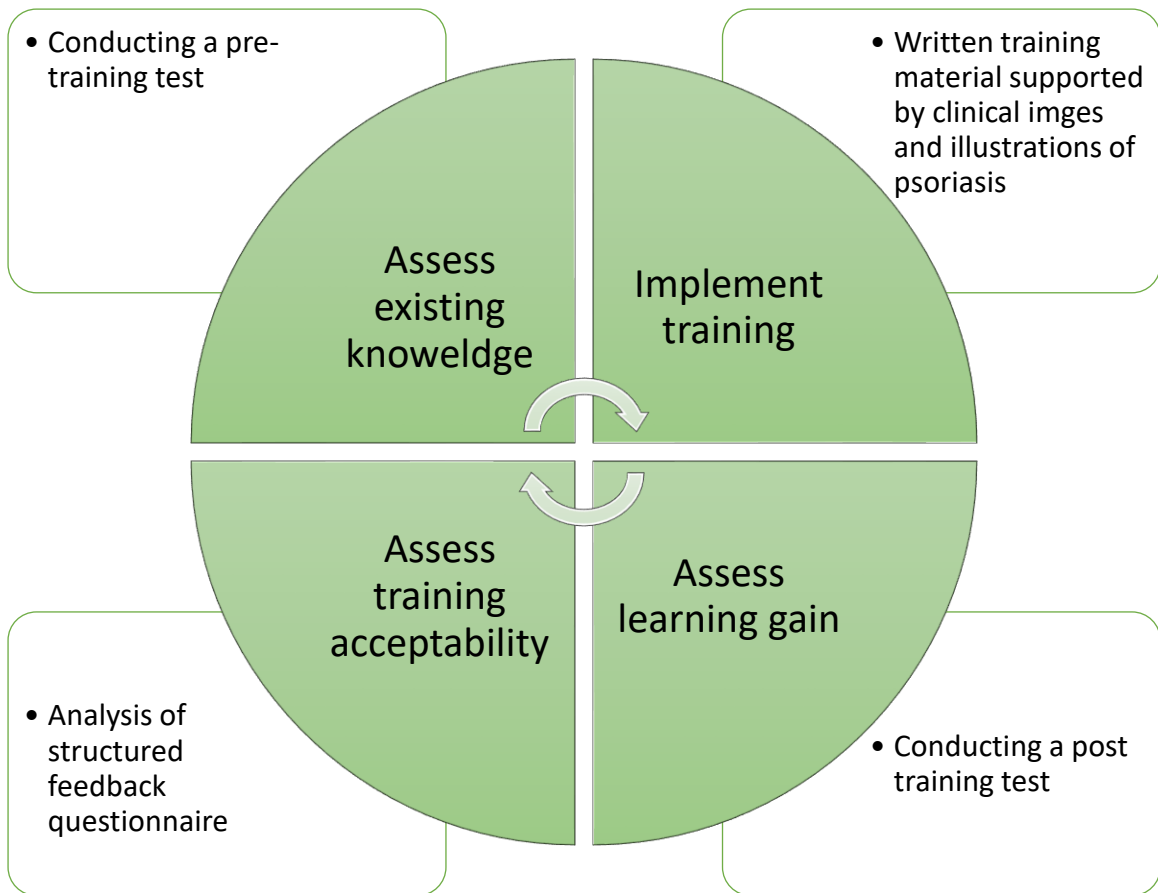
Figure 6. 1. Conceptual framework of the training tool

6.2.1.1.   Demographic questionnaire

After completing an online consent procedure, participants were required to complete an online demographic questionnaire. Demographic questions included gender, profession, years in clinical practice. Participants were also asked to indicate the level of confidence in their diagnostic skills of psoriasis on a five-points Likert scale ranging from 0 "Not confident at all", to 5 "Completely confident".

6.2.1.2.   Training

The training section involved completing three steps as follows:

1.   A pre-training test to assess prior knowledge and skills in diagnosing psoriasis. Participants were asked to complete a test designed to assess their ability to identify visible clinical signs of psoriasis. Participants were shown photographs of different skin conditions accompanied by a brief clinical history and were asked to identify the skin condition illustrated in the photograph from a list of five choices which included chronic plaque psoriasis, three differential diagnoses (e.g. eczema, tinea and pityriasis rosea) and an option for 'don't know'. The results were assessed in terms of a total score based on summation of the answers to the 10 case scenarios, hence the maximum score was 100 (i.e., respondents get 10 points for answering each case scenario with the correct answer and alternatively 0 for each wrong answer).

2.   A training session: the training session contained information on the clinical diagnosis of chronic plaque psoriasis based on findings from our recent international e-Delphi consensus study reported in chapter 5 of this thesis. The training was supported by illustrations of psoriasis. The illustrations were specifically drawn for the purpose of the

training tool by medical illustrator (AT) (figure 6.2 and 6.3) and were intended to support

participants' learning about the visible signs of psoriasis. Also, there were 12 clinical images

of chronic plaque psoriasis on real patients to help improve understanding for participants.

A

B

Figure 6. 2. Example illustrations of chronic plaque psoriasis used in the training tool

Note:

A. Chronic plaque psoriasis on light skin colour. Showing characteristic well-demarcated pink/red plaques covered with silvery white scales.
B. Chronic plaque psoriasis on dark skin colour showing grey plaques of psoriasis.

A

B

Figure 6. 3. Example illustrations of psoriasis nail disease used in the training tool

    A. Subungual hyperkeratosis of fingernails with nail destruction.
    B. Onycholysis of the nails with oil-spot sign.

3.   A post-training test: to establish the learning gain that may be attributable to the training. Participants were asked to complete a post-training test to identify visible clinical signs of chronic plaque psoriasis. The post-training test consisted of 10 case scenarios with the same content (medical history and clinical images) and sequence as the pre-training test to determine whether the training has made any impact. The post-training test was scored the same way as the pre-training test with 10 points for each right answer, 0 points for each wrong answer and a maximum score of 100. At the end of the post-training test, participants were notified about their results and provided with an explanation of the correct and incorrect answers. Since the pre-training and post-training tests were similar, explanations for the right and wrong answers were only provided after completing the post-training test. Figure 6.4 illustrates the study procedures.

The clinical case scenarios included in the pre- and post-training tests were reviewed by an experienced dermatologist (CEMG) to ensure their relevance to the aims and objectives of this project. All the case studies had the same format.

6.2.1.3.   Feedback questionnaire

After completing the training session, participants were required to complete a feedback questionnaire. The aim of the feedback section was to collect users' views on the design, content, length of time required to complete the training and the acceptability of using the training tool as a resource for future reference.

The feedback survey comprised two parts. Part 1 consisted of 11 questions where study participants were required to estimate the level of their agreement with each one of the proposed statements on a 5-points Likert scale ranging from 1 "poor" to 5 "excellent".

These 11 statements focused on the design, content and acceptability of the training tool as a reference for future use.

Part 2 of the feedback questionnaire consisted of 5 questions focusing on the technical part of the training tool such as any difficulties while using the training tool and the length of the time required to complete all parts of the study. In this Part, participants were asked to answer with "yes" or "no" and to provide clarification to their answers wherever needed.

Open-text comments were also invited at the end of the feedback questionnaire where participants were encouraged to add their comments on general aspects of the training tool such as the overall design of the training tool or more focused feedback on aspects they thought might have improved the training tool performance such as providing more information about the diagnostic criteria, more supporting educational material, more clinical images and illustrations and more details about the other differential diagnoses of chronic plaque psoriasis that were included in the pre-training and post training tests.
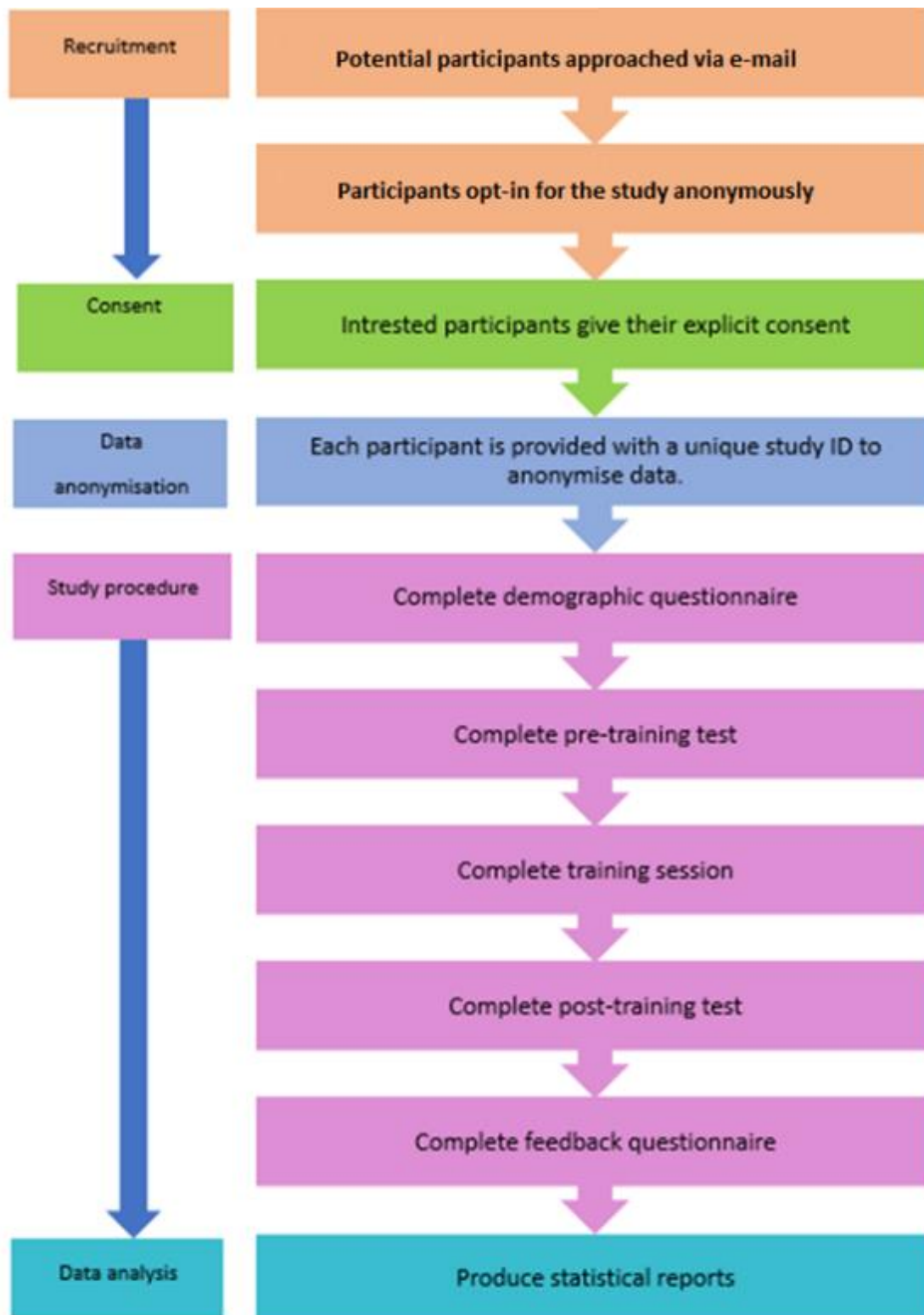
Figure 6. 4. flow diagram of the study process

6.3. Participant groups and sampling

The targeted groups of participants for this study were primary healthcare professionals including GPs, nurses and pharmacists working in general practices in England.

Inclusion criteria for participants were being:

- A primary healthcare professional (GP, nurse or pharmacist).

- currently employed by a general practice in England.

Exclusion criteria were:

- Individuals who had completed a specific postgraduate training in dermatology (e.g. Diploma or master's degree).

A convenience sampling approach of 60 participants (20 participants per professional group) was used in this study design to allow the collection of pre- and post-evaluation data and to permit comparing diagnostic scores across three groups of participants (GP, nurse, or pharmacist). Convenience sampling is a method of non-probability sampling where researchers will choose their study sample based solely on the convenience (148).

6.4. Recruitment

Participants for this study were approached in two ways:

1. The NIHR CRN. Invitation e-mails were sent by a CRN coordinator to general practices in Greater Manchester and the Northwest coast region on behalf of the study team. The invitation e-mail included the participant information sheet, participants identification centre (PIC) agreement and a document outlining the

study procedures. Interested general practices were invited to contact the principal researcher (MA) if they wished to participate in the study.

2. Research team professional networks. Similarly, invitation e-mails were sent to potential participants from the research team professional networks. Interested individuals were also asked to distribute the invitation e-mail to eligible individuals from their professional network.

6.5. Outcome measure

The outcome measure was the change in the mean diagnostic score between pre- and post-training tests (i.e., accuracy of psoriasis diagnosis).

6.6. Data analysis

Data was exported into Excel (Microsoft Corporation, Redmond, WA, USA) and imported into Stata, v.16 (Stata Corp LLC) to perform statistical analyses. Descriptive statistics were used to summarize variables, with the median and IQR given for non-normal continuous variable (years of clinical experience) and frequency with percentages for categorical variable (gender).

A paired t-test was performed to determine whether there was a statistically significant mean difference between the pre- and post-training test scores for participants. Analysis of covariance (ANCOVA) was used to compare total diagnostic scores between the three groups of participants as baseline (i.e., compare mean diagnostic scores of pre-training test results between three groups of participants). A post-hoc test using Bonferroni correction was used to determine whether any differences between mean scores of pre-training test results for the three groups of participants were significant.

A multiple regression analysis was used to predict the effect of predefined covariates on the post-training test scores. Covariates included profession, gender, years of clinical experience.

Cronbach's Alpha was used to measure the reliability (i.e., internal consistency) of the feedback questionnaire. Open-text responses were categorized into two groups, strengths and limitations with content analysis.

6.4. Results

6.4.1. Demographic characteristics

The healthcare professional demographics are shown in Table 6.1. A total of 60 participants completed the study (20 per health professional group). Of those, 48 (80%) were female and 12 (20%) were male participants. Participants were employed in general practices in the Northwest of England, mainly in the Greater Manchester and Liverpool regions. The mean number of years of clinical experience varied across the three groups with median of 12.5 (QR 4-17) and 5 years (3-13) for the GPs and nurses' groups respectively. While the median number of years of clinical experience in primary care for the pharmacist group was 2.5 (2-4.5) years.

Table 6. 1: Healthcare professional demographics

Healthcare professional	Male Frequency (%)	Female Frequency (%)	Years of clinical experience Median (IQR)
GP	8 (40%)	12 (60 %)	12.5 (4-17)
Nurse	0 (0%)	20 (100 %)	5 (3-13)
Pharmacist	16 (80%)	4 (20 %)	2.5 (2-4-5)

6.4.2. Diagnostic skills at baseline

To assess the existing knowledge of participants (figure 6.1), the mean diagnostic scores of the pre-training test were compared between GPs, nurses and pharmacists at baseline.

The mean diagnostic scores for each one of the three healthcare professional groups are shown in Table 6.2. There was a statistically significant difference between the mean

diagnostic scores between groups as determined by one-way ANOVA testing. Post hoc tests using Bonferroni correction revealed that the difference in mean scores was significant between GPs and both pharmacists and nurses' groups. However, there were no statistically significant differences between the mean diagnostic scores between nurses and pharmacists. No significant outliers were identified from the pre-training test scores.

Table 6. 2: Mean diagnostic scores for health professionals at baseline (pre-training test)

Healthcare professional	Mean diagnostic score (range)	95% CI	SD.
GP	66 (50-90)	59.85 – 72.14	13.13
Nurse	37.5 (0-70)	27.44 – 47.55	21.49
Pharmacist	43.5 (20-70)	37- 49.99	13.86

6.4.3. Comparative diagnostic scores (pre- and post-training tests scores)

Data analysis showed that the median diagnostic score of the post-training test were higher than the median diagnostic score of the pre-training test suggesting a learning gain attributed to the training course (Figure 6.5).
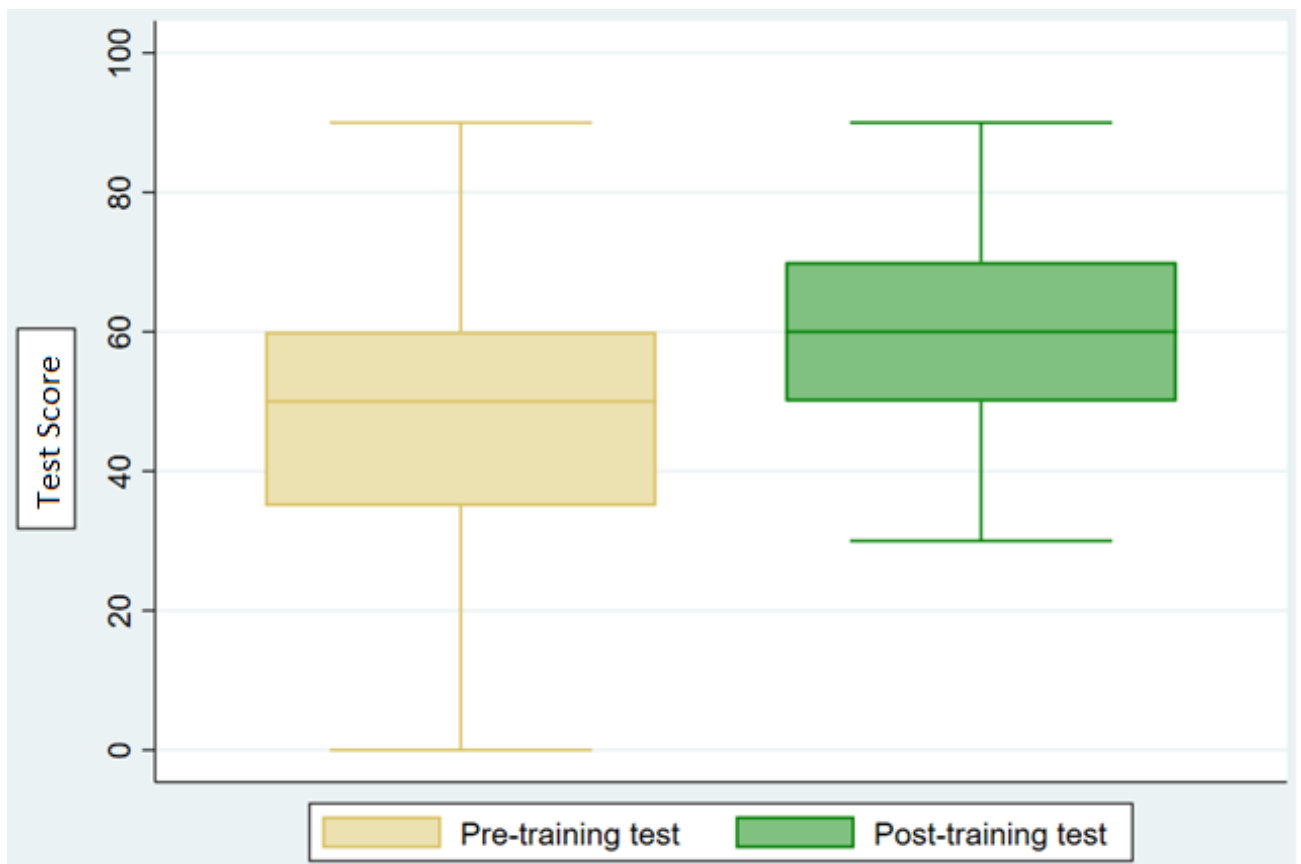
Figure 6. 5. A Box-and-Whisker plot showing median and IQR of the pre- and post-training tests scores

A paired t-test was performed to determine whether there was a statistically significant difference between mean diagnostic scores of the pre-training and post-training tests for the whole sample. The mean diagnostic score at baseline (pre-training test) was 49 with 95% CI of 43.71 to 54.29. A statistically significant increase of 14.67 (95% CI, 10.5076 to

151

18.82573), p < .0005 was obtained after subtracting pre-training from post-training test scores. After training, the mean diagnostic score for the post-training test was 63.67 (95% CI, 60.04 to 67.28).

Further analysis showed that the mean diagnostic scores for all three professional groups increased after completing the training and the difference was statistically significant (Table 6.3). The most noticeable increase in the mean diagnostic score between pre- and post-training test was in the nurses group. In this profession group, the mean diagnostic score at baseline (pre-training test) was 37.5 (95% CI, 27.44 to 47.55). After training there was a statistically significant increase to a mean diagnostic score of 60.5 (95% CI, 53.79 to 67.2) in the post-training test. Similarly, in the pharmacists' group, the mean diagnostic score at baseline (pre-training test) was 43.5 (95% CI, 37 to 49.9), with statistically significant increase to a mean score of 59.5 (95% CI, 54.59 to 64.41) in the post-training test. However, the difference in the mean diagnostic score for the GPs group was less noticeable. For the latter group (i.e., GPs), the mean diagnostic score of the pre-training test was 66 (95% CI, 59.85 to 72.14) with a small but statistically significant increase to 71 (95% CI, 64.22 to 77.77) in the post-training test. Table 6.6 show of the median diagnostic scores of the pre- and post-training tests with 95% CIs across three profession groups.

Table 6. 3: Difference between outcome scores according to profession

Profession	Pre-training test score Mean (95% CI)	Post-training test score Mean (95% CI)	P Value
Nurse	37.5 (27.44 – 47.55)	60.5 (53.79 – 62.2)	<0.0001
Pharmacist	43.5 (37- 49.99)	59.5 (54.58 – 64.41)	0.002
GP	66 (59.85 – 72.14)	71 (64.22 – 77.77)	0.04
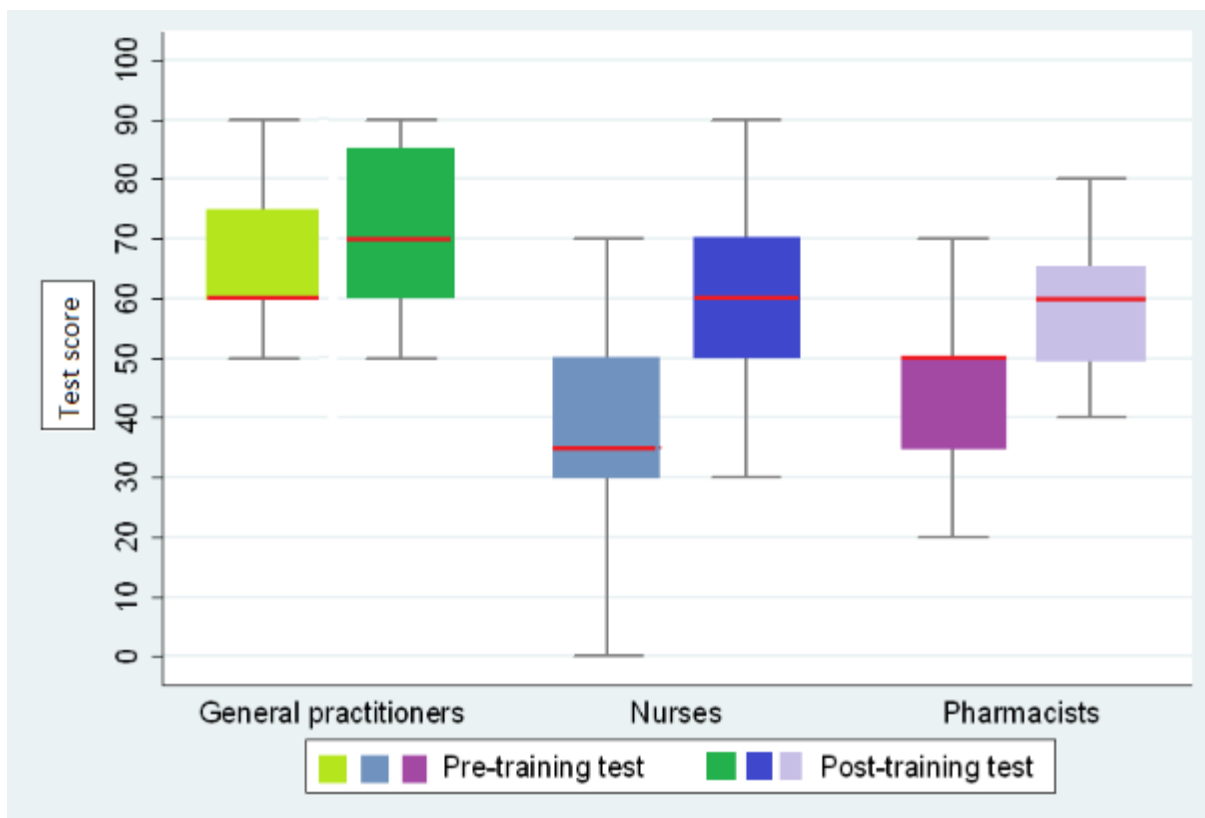
Figure 6. 6. Change in test score after training per profession group

When testing the effect of the pre-defined covariates using a multiple regression analysis, it was found that only profession significantly affected the outcome score (i.e., mean difference between pre-training and post-training tests scores), ($R2 = 0.23$, $F (4, 55) = 4.16$, $p < 0.000$).

The nurses' group had higher increase in their mean diagnostic score from the baseline followed by the pharmacists' group and the least increase in the mean diagnostic score was seen in the GPs group. Years of clinical experience in primary care also affected the outcome score, having more than 10 years of clinical experience in primary care resulted in higher mean diagnostic score at baseline and lower difference in the mean diagnostic score between pre and post training tests. However, the effect of the years of clinical experience was not statistically significant.

6.4.4. Feedback

A reliability analysis was performed to assess for the internal consistency of the 5 points Likert scale. Cronbach's alpha (α) showed the questionnaire to reach acceptable reliability, α =0.92. Further analysis of the feedback questionnaire shows that 94% of the participants found that the training tool was well structured, and the design was easy to follow. 88% of the participants indicated that the learning objectives (i.e., improve diagnostic ability of participants for chronic plaque psoriasis) were met by completing the training course. 80% of the participants agreed that the written material was clear, easy to understand, at the right level for them and contained the right amount of detail.

Similarly, 85% of the participants found the visual aid (i.e., illustrations and clinical images) were useful to support their understanding. However, 16% of the participants found that more details are required in the clinical case scenarios to make a clinical diagnosis of chronic plaque psoriasis and to rule out other differential diagnoses. The majority of participants (84%) agreed that the training tool could be used as an educational resource for future reference. Figure 6.7 shows participants' rating of each of the 11 proposed usefulness statements.

The written training material for this course was clear and easy to understand. — 2, 1, 9, 48

This course provided a good introduction to the clinical diagnostic criteria of chronic plaque psoriasis. — 3, 13, 44

The learning objectives set for this training course are met by studying the material. — 7, 14, 39

The use of illustrations was helpful to improve my understanding. — 2, 2, 7, 49

The training material were helpful. — 3, 14, 43

The information provided in the clinical case scenarios were enough — 2, 8, 19, 31

The use of clinical images was helpful to improve my understanding — 2, 5, 53

There were enough illustrations to learn about each diagnostic criterion — 4, 5, 12, 39

I would find it useful to have access to this training course as a resource for future reference — 5, 3, 7, 44

The training course contained the right amount of detail — 6, 4, 11, 39

The content was at the right level for me — 5, 5, 10, 39

■ Poor ■ Fair ■ Average ■ Good ■ Excellent

Figure 6. 7. Satisfaction of primary care professionals with the online training tool using a five-points Likert scale.

To assess the effect of the training tool on improving the confidence of health care professionals in their diagnostic skills for psoriasis, participants were asked to rate their level of confidence with their diagnostic skills on a 5 points Likert scale ranging from 1 "Not confident at all" to 5 "completely confident" before and after the training. Data analysis showed that participants across all three professional groups were more confident in their diagnostic skills after the training. Figure 6.8 shows the change of confidence level in diagnostic skills for GPs, nurses and pharmacists.
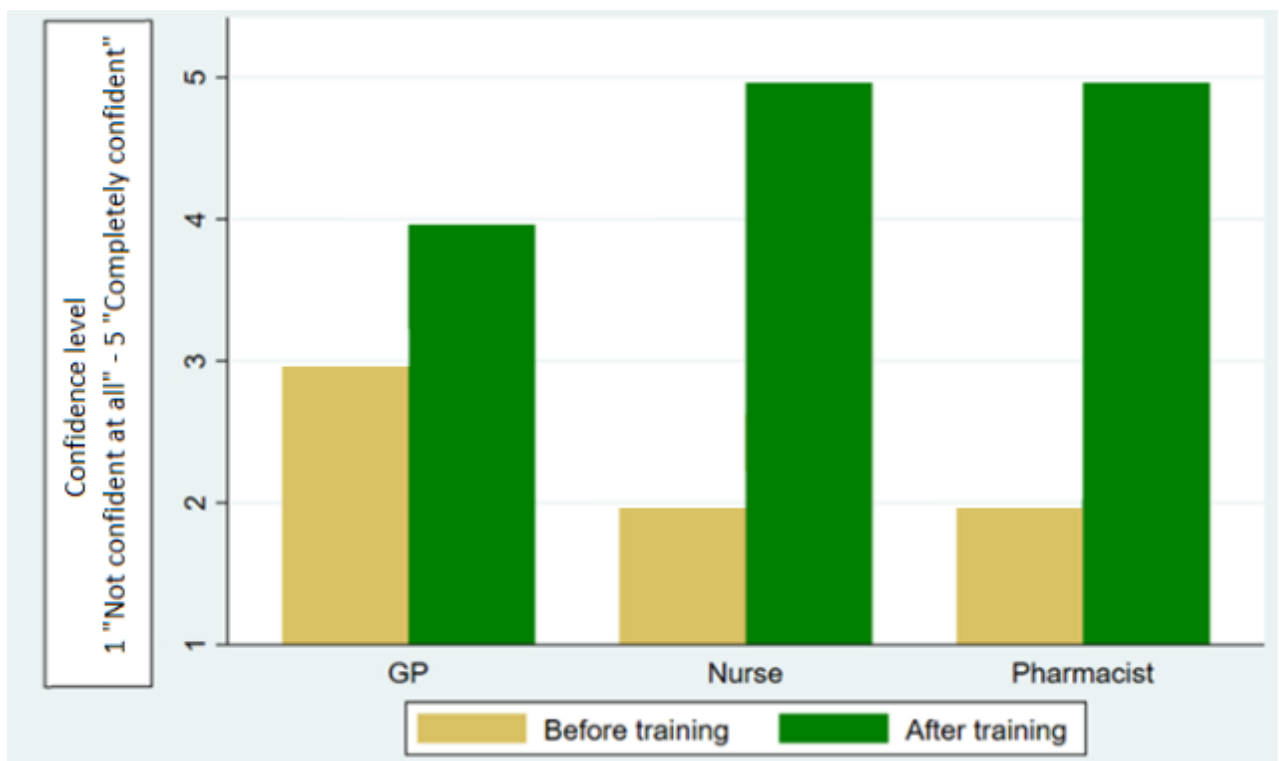
Figure 6. 8. Level of confidence with diagnostic skills for psoriasis before and after training.

The second part of the feedback questionnaire involved completing "Yes" and "No"

questions regarding the technical aspects and length of time required to complete the

whole process starting from answering the demographic questions to the feedback survey.

No participant faced any technical issue and the mean length of time required for

participation was 35 minutes with standard deviation (SD) of 20.31 minutes.

The content analysis of the participants' open-text responses identified number of strengths

and limitations of the training tool. These specific comments were illustrated in tables 6.4

and 6.5.

Table 6. 4: Open-text responses illustrating strengths of the training tool

Comment	Profession	Years of clinical experience
Made me realise there are some gaps in my knowledge	GP	5 years
great course	Pharmacists	3 years
I thought this was helpful and I would recommend it. I thought the cases were well designed to illustrate differential diagnoses which could easily be confused with psoriasis and should be considered. It has also made me read up on those. Thanks	GP	3 years
I loved the course, thanks a lot. P.S. I do not diagnose dermatological conditions; however, I would like to do more courses like that, so it gives me confidence as it gave about chronic plaque psoriasis.	Pharmacists	5 years
Thank you for using different skin colours as this is often a challenge when looking for dermatology training/resources	Nurse	2 years
Good clear steps/guidance/pictures. Some of my initial correct scores were based on years of GP work	GP	25 years
very good course great pictures & helpful to use different skin types & skin tones to aid learning.	GP	1 years
Really useful for training grade doctors. Great pics and detail. Nice approach to learning	GP	20 years
Further training packages like this with good images & description is a good teaching aid. Well done!	Nurse	20 years
brilliant course / really liked to visual tools to help to show the conditions. Very informative and interesting with just right amount of information.	Nurse	18 years

Table 6. 5: Open-text responses illustrating limitations of the training tool

Comment	Profession	Years of clinical experience
would be good to have some information about alternative diagnoses so I could have a better sense of when it is something other than chronic plaque psoriasis	Pharmacists	2.5 years
More detail in training material	Pharmacists	2 years
I would have preferred more pictures of key differentials (like lichen simplex) that we see less often	GP	1 year
The cases of chronic plaque psoriasis were all fairly straightforward, perhaps some trickier ones or broader psoriasis diagnoses would be another useful course to develop.	GP	3 years
More information and pictures on the other diagnoses at the end	GP	6 years
Insufficient information about the other skin conditions mentioned in the training to make a useful comparison.	Nurse	15 years
Audio option of written text. Option to produce a PDF printout of training slides at the end to be kept for reference.	Nurse	12 years
Would be more useful for an ANP or trainee GP level.	GP	16 years
Would be useful to look back at the case study photos along with the information provided in relation to the correct answer.	GP	6 years

6.5. Discussion

The aim of this study was to develop and evaluate the performance of an online training tool in improving the diagnostic ability of primary healthcare professionals (GPs, nurses and pharmacists) for psoriasis and to explore the comparative diagnostic ability of participants at baseline and after the training.

The preliminary results suggest that the newly developed e-learning tool for psoriasis improved the diagnostic ability of participants and that the diagnostic ability of GPs was on average, higher than nurses and pharmacists. This reflects professional training and the required clinical skills to diagnose psoriasis.

The data show that after training, participants report being more confident in making a diagnosis of psoriasis.

Several studies have compared the clinical diagnostic abilities of general practitioners with those of dermatologists. These studies suggested that the primary care practitioners lacked optimal dermatological diagnostic skills. A randomised control trial conducted by Griffiths et. al. (10) to assess the impact of training and guidelines on the management of psoriasis and referral rate to specialist dermatology service found that following guidelines while managing psoriasis in primary care can positively enhance the appropriateness of patient referral to specialist settings.

However. many of the studies on this subject are from Australia and the USA so it is unclear how generalisable these findings may be to the UK setting. A retrospective analysis of referrals to dermatology departments in Australia demonstrated a low concordance in diagnoses between GPs and dermatologists across a whole range of skin conditions

including psoriasis. GPs were only able to diagnose 45% of the skin conditions correctly. The study further reflected on the GPs' low confidence in their diagnostic skills (125). Similarly, a literature review undertaken by Federman et al. (136) compared the diagnostic skills of dermatologists and family physicians in the USA and found that only 52% of family doctors correctly diagnosed skin conditions. Other published work that produced similar findings included a study conducted by Tucker, et. al. (131) which found that in general, the ability of GPs to recognise skin conditions was superior to pharmacists and nurses.

Little is known about the diagnostic ability of nurses for skin conditions. However, it is evident that nurses working in a variety of roles, with varying levels of expertise, are involved in the treatment management of patients with skin disease including the most commonly seen skin conditions in primary care (i.e. acne, eczema and psoriasis). In a survey of 638 638 qualified nurse working in primary care, Courtenay et al. (149) found that only forty-four participants (6.9%) had a postgraduate qualification in dermatology including a diploma and master's degree. However, it is unclear what percentage of these postgraduate qualifications were related to clinical dermatology and the diagnosis of skin conditions such as psoriasis. Furthermore, 433 (68%) had undertaken study periods study (a day or few days) to attend dermatology training courses whilst working in a primary care centre. This may reflect that nurses working in primary care are generally keen to enhance their knowledge in dermatology and that short term training courses are more convenient to serve their goals than long term educational courses (e.g. Diploma and master's degree). This also highlight the importance of offering online training courses to provide more flexibility for the learner.

Similarly, the role of pharmacists in diagnosing and managing skin conditions in primary care setting is under-researched. An exploratory study conducted by Tucker et al., (132) found that the comparative diagnostic ability of pharmacists was less than the diagnostic ability of general practitioners for a range of skin conditions such as tinea corporis which could mimic psoriasis. In another study conducted by Tucker et al (150) self-reporting questionnaire was sent and completed by 818 community pharmacists in England and Wales found that 78% of participants felt that patients seek pharmacists' advice on certain skin problems such as dry skin on a weekly basis. The study also reported that 64.8% had undertaken postgraduate training in dermatology in the form of diploma or master's degree and those agreed that they played an important role in managing patients with skin problems.

Profession appeared to have an impact on the change in diagnostic scores before and after training, suggesting that prior knowledge (i.e., training in undergraduate and/or post graduate level) provided general practitioners more confidence in their diagnostic skills for psoriasis at baseline (before training) than nurses and pharmacists. Even though results from this exploratory investigation suggest that the confidence of nurses and pharmacists in making a diagnosis of psoriasis is higher than that of general practitioners after training, this does not necessarily mean that the training was more beneficial for nurses and pharmacists rather than general practitioners. Nevertheless, this may reflect that general practitioners are aware of the challenges associated with making a diagnosis of psoriasis and that the training helped to refresh their pre-existing knowledge, so they scored higher in the post-training test.

Few of the participants who were general practitioners expressed concerns about the apparent simplicity of the psoriasis cases that were included in the pre and post training

tests. This may reflect the fact that general practitioner's exposure to dermatological problems during their day-to day clinical practice (i.e. experiential learning) provide them with basic concepts and skills which allow them to deal correctly with skin problems more confidently than nurses and pharmacists. However, depending exclusively on experiential learning may limit general practitioners' thoughts when making a list of differential diagnosis of a presenting skin problem (i.e. thinking first of the skin conditions they encounter during their clinical practice). Hence, an additional training course may be a step towards further enhancing their knowledge when managing skin conditions.

Nurses and pharmacists liked the training tool clarity and simplicity, but some general practitioners with few years clinical experience felt it was too limited in terms of the suggested differential diagnoses. This might be justified by the fact that that this exploratory investigation aimed to develop and test the performance of a prototype training tool that uses a novel component which has never been tested before which is the use of medical illustrations of psoriasis. This approach is analogous to bird field guides learning approach where the best ones use indicative paintings rather than photographs.

Furthermore, we intend to use the training tool as part of an instructional sequence that starts when the non-dermatologist learns the consensus agreed clinical diagnostic criteria and ends when the learner knows how to apply these diagnostic criteria in clinical practice to consider or role out chronic plaque psoriasis diagnosis. For the non-trained individual (non-dermatologist such as nurses and pharmacists with very limited exposure to dermatology training), the training tool may limit their thoughts around the possible differential diagnosis for chronic plaque psoriasis to the conditions discussed in the training tool instead of having a wider background knowledge on the conditions that they may

encounter during clinical practice (i.e. conditions that could mick psoriasis starting from

contact dermatitis and ending with more serious skin conditions such as skin malignancies).

While training courses usually offered as adjuncts to help healthcare professionals to

improve their understanding around certain area of disease diagnosis and management,

future work plans were discussed in chapter 7 of this thesis and included recommendations

to validate the performance of the training tool in a larger cohort of participants to ensure

its usefulness in improving diagnostic skills of non-dermatologists and at the same time to

identify key areas of improvement to ensure the training tool usability in different settings

such as lower- and middle-income countries (i.e. poor resource settings).

WHO suggested the need to increase substantially health financing and the recruitment,

development, training and retention of the health workforce in low-resource settings,

especially in least developed countries. The resolution further explained that strengthening

the health workforce means supporting more general practitioners with appropriate

training in the management of skin diseases. Reflecting on these concepts, utilisation of this

training tool and similar training tools should be aimed primarily at general practitioners in

resource limited setting (i.e., economies with limited funding). However, in some parts of

the world with very limited resources (i.e., middle- and lower-income countries) accessibility

to physicians including general practitioners might be challenging. Hence, findings from this

exploratory investigation suggest the need to support the wider multidisciplinary workforce

including pharmacists, nurses and community health workers to help provide care for

patients with psoriasis. Findings from this study suggest that that nurses and pharmacists

showed a significant improvement in their diagnostic skills for chronic plaque psoriasis

following training which means that with properly designed training tools we may enhance

the workforce even more by training healthcare providers other than physicians such as

nurses and pharmacists. Hence, the targeted learner group may be adjusted according to staff availability in a limited resource setting. For example, in an area with only 2 general practitioners and 10 nurses, the training tool may be directed to the nurses' group to serve the needs of the population and enhance the workforce. Adjustments to the training tool may be made to accommodate the existing knowledge and basic skills acquired by the intended learners' group.

It is believed that the results are pertinent to management of psoriasis in non-specialist dermatology settings. Findings from this study tentatively suggest that further training in dermatology for non-dermatologist healthcare providers could be beneficial in terms of early recognition of psoriasis, hence, appropriate and timely treatment approach and less referrals to specialist dermatology clinics. Further work is required to determine the accuracy of these preliminary findings on a larger study population. Furthermore, the training tool could be used as a reference for non-medical investigators while conducting field studies on the incidence and prevalence of psoriasis.

Chapter 7 – Discussion

The aim of this chapter is to discuss the findings of each one of the three component studies and reflect on the implications of the findings for policy and practice. First, I will provide an overview on the main findings in this thesis and reflect on the strengths and potential limitations of the empirical studies. At the end, I will provide recommendations for future research and the overall conclusions.

7.1. Brief summary

The overarching aim of the work presented in this thesis is to understand the pre-diagnostic period and the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK.; develop expert-agreed diagnostic criteria for chronic plaque psoriasis; subsequently applying these criteria to develop a training tool to improve psoriasis diagnosis by non-dermatologists. A case-control study for people with and without psoriasis was first conducted using data collected during routine consultations in primary care settings (chapter 4). This population-based analysis aimed to identify potential opportunities for an earlier diagnosis of psoriasis in primary care settings in the UK. The following step was to develop expert-agreed clinical diagnostic criteria for the most common form of psoriasis (chronic plaque psoriasis) in adults. The clinical diagnostic criteria aimed to facilitate psoriasis case recognition by non-dermatologists (chapter 5). Consequently, the outcome of the e-Delphi study was used to develop a training tool to improve psoriasis diagnosis. The impact of the newly developed training tool was evaluated in a pre- and post-training study (chapter 6). The aim of this discussion chapter is to summarise the key findings from this PhD programme and discuss their contribution to current knowledge. The strengths and limitations of the work are also discussed. In addition, the clinical implications from the findings and the proposals for future research building from this programme are also presented in this chapter.

7.2. Psoriasis diagnosis in primary care settings in the UK

Evidence presented throughout the previous chapters of this thesis suggested that psoriasis represents one of the most frequent reasons for a new dermatological consultation in a primary care setting in the UK (126). Patients with psoriasis are usually managed in primary care, with specialist referral being needed at some point for up to 60% of people (28). Furthermore, it was highlighted in chapter 2 of this thesis that psoriasis could be misdiagnosed as eczema, tinea and pityriasis rosea (86), however; in Chapter 4 (population-based analysis of EHRs), it has been hypothesized that these diagnoses could represent potential opportunities for earlier diagnosis of psoriasis in primary care settings in the UK.

The findings presented in chapter 4 of this thesis suggest that people with psoriasis were frequently reporting symptoms suggestive of psoriasis such as itching, skin rash, skin texture changes (e.g. scale, plaque and crust) and dry skin several years before a diagnosis of psoriasis was recorded which might represent other potential opportunities for earlier diagnosis of psoriasis.

Additionally, people who ended up with a psoriasis diagnosis were frequently prescribed topical corticosteroids and/or topical antifungal medications to treat their skin conditions which might mask symptoms of psoriasis and contribute to potential delay in diagnosis.

The work presented in chapter 4 demonstrated that people who were diagnosed with psoriasis had higher number of visits to their GP from 5 years before diagnosis than those without the disease. This suggest that people with a psoriasis diagnosis may seek additional care when dealing with the symptoms (i.e., itching, skin rash, skin texture changes and dry skin), before their diagnosis of psoriasis being first documented.

To my knowledge this is the first study to explore the pre-diagnostic period of people with psoriasis and to retrospectively analyse EHRs for ten years before diagnosis and compare the findings to those without a psoriasis diagnosis. Findings from this retrospectively analyse of EHR cast new light on health care activities for individuals who ended up with psoriasis diagnosis (within up to 10 years) and argue that potential opportunities for earlier diagnosis of psoriasis may be identified from primary care records.

The main strength of this study is that two case-control studies have been conducted using primary care data delineated from two independent databases, CPRD GOLD and CPRD Aurum. Similar findings were reported from both studies which give validity to the study outcome. Furthermore, due to the wide geographic coverage of both databases, their data considered to be representative of the UK general population in terms of age, gender and ethnicity (95, 102).

More importantly, using EHRs to compare healthcare events between people with and without psoriasis helped to avoid recall bias that is common in traditional retrospective studies (127).

One concern about the findings of this study is that only adults aged 18 years and above were enrolled in this retrospective analysis of medical records. Nevertheless, epidemiological studies showed that the global prevalence of psoriasis is higher in adults than children, thus it was appropriate to start with exploring the potential opportunities for earlier diagnosis of psoriasis in the older age group (age 18 years and above).

The findings from this case-control study promote raising awareness about psoriasis diagnosis among primary care professionals and encourage non-dermatologists to follow

expert agreed diagnostic criteria for chronic plaque psoriasis in order to avoid potential

delay in establishing a timely diagnosis of psoriasis.

7.3. Establishing consensus-agreed diagnostic criteria for psoriasis

Having identified the knowledge gap existing with psoriasis diagnosis through an extensive review of the literature (chapter 2), uniform clinical diagnostic criteria chronic plaque psoriasis in adults were required to serve as a diagnostic tool in clinical and research settings (chapter 5). Research to develop diagnostic criteria has not been prioritized for skin disease and validated clinical diagnostic criteria for different skin conditions were found to be limited. Examples include studies that have developed sets of diagnostic criteria for eczema (128) and Behçet disease (129). In the case of psoriasis, other consensus statements have been produced which cover specific and less common variants of the disease such as pustular psoriasis (32). However, recommendations from the aforementioned study apply to a small subset of psoriasis patients (individuals with pustular disease).

This gap has been addressed for psoriasis in children through research coordinated by Burden-Teh et al, (2019). A consensus study with psoriasis experts has identified 18 criteria to support the diagnosis of chronic plaque psoriasis in children, focusing on the clinical appearance of skin lesions and their anatomical sites (91). Diagnostic accuracy of these diagnostic criteria was then tested and used to develop the best predictive model for psoriasis in children (aged < 18 years) (111). Due to the possible different clinical presentations of psoriasis in children and adults, it was then appropriate to revisit this research question to develop clinical diagnostic criteria for chronic plaque psoriasis in adults.

Three rounds of an international e-Delphi study with 50 members of the IPC were conducted to reach consensus on clinical examination-based diagnostic criteria for chronic plaque psoriasis in adults (age 18 years and above). The consensus exercise yielded 9 clinical diagnostic items with one criterion being designated as essential and 8 criteria being supportive criteria. Consensus ratings determined that the clinical diagnosis of chronic plaque psoriasis requires the presence of the essential criterion plus four or more of the supportive clinical diagnostic criteria.

Additionally, a general definition of chronic plaque psoriasis was suggested to help signpost the most commonly affected body sites by psoriasis.

The main strengths of this study include firstly the clinical examination-based diagnostic criteria for chronic plaque psoriasis in adults were based on input from international clinical experts. The expert panel represented a diverse sample of clinicians, with most of them having more than 20 years of clinical experience in managing psoriasis patients reflecting high level of experience and skills within the recruited group. Second, due to the web-based survey approach of this Delphi exercise, geographical limitations were overcome. It has been established that psoriasis may present differently on different skin colours (130), the characteristic red/pink well-demarcated plaque that is covered with silvery/white scales on lighter skin colour is less evident on darker skin colour. Psoriasis lesions on darker skin mostly appear grey in colour rather than red/pink colour which make the diagnosis even more challenging for the non-experienced eye. Participants represented a population of expert dermatologists from 27 countries across six continents. Such diverse inclusion of experts from different geographical regions helped collation of evidence on the clinical diagnosis of chronic plaque psoriasis across wide ethnic backgrounds. One of the supportive

criteria `Lesions are pink to red in colour. In deeply pigmented skin, lesions may be grey in colour' captured the different clinical presentations of chronic plaque psoriasis in skin of varying colour.

The main limitation of this e-Delphi exercise is that it only included recommendation for chronic plaque psoriasis diagnosis on adults aged 18 years and above. However, it is difficult to establish a standardised diagnostic tool that covers the entire spectrum of psoriasis patients. Challenges include the fact that psoriasis lesions may present differently in different age groups (12), skin colour (18) and affected body sites (20). Important consideration when interpreting the results of this exercise is that the diagnostic dataset is intended to guide the clinical diagnosis of chronic plaque psoriasis in non-specialist dermatology setting.

7.4. Improving the diagnostic skills of non-dermatologists using newly developed training tool for psoriasis.

Difficulties do not only arise with recognising clinical features of psoriasis, but also in correctly educating healthcare professionals about psoriasis diagnosis. It has been established that despite the relatively high incidence of skin disorders in the community, dermatology training is still overlooked in the curriculum of undergraduate and postgraduate medical training (123, 124). Furthermore, one area where there has been limited research and yet a significant demand for primary care support is dermatology. Previous studies have investigated the diagnostic ability of primary care professionals (e.g. GPs, nurses and pharmacists) and found that they may lack optimal dermatological diagnostic skills for a wide range of skin conditions (125, 131-134). A randomised control

trial conducted by Griffiths et al (2006) to assess the impact of training and guidelines on the management of psoriasis and referral rate to specialist dermatology service found that following guidelines while managing psoriasis in primary care can positively enhance the appropriateness of patients' referral to specialist settings (135).

A retrospective analysis of referrals to dermatology departments in Australia demonstrated a low concordance in diagnoses between GP and dermatologists across a whole spectrum of skin conditions including psoriasis. GPs were only able to diagnose 45% of the skin conditions correctly. The study further reflected on the GPs' low confidence in their diagnostic skills for a range of skin conditions one of which was psoriasis (125). Similarly, a literature review undertaken by Federman et al (136) compared the diagnostic skills of dermatologists and family physicians in the USA and found that only 52% of family doctors correctly diagnosed skin conditions. Indeed, the above discussed studies (125, 136) were from Australia and the United States so it is unclear how generalisable these findings may be in the UK.

Other published work compared the diagnostic ability of primary care professionals including GPs, nurses and pharmacists found that in general, the ability of GPs to recognise skin conditions was superior to pharmacists and nurses (132). To address this problem, additional training in diagnosing skin conditions such as psoriasis need to be offered to primary care professionals during their clinical training.

As explained earlier in chapter 1 of this thesis, this PhD programme presents an evolving project were each research question builds on the findings from earlier chapter. Hence, the outcome of the e-Delphi consensus exercise to develop clinical diagnostic criteria for chronic plaque psoriasis in adults (chapter 5) were used to develop an educational tool for primary

healthcare professionals (GPs, nurses and pharmacists) to help them improve their diagnostic skills for psoriasis. A total of 60 participants completed the study (20 per health professional group). Participants were employed in general practices in the Northwest of England, mainly in the Greater Manchester and Liverpool regions. The study findings suggest that a newly developed e-learning tool for psoriasis improved the diagnostic ability of primary care practitioners and that the diagnostic ability of GPs is, on average, were higher than nurses and pharmacists. Thus, reflecting an association between profession and required clinical skills to diagnose psoriasis.

In addition, data suggests that after training, participants were more confident in making a diagnosis of psoriasis.

The main strength of this study is that the training materials were based on the findings from a recent international e-Delphi exercise to develop clinical examination-based diagnostic criteria for chronic plaque psoriasis in adults (137). As outlined in chapter 5 of this thesis, the outcome of the e-Delphi exercise is applicable to a wide range of ethnic backgrounds (i.e., different skin colours) and thus the training tool included recommendation on how to recognise psoriasis on lighter as well as darker skin colour. Furthermore, the training tool included a visual aid in the form of illustrations and clinical images for psoriasis to help support understanding of the written training material. The lack of representative clinical images for skin conditions especially for individuals with darker skin has been highlighted in recent literature (138). To overcome this challenge, medical illustrations were used to compensate for the limited availability of such clinical images. The use of medical illustrations for this study has been proposed by an experienced dermatologist (CEMG). An additional strength of this study is that it has been delivered

entirely online. Virtual delivery of this training course helped to overcome geographical limitations and provided flexibility for interested individuals to take part at their convenience. A possible limitation of this study is the use of a convenience sampling approach. The justification of the use of this sampling approach is time and resource restrictions. The small number of participants in each group may restrict the generalisability of the findings. However, the present study was conducted as a feasibility testing of the impact of the newly developed training tool on improving the diagnostic skills of healthcare professionals.

The findings from this study suggested that further training in dermatology for healthcare professionals could be beneficial in terms of early recognition of psoriasis, hence, appropriate and timely treatment approach and less referrals to specialist dermatology clinics.

7.5. Implications for clinical practice and policy

The findings in this thesis will be of interest to the clinical community especially non-dermatologists (e.g. primary healthcare professionals) and to those involved in psoriasis diagnosis and management where access to specialist dermatology care is limited such as in lower- and middle-income countries. Findings documented in this thesis will also be of interest to researchers conducting epidemiological field studies on the incidence and prevalence of psoriasis and those conducting clinical trials where uniform definition of chronic plaque psoriasis case is required to set accurate inclusion and exclusion criteria for study participants.

Together, the information gained from these studies can be positioned to provide a clearer picture of the possible opportunities to improve accurate and timely diagnosis of psoriasis. Hence, it could enhance better management outcome. Furthermore, findings in this thesis represent an action taken to address the issue of delayed psoriasis diagnosis that was highlighted by the WHO in their recent report on the global burden of psoriasis in 2014 and the Priority Setting Partnership (PSP) in their meeting to address unanswered questions about psoriasis (139). The PSP aimed to identify unmet needs and unanswered questions about psoriasis, which, if addressed by research, could improve clinical outcomes for patients. Ten research questions from people with psoriasis, their careres and healthcare professionals were agreed (139). two of these top ten questions were related to the work presented in this thesis:

1.   Does treating psoriasis early (or proactively) reduce the severity of the disease, make it more likely to go into remission, or stop other health conditions developing?

1.   Does treating psoriasis help improve other health conditions, such as psoriatic arthritis, cardiovascular disease, metabolic syndrome, and stress?

For the practicing physician, the outcome of this study may help to alert physicians to consider psoriasis among other differential diagnosis when the patient present with the following medical history and symptoms and signs of a skin condition:

1.   Frequent visits to their GP regarding skin problems.

2.   Being diagnosed with seborrhoeic dermatitis, other eczema (including contact dermatitis, atopic dermatitis, neurodermatitis, discoid eczema, asteatotic eczema and hand dermatitis), tinea corporis, candida skin infections and/or pityriasis rosea in the past yet not being satisfied with the treatment outcome.

3.   Frequently complaining of itching, dry skin, rash and skin texture changes (scale, plaque and crust).

4.   Using topical corticosteroids and/or topical antifungal medication as prescribed by their clinician and or pharmacists with no or minimal improvement.

Physicians and other healthcare professionals involved in psoriasis diagnosis (such as primary care and community pharmacists and nurses) should be well informed about the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK and are encouraged to follow the consensus agreed clinical diagnostic criteria for when suspecting a diagnosis of psoriasis (137).

The outcome from this thesis is of particular importance to healthcare professionals involved in psoriasis diagnosis and management in resource poor settings. The WHO has highlighted that specialist dermatology care is unavailable for the majority of people living

with psoriasis, especially in low- and middle-income countries (51). The population-based analysis reported in chapter 4 of this thesis was conducted using primary-care data in the UK. So, the generalisability of the study findings to other countries is still unknow. Yet, findings from this study could be used to acknowledge healthcare professionals about patterns of skin disease leading to the diagnosis of psoriasis. It has been reported that people with psoriasis in countries with poor access to specialist dermatology care are misdiagnosed with other skin conditions such as eczema, fungal infections and pityriasis rosea. Thus, they might be prescribed with topical medications that could mask symptoms of psoriasis and contribute to a further delay in diagnosis (140).

To address this, it is required to increase the capacity of the healthcare workforce through specifically designed training courses to enhance the knowledge of physicians (non-dermatologists) and other health-care providers such as nurses and community health workers. Thus, contributing to a faster dermatological diagnosis in countries where there is a lack of skin care specialists. An example of the work initiated to support the education of healthcare professionals for dermatological conditions is the Regional Dermatology Training Centre (RDTC) in the United Republic of Tanzania which was established by the International Foundation for Dermatology (IFD) (1992). In 2019, The Global Psoriasis Atlas (GPA) conducted a workshop to educate healthcare professionals and medical students in the RDTC in Tanzania on psoriasis diagnosis and management (140). Similar training workshops may benefit from the newly developed training tool to enhance the learning experience. Another potential use of this training tool is in educational masterclasses, online webinars and outreach programmes organised by dermatology lead research organisations such as the IPC which aims to improve the care for people with psoriasis through education and research.

The use of online training tool to educate healthcare professionals about psoriasis is especially related to the current surge in the utilisation of telemedicine (specifically tele dermatology) specifically during the COVID-19 pandemic which resulted in extra challenge in providing face to face educational events.

The training tool could also be used as a reference for medical students and junior doctors to help them improve their diagnostic skills for psoriasis.

Early diagnosis of psoriasis may help to initiate timely, targeted and person-specific treatment. It may also promote advice about psoriasis and lifestyle as early as possible in the disease course. Lifestyle changes such as the participation in physical activities, weight management, reducing alcohol intake and smoking cessation have been suggested as possible favourable psoriasis disease course-modifiers (50, 84, 141). More importantly, early recognition of psoriasis helps to screen and follow-up for comorbidities (e.g. PsA and CVD) thereby improving disease course and burden and minimise the chance of cumulative life-course impairment (142-144).

Finally, findings from this thesis are also of importance to researchers involved in epidemiological field studies for psoriasis (i.e., studies on the incidence and prevalence of psoriasis). Applying the consensus agreed diagnostic criteria will help non-medical research investigators to produce comparable epidemiological data. The newly developed training tool could be used as an educational resource for research investigators to help them apply the diagnostic criteria of chronic plaque psoriasis in their field research for psoriasis. It has been suggested that variation of prevalence estimates may be caused by a lack of standardized definitions for an incident case of psoriasis (145). Hence, the key to

harmonizing global data will be a standardised approach to its collection and analysis (i.e., following consensus agreed diagnostic criteria) (145).

7.6. Recommendations for future research

Future recommendations for research arising from this PhD project include validating and testing the reliability of the clinical examination-based diagnostic criteria for chronic plaque psoriasis in a multicentre specialist dermatology setting (i.e., secondary care) in the UK and to develop the best predictive diagnostic model for chronic plaque psoriasis in adults. The outcome of the validation study could then be used as a framework to test the accuracy of the best predictive diagnostic model in a multicentre international setting including non-dermatology settings such as in parts of the world where access to specialist dermatology care is restricted (e.g. middle-lower income countries).

Furthermore, future work may be needed to investigate the pre-diagnostic period of psoriasis using data from specialist dermatology settings to explore whether opportunities for earlier diagnosis of psoriasis could be identified from secondary care data and subsequently applying solutions to overcome the issue of delayed diagnosis of psoriasis. Such studies could be conducted using linked secondary care data such as HES database.

Future work may also be undertaken to confirm the preliminary findings obtained from the newly developed training tool study in a larger population of participants. Such follow-up study could be conducted in a sample of international healthcare professionals (non-dermatologists) that could be recruited online. Further work may also be needed to test the effectiveness of the newly developed training tool in improving diagnostic skills of physicians and other healthcare professionals for psoriasis in resource poor settings.

It is also recommended that emerging technologies in the field of diagnostic dermatology such as molecular medicine (119) and machine learning algorithms (146) should be considered in psoriasis diagnosis. However, until additional evidence is established, clinical diagnosis of psoriasis is the reference standard that other methods of diagnosis should be validated against.

7.7. Limitations

The work presented in this thesis had a number of limitations specifically related to each one of the three conducted research studies. First, in chapter 4 of this thesis, analysis of EHR investigated patients' journeys before first diagnosis of psoriasis is recoded by general practitioner. However, participants were only included if they were 18 years of age when they first diagnosed with psoriasis. Nevertheless, epidemiological studies showed that the global prevalence of psoriasis is higher in adults than children, thus it was appropriate to start with exploring the potential opportunities for earlier diagnosis of psoriasis in the older age group (age 18 years and above). Future research recommendations that were discussed in chapter 7 of this thesis included suggestions to conduct similar longitudinal analysis of electronic health records targeting the younger age group (i.e. people aged less than 18 years when they first received psoriasis diagnosis).

Second, the main limitation of the e-Delphi exercise presented in chapter 5 of this thesis is that it only included recommendation for chronic plaque psoriasis diagnosis on adults aged 18 years and above. However, it is difficult to establish a standardised diagnostic tool that covers the entire spectrum of psoriasis patients. Challenges include the fact that psoriasis lesions may present differently in different age groups (12), skin colour (18) and affected body sites (20). Important consideration when interpreting the results of this exercise is that the diagnostic dataset is intended to guide the clinical diagnosis of chronic plaque psoriasis in non-specialist dermatology setting.

Third, for the training tool study discussed in chapter 6 of this thesis, a possible limitation of this study is the use of a convenience sampling approach. The justification of the use of this sampling approach is time and resource restrictions. The small number of participants in

each group may restrict the generalisability of the findings. However, the present study was conducted as a feasibility testing of the impact of the newly developed training tool on improving the diagnostic skills of healthcare professionals.

7.8. Conclusions

The work presented in this thesis documents a stepwise approach to improve psoriasis diagnosis in non-specialist dermatology settings. Healthcare providers, especially non-dermatologists, should be aware of the potential opportunities for earlier diagnosis of psoriasis and should be encouraged to follow the consensus agreed clinical diagnostic criteria to prevent detrimental delay in establishing diagnosis of psoriasis. Special attention should be made to expand the capacity of the healthcare providers for psoriasis diagnosis and management. Healthcare organisations should provide dermatology training for non-dermatologists (such as primary healthcare physicians, nurses and pharmacists) to improve their diagnostic skills for psoriasis. This is crucially important for settings where access to specialist dermatology care is restricted. It is also recommended to consider other solutions such as tele-dermatology in those parts of the world with restricted access to specialist dermatology care.

Reflecting on the multiple hypothesis presented in chapter 2 of this thesis, I suggest that several factors may contribute to the delayed diagnosis of psoriasis in non-specialist dermatology settings such as in primary care settings or in those parts of the world where access to specialist dermatology setting is restricted such as in lower-middle income countries. Such factors include the absence of well-defined and validated diagnostic criteria for psoriasis (12) and the limited dermatology knowledge and training of primary care professionals (13). On the other hand, many studies on the incidence and prevalence of psoriasis reported inconsistencies in the epidemiological data due to the non-standardised psoriasis case definition (1, 2).

To address these problems, detailed investigation of the pre-diagnostic period and the patterns of skin disease leading to the diagnosis of psoriasis in primary care setting in the UK was conducted as shown in chapter 4 of this thesis and showed that potential opportunities for an earlier diagnosis of psoriasis in primary care setting may be present from five years prior to psoriasis diagnosis. Hence, suggesting possible delays in psoriasis diagnosis of up to five years for some individuals.

Developing a standardised approach for psoriasis diagnosis to be used in clinical and research settings could play a vital role in improving care for psoriasis patients and producing more reliable epidemiological data. Hence the work presented in chapter 5 of this thesis was intended to standardise psoriasis case definition in clinical and research setting. This is especially important to help non-dermatologist investigators identify psoriasis cases particularly in resource poor settings. Development of a clinical diagnostic tool for the most common type of psoriasis, chronic plaque psoriasis, will also help to provide better medical care in terms of earlier diagnosis and treatment.

Additionally, since non-dermatologists such as primary care professionals are the first point of contact for psoriasis patients in many countries including the United Kingdom, it is important for them to be able to diagnosis the disease and to differentiate between psoriasis and other skin conditions mimicking psoriasis in its clinical presentation. The aim of the work presented in chapter 6 of this thesis was then to develop and evaluate the performance of an online training tool in improving the diagnostic ability of primary healthcare professionals (GPs, nurses and pharmacists) for psoriasis and to explore the comparative diagnostic ability of participants at baseline and after the training. The preliminary results suggest that the newly developed e-learning tool for psoriasis improved

the diagnostic ability of participants, and that the diagnostic ability of GPs was on average, higher than nurses and pharmacists. This reflects professional training and the required clinical skills to diagnose psoriasis.

References

1.   Parisi R, Iskandar IY, Kontopantelis E, Augustin M, Griffiths CEM, Ashcroft DM. National, regional and worldwide epidemiology of psoriasis: systematic analysis and modelling study. BMJ. 2020;369.

2.   Iskandar I, Parisi R, Griffiths CEM, Ashcroft D, Atlas GP. Systematic review examining changes over time and variation in the incidence and prevalence of psoriasis by age and gender. Br J Dermatol. 2021;184(2):243-58.

3.   Martínez-García E, Arias-Santiago S, Valenzuela-Salas I, Garrido-Colmenero C, García-Mellado V, Buendía-Eisman A. Quality of life in persons living with psoriasis patients. J Am Acad Dermatol. 2014;71(2):302-7.

4.   Griffiths CEM, Barker JN. Pathogenesis and clinical features of psoriasis. The Lancet. 2007;370(9583):263-71.

5.   Dalal G, Wright SJ, Vass CM, Davison NJ, Vander Stichele G, Smith CH, et al, PSORT consortium. Patient preferences for stratified medicine in psoriasis: a discrete choice experiment. Br J Dermatol. 2021;185(5):978-87.

6.   Yiu ZZ, Barker JN, Barnes MR, Di Meglio P, Emsley R, Reynolds NJ, et al, PSORT Consortium. Meeting Report: Psoriasis Stratification to Optimize Relevant Therapy Showcase. J Invest Dermatol.2021;141(8):1872-8.

7.   Griffiths CE, Barnes MR, Burden AD, Nestle FO, Reynolds NJ, Smith CH, et al, Psort Consortium. Establishing an academic-industrial stratified medicine consortium: psoriasis stratification to optimize relevant therapy. J Invest Dermatol. 2015; 135(12):2903-7.

8.   Griffiths CEM, Armstrong AW, Gudjonsson JE, Barker JNWN. Psoriasis. The Lancet. 2021;397(10281):1301-15

9.   Ladizinski B, Lee KC, Wilmer E, Alavi A, Mistry N, Sibbald RG. A review of the clinical variants and the management of psoriasis. Adv Skin Wound Care. 2013; 26(6):271-84.

10.   Langley R, Krueger G, Griffiths CEM. Psoriasis: epidemiology, clinical features and quality of life. Ann Rheum Dis. 2005; 64 (suppl 2):ii18-ii23.

11.   Lisi P. Differential diagnosis of psoriasis. Reumatismo. 2007;59(s1):56-60.

12.   Burden-Teh E, Phillips R, Thomas K, Ratib S, Grindlay D, Murphy R. A systematic review of diagnostic criteria for psoriasis in adults and children: evidence from studies with a primary aim to develop or validate diagnostic criteria. Br J Dermatol. 2018;178(5):1035-43.

13.   Young M, Aldredge L, Parker P. Psoriasis for the primary care practitioner. J Am Assoc Nurse Pract. 2017; 29(3):157-78.

14.	Henseler T, Christophers E. Psoriasis of early and late onset: characterization of two types of psoriasis vulgaris. J Am Acad Dermatol. 1985;13(3):450-6.

15.	Pathirana D, Ormerod AD, Saiag P, Smith C, Spuls PI, Nast A, et al European S3-guidelines on the systemic treatment of psoriasis vulgaris. J Eur Acad Dermatol Venereol. 2009;23 Suppl 2:1-70.

16.	Naldi L, Gambini D. The clinical spectrum of psoriasis. Clin Dermatol. 2007;25(6):510-8.

17.	Cohen S, Baron S, Archer C, British Association of Dermatologists and Royal College of General Practitioners. Guidance on the diagnosis and clinical management of psoriasis. Clin Exp Dermatol. 2012;37:13-8.

18.	Kaufman BP, Alexis AF. Psoriasis in skin of color: insights into the epidemiology, clinical presentation, genetics, quality-of-life impact and treatment of psoriasis in non-white racial/ethnic groups. Am J Clin Dermatol. 2018;19(3):405-23.

19.	Menter A, Gottlieb A, Feldman SR, Van Voorhees AS, Leonardi CL, Gordon KB, et al Guidelines of care for the management of psoriasis and psoriatic arthritis: Section 1. Overview of psoriasis and guidelines of care for the treatment of psoriasis with biologics. J Am Acad Dermatol. 2008;58(5):826-50.

20.	Johnson MAN, Armstrong AW. Clinical and histologic diagnostic guidelines for psoriasis: a critical review. Clin Rev Allergy Immunol. 2013;44(2):166-72.

21.	Griffiths CEM, Christophers E, Barker J, Chalmers R, Chimenti S, Krueger G, et al A classification of psoriasis vulgaris according to phenotype. Br J Dermatol. 2007;156(2):258-62.

22.	Ferguson F, Lada G, Hunter H, Bundy C, Henry AL, Griffiths CEM, et al Diurnal and seasonal variation in psoriasis symptoms. J Eur Acad Dermatol Venereol. 2020; 35(1):e45-e47.

23.	Chalmers R, O'Sullivan T, Owen C, Griffiths CEM. A systematic review of treatments for guttate psoriasis. Br J Dermatol. 2001;145(6):891-4.

24.	Raychaudhuri SK, Maverakis E, Raychaudhuri SP. Diagnosis and classification of psoriasis. Autoimmun Rev. 2014;13(4-5):490-5.

25.	Boehncke W, Schön M. Psoriasis. Psoriasis Lancet. 2015:983-94.

26.	Zhao G, Feng X, Na A, Jiang Y, Cai Q, Kong J, et al Acute guttate psoriasis patients have positive streptococcus hemolyticus throat cultures and elevated antistreptococcal M6 protein titers. J dermatol. 2005;32(2):91-6.

27.   Naldi L, Peli L, Parazzini F, Carrel CF, Psoriasis Study Group of the Italian Group for Epidemiological Research in Dermatology. Family history of psoriasis, stressful life events and recent infectious disease are risk factors for a first episode of acute guttate psoriasis: results of a case-control study. J Am Acad Dermatol. 2001;44(3):433-8.

28.   National Institute for Health and Care Excellence. Psoriasis overview. 2012 [13/05/22]. Available from: https://pathways.nice.org.uk/pathways/psoriasis#path=view%3A/pathways/psoriasis/psoriasis-overview.xml&content=view-index.

29.   Raboobee N, Aboobaker J, Jordaan HF, Sinclair W, Smith JM, Todd G, et al Guidelines on the management of psoriasis in South Africa. S Afr Med J. 2010;100(4):255-86.

30.   Twelves S, Mostafa A, Dand N, Burri E, Farkas K, Wilson R, et al Clinical and genetic differences between pustular psoriasis subtypes. J Allergy Clin Immunol. 2019;143(3):1021-6.

31.   Griffiths CEM, Barker J, Bleiker TO, Chalmers R, Creamer D, editors. Rook's Textbook of Dermatology, 9th ed. UK: Wiley-Blackwell; 2016.

32.   Navarini AA, Burden AD, Capon F, Mrowietz U, Puig L, Köks S, et al European consensus statement on phenotypes of pustular psoriasis. J Eur Acad Dermatol Venereol. 2017;31(11):1792-9.

33.   Baran R. The burden of nail psoriasis: an introduction. Dermatology. 2010;221(Suppl. 1):1-5.

34.   Jiaravuthisan MM, Sasseville D, Vender RB, Murphy F, Muhn CY. Psoriasis of the nail: anatomy, pathology, clinical presentation and a review of the literature on therapy. J Am Acad Dermatol. 2007;57(1):1-27.

35.   Crowley JJ, Weinberg JM, Wu JJ, Robertson AD, Van Voorhees AS. Treatment of nail psoriasis: best practice recommendations from the Medical Board of the National Psoriasis Foundation. JAMA dermatology. 2015;151(1):87-94.

36.   Armesto S, Esteve A, Coto-Segura P, Drake M, Galache C, Martínez-Borra J, et al Nail psoriasis in individuals with psoriasis vulgaris: a study of 661 patients. Actas Dermosifiliogr. 2011;102(5):365-72.

37.   Raposo I, Torres T. Nail psoriasis as a predictor of the development of psoriatic arthritis. Actas Dermosifiliogr. 2015;106(6):452-7.

38.   Zeng J, Luo S, Huang Y, Lu Q. Critical role of environmental factors in the pathogenesis of psoriasis. J dermatol. 2017;44(8):863-72.

39. Kimball AB, Gladman D, Gelfand JM, Gordon K, Horn EJ, Korman NJ, et al National Psoriasis Foundation clinical consensus on psoriasis comorbidities and recommendations for screening. J Am Acad Dermatol. 2008;58(6):1031-42.

40. Miller IM, Ellervik C, Yazdanyar S, Jemec GB. Meta-analysis of psoriasis, cardiovascular disease and associated risk factors. J Am Acad Dermatol. 2013;69(6):1014-24.

41. Parisi R, Rutter MK, Lunt M, Young HS, Symmons DP, Griffiths CEM, et al Psoriasis and the risk of major cardiovascular events: cohort study using the clinical practice research datalink. J Investig Dermatol. 2015;135(9):2189-97.

42. Mottillo S, Filion KB, Genest J, Joseph L, Pilote L, Poirier P, et al The metabolic syndrome and cardiovascular risk: a systematic review and meta-analysis. JACC. 2010;56(14):1113-32.

43. Mulder DJ, Noble AJ, Justinich CJ, Duffin JM. A tale of two diseases: the history of inflammatory bowel disease. J Crohns Colitis. 2014;8(5):341-8.

44. Skroza N, Proietti I, Pampena R, La Viola G, Bernardini N, Nicolucci F, et al Correlations between psoriasis and inflammatory bowel diseases. BioMed Res. Int. 2013;2013.

45. Lee SH, eun Kwon J, Cho M-L. Immunological pathogenesis of inflammatory bowel disease. Intest Res. 2018;16(1):26.

46. Gladman DD. Psoriatic arthritis. Dermatol. Ther. 2009; 22(1)40-55.

47. Orbai A-M, De Wit M, Mease P, Shea JA, Gossec L, Leung YY, et al International patient and physician consensus on a psoriatic arthritis core outcome set for clinical trials. Ann Rheum Dis. 2017;76(4):673-80.

48. Burden A, Boon MH, Leman J, Wilson H, Richmond R, Ormerod A. Diagnosis and management of psoriasis and psoriatic arthritis in adults: summary of SIGN guidance. BMJ. 2010;341 :c5623.

49. Abuabara K, Azfar R, Shin D, Neimann A, Troxel A, Gelfand J. Cause-specific mortality in patients with severe psoriasis: a population-based cohort study in the UK. Br J Dermatol. 2010;163(3):586-92.

50. Trafford AM, Parisi R, Kontopantelis E, Griffiths CEM, Ashcroft DM. Association of psoriasis with the risk of developing or dying of cancer: a systematic review and meta-analysis. JAMA dermatology. 2019;155(12):1390-403.

51. WHO. Global Report on Psoriasis. Geneva: WHO; 2016. Available from: http://apps.who.int/iris/bitstream/10665/204417/1/9789241565189_eng.pdf.last (Last accesses 11 May 2022).

52.   Finlay AY, Khan G, Luscombe DK, Salek M. Validation of sickness impact profile and psoriasis disability index in psoriasis. Br J Dermatol. 1990;123(6):751-6.

53.   Rapp SR, Feldman SR, Exum ML, Fleischer Jr AB, Reboussin DM. Psoriasis causes as much disability as other major medical diseases J Am Acad Dermatol. 1999;41(3):401-7.

54.   Feldman SR. Psoriasis causes as much disability as other major medical diseases. J Am Acad Dermatol. 2020;82(1):256-7.

55.   Kleyn CE, Talbot PS, Mehta NN, Sampogna F, Bundy C, Ashcroft DM, Kimball AB, Van de Kerkhof P, Griffiths CE, Valenzuela F, Van Der Walt JM. Psoriasis and mental health workshop report: exploring the links between psychosocial factors, psoriasis, neuroinflammation and cardiovascular disease risk. Acta Derm Venereol. 2020 Jan 31;100:1-8.

56.   Parisi R, Webb R, Kleyn C, Carr M, Kapur N, Griffiths CEM, et al Psychiatric morbidity and suicidal behaviour in psoriasis: a primary care cohort study. Br J Dermatol. 2019;180(1):108-15.

57.   Kimball AB, Jacobson C, Weiss S, Vreeland MG, Wu Y. The psychosocial burden of psoriasis. Am J Clin Dermatol. 2005;6(6):383-92.

58.   Warren R, Kleyn C, Gulliver W. Cumulative life course impairment in psoriasis: patient perception of disease-related impairment throughout the life course. Br J Dermatol. 2011;164:1-14.

59.   Kimball A, Gieler U, Linder D, Sampogna F, Warren R, Augustin M. Psoriasis: is the impairment to a patient's life cumulative? J Eur Acad Dermatol Venereol. 2010;24(9):989-1004.

60.   Bożek A, Reich A. The reliability of three psoriasis assessment tools: psoriasis area and severity index, body surface area and physician global assessment. Adv Clin Exp Med. 2017;26(5):851-6.

61.   Spuls PI, Lecluse LL, Poulsen M-LN, Bos JD, Stern RS, Nijsten T. How good are clinical severity and outcome measures for psoriasis?: quantitative evaluation in a systematic review. J Investig Dermatol. 2010;130(4):933-43.

62.   Chularojanamontri L, Griffiths CEM, Chalmers RJ. The Simplified Psoriasis Index (SPI): a practical tool for assessing psoriasis. J Investig Dermatol. 2013;133(8):1956-62.

63.   Strober B, Ryan C, van de Kerkhof P, van der Walt J, Kimball AB, Barker J, et al Recategorization of psoriasis severity: Delphi consensus from the International Psoriasis Council. J Am Acad Dermatol. 2020;82(1):117-22.

64. Augustin M, Alvaro-Gracia J, Bagot M, Hillmann O, van de Kerkhof P, Kobelt G, et al A framework for improving the quality of care for people with psoriasis. J Eur Acad Dermatol Venereol. 2012;26:1-16.

65. Basra M, Fenech R, Gatt R, Salek M, Finlay AY. The Dermatology Life Quality Index 1994–2007: a comprehensive review of validation data and clinical results. Br J Dermatol. 2008;159(5):997-1035.

66. Kirby B, Fortune D, Bhushan M, Chalmers R, Griffiths CEM. The Salford Psoriasis Index: an holistic measure of psoriasis severity. Br J Dermatol. 2000;142(4):728-32.

67. Kitchen H, Cordingley L, Young H, Griffiths CEM, Bundy C. Patient-reported outcome measures in psoriasis: the good, the bad and the missing! Br J Dermatol. 2015;172(5):1210-21.

68. Scottish Intercollegiate Guidelines Network (SIGN). Diagnosis and management of psoriasis and psoriatic arthritis in adults. 2010 [10/05/22]. Available from: https://www.sign.ac.uk/media/1059/sign121.pdf.

69. Armstrong AW, Read C. Pathophysiology, clinical presentation and treatment of psoriasis: a review. JAMA. 2020;323(19):1945-60.

70. Uva L, Miguel D, Pinheiro C, Antunes J, Cruz D, Ferreira J, et al Mechanisms of action of topical corticosteroids in psoriasis. Int J Endocrinol, 2012 (2012), p. 561018.

71. Mason J, Mason A, Cork M. Topical preparations for the treatment of psoriasis: a systematic review. Br J Dermatol. 2000;142(3):351-64.

72. Coondoo A, Phiske M, Verma S, Lahiri K. Side-effects of topical steroids: A long overdue revisit. Indian Dermatol Online J. 2014;5(4):416.

73. Van de Kerkhof PC, Franssen ME. Psoriasis of the scalp. Am J Clin Dermatol. 2001;2(3):159-65.

74. Wong T, Hsu L, Liao W. Phototherapy in psoriasis: a review of mechanisms of action. J Cutan Med Surg. 2013;17(1):6-12.

75. Kalb RE, Strober B, Weinstein G, Lebwohl M. Methotrexate and psoriasis: 2009 National Psoriasis Foundation consensus conference. J Am Acad Dermatol. 2009 May 1;60(5):824-37.

76. West J, Ogston S, Foerster J. Safety and efficacy of methotrexate in psoriasis: a meta-analysis of published trials. PloS One. 2016;11(5):e0153740.

77. Griffiths CEM, Dubertret L, Ellis C, Finlay A, Finzi A, Ho VC, et al Ciclosporin in psoriasis clinical practice: an international consensus statement. Br J Dermatol. 2004;150:11-23.

78.   Menter A, Griffiths CEM. Current and future management of psoriasis. The Lancet. 2007;370(9583):272-84.

79.   Sbidian E, Chaimani A, Afach S, Doney L, Dressler C, Hua C, et al Systemic pharmacological treatments for chronic plaque psoriasis: a network meta-analysis. Cochrane Database Syst. 2020(1): CD011535.

80.   Smith C, Jabbar-Lopez Z, Yiu Z, Bale T, Burden A, Coates L, et al British Association of Dermatologists guidelines for biologic therapy for psoriasis 2017. Br J Dermatol. 2017;177(3):628-36.

81.   Yiu ZZ, Smith CH, Ashcroft DM, Lunt M, Walton S, Murphy R, et al Risk of serious infection in patients with psoriasis receiving biologic therapies: a prospective cohort study from the British Association of Dermatologists Biologic Interventions Register (BADBIR). J Investig Dermatol. 2018;138(3):534-41.

82.   Davison N, Warren R, Mason K, McElhone K, Kirby B, Burden A, et al Identification of factors that may influence the selection of first-line biological therapy for people with psoriasis: a prospective, multicentre cohort study. Br J Dermatol. 2017;177(3):828-36.

83.   Rutter M, Kane K, Lunt M, Cordingley L, Littlewood A, Young H, et al Primary care-based screening for cardiovascular risk factors in patients with psoriasis. Br J Dermatol. 2016;175(2):348-56.

84.   Parisi R, Webb RT, Carr MJ, Moriarty KJ, Kleyn CE, Griffiths CEM, et al Alcohol-related mortality in patients with psoriasis: a population-based cohort study. JAMA dermatology. 2017;153(12):1256-62.

85.   Auker L, Cordingley L, Griffiths CEM, Young H. Physical activity is important for cardiovascular health and cardiorespiratory fitness in patients with psoriasis. Clin Exp Dermatol. 2022;47(2):289-96.

86.   Armstrong AW, Read C. Pathophysiology, Clinical Presentation and Treatment of Psoriasis: A Review. JAMA Dermatology. 2020;323(19):1945-60.

87.   Kim WB, Jerome D, Yeung J. Diagnosis and management of psoriasis. Can Fam Physician. 2017;63(4):278-85.

88.   Plunkett A, Marks R. A review of the epidemiology of psoriasis vulgaris in the community. Australas J Dermatol. 1998;39(4):225-32.

89.   Schäfer T. Epidemiology of psoriasis. Dermatology. 2006;212(4):327-37.

90.   Nair R, Aggarwal R, Khanna D, editors. Methods of formal consensus in classification/diagnostic criteria and guideline development. Semin Arthritis Rheum; 2011; 41(2):95-105.

91. Burden-Teh E, Thomas K, Gran S, Murphy R. Development of clinical diagnostic criteria for chronic plaque psoriasis in children: an electronic Delphi consensus study with the International Psoriasis Council. Br J Dermatol. 2019;181(4):856.

92. Heatley C. Beyond skin: the need for a new approach to the management of psoriasis in primary care and Iona Heath's Harveian Oration. Br J Gen Pract. 2013;63(606):10-1.

93. Girolomoni G, Griffiths CEM, Krueger J, Nestle F, Nicolas J, Prinz J, et al Early intervention in psoriasis and immune-mediated inflammatory diseases: A hypothesis paper. J Dermatol Treat. 2015;26(2):103-12.

94. Coorevits P, Sundgren M, Klein GO, Bahr A, Claerhout B, Daniel C, et al Electronic health records: new opportunities for clinical research. J. Intern. Med. 2013;274(6):547-60.

95. Herrett E, Gallagher AM, Bhaskaran K, Forbes H, Mathur R, Van Staa T, et al Data resource profile: clinical practice research datalink (CPRD). Int J Epidemiol. 2015;44(3):827-36.

96. Springate D, Parisi R, Kontopantelis E, Reeves D, Griffiths CEM, Ashcroft D. Incidence, prevalence and mortality of patients with psoriasis: a UK population-based cohort study. Br J Dermatol. 2017;176(3):650-8.

97. Kontopantelis E, Panagioti M, Farragher T, Munford LA, Parisi R, Planner C, et al Consultation patterns and frequent attenders in UK primary care from 2000 to 2019: a retrospective cohort analysis of consultation events across 845 general practices. BMJ open. 2021;11(12):e054666.

98. Casey JA, Schwartz BS, Stewart WF, Adler NE. Using electronic health records for population health research: a review of methods and applications. Annu. Rev. Public Health. 2016;37:61-81.

99. Purves IN. The paperless general practice. BMJ; 1996;312:1112.

100. Scholfield J.K., Grindlay D., Williams H.C. Skin Conditions in the UK: A Health Needs Assessment. University of Nottingham, Centre of Evidence Based Dermatology UK; Nottingham, UK. 2009. [10/05/22]. Available from: https://www.nottingham.ac.uk/research/groups/cebd/documents/hcnaskinconditionsuk2009.pdf.

101. CPRD.com. Clinical Practice Research Datalink [Internet].2022 [updated 2022 May 10; cited 2022 May 14]. Available from: https://cprd.com/data-highlights.

102. Wolf A, Dedman D, Campbell J, Booth H, Lunn D, Chapman J, et al Data resource profile: Clinical practice research datalink (cprd) aurum. Int J Epidemiol. 2019;48(6):1740-g.

103. Davé S, Petersen I. Creating medical and drug code lists to identify cases in primary care databases. Pharmacoepidemiol Drug Saf. 2009;18(8):704-7.

104.   Watson J, Nicholson BD, Hamilton W, Price S. Identifying clinical features in primary care electronic health record studies: methods for codelist development. BMJ open. 2017;7(11).

105.   Scotland. Health D. British national formulary (BNF) - revised distribution: Great Britain, Scottish Executive, Health Department. 2001. [12/05/22]. Available from: https://bnf.nice.org.uk/.

106.   Noble M, Wright G, Smith G, Dibben C. Measuring multiple deprivation at the small-area level. Environ Plan. 2006;38(1):169-85.

107.   Deas I, Robson B, Wong C, Bradford M. Measuring neighbourhood deprivation: a critique of the Index of Multiple Deprivation. Environ Plan. 2003;21(6):883-903.

108.   Noble S, McLennan D, Noble M, et al The English indices of deprivation. (Ministry of Housing, Communities & Local Government). 2019. [12/5/22]. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/833947/IoD2019_Research_Report.pdf.

109.   Nelson PA, Barker Z, Griffiths CEM, Cordingley L, Chew-Graham CA. 'On the surface': a qualitative study of GPs' and patients' perspectives on psoriasis. BMC Fam Pract. 2013;14(1):1-10.

110.   Chiang YZ, Tan KT, Chiang YN, Burge SM, Griffiths CEM, Verbov JL. Evaluation of educational methods in dermatology and confidence levels: a national survey of UK medical students. Int J Dermatol. 2011;50(2):198-202.

111.   Burden-Teh E, Murphy R, Gran S, Nijsten T, Hughes C, Abdul-Wahab A, et al Identifying the best predictive diagnostic criteria for psoriasis in children (< 18 years): a UK multicentre case–control diagnostic accuracy study (DIPSOC study). Br J Dermatol. 2022;186(2):341-51.

112.   McMillan SS, King M, Tully MP. How to use the nominal group and Delphi techniques. Int J Clin Pharm. 2016;38(3):655-62.

113.   Vernon W. The Delphi technique: a review. Int J Ther Rehabil. 2009;16(2):69-76.

114.   Murphy M, Black N, Lamping D, McKee C, Sanderson C, Askham J, et al Consensus development methods and their use in clinical guideline development. Health technology assessment (Winchester, England). 1998;2(3):i-88.

115.   Simpson R, Thomas K, Leighton P, Murphy R. Diagnostic criteria for erosive lichen planus affecting the vulva: an international electronic-D elphi consensus exercise. Br J Dermatol. 2013;169(2):337-43.

116.   Maverakis E, Ma C, Shinkai K, Fiorentino D, Callen JP, Wollina U, et al Diagnostic criteria of ulcerative pyoderma gangrenosum: a Delphi consensus of international experts. JAMA dermatology. 2018;154(4):461-6.

117.   Keeney S, Hasson F, McKenna HP. A critical review of the Delphi technique as a research methodology for nursing. Int J Nurs Stud. 2001;38(2):195-200

118.   Preston CC, Colman AM. Optimal number of response categories in rating scales: reliability, validity, discriminating power and respondent preferences. Acta Psychol. 2000;104(1):1-15.

119.   Kamsteeg M, Jansen P, Van Vlijmen-Willems I, Van Erp P, Rodijk-Olthuis D, Van Der Valk P, et al Molecular diagnostics of psoriasis, atopic dermatitis, allergic contact dermatitis and irritant contact dermatitis. Br J Dermatol. 2010;162(3):568-78.

120.   Liu Y, Jain A, Eng C, Way DH, Lee K, Bui P, et al A deep learning system for differential diagnosis of skin diseases. Nat. Med. 2020:1-9.

121.   McCormick A, Fleming D, Charlton J. Morbidity statistics from general practice. Fourth national study 1991-1992. A study carried out by the Royal College of General Practitioners, the Office of Population Censuses and Surveys and the Department of Health. London: HM Stationery Office, 1995. (Series MB5 No 3.)

122.   Khalid JM, Globe G, Fox KM, Chau D, Maguire A, Chiou C-F. Treatment and referral patterns for psoriasis in United Kingdom primary care: a retrospective cohort study. BMC Dermatol. 2013;13(1):1-7.

123.   Davies E, Burge S. Audit of dermatological content of UK undergraduate curricula. Br J Dermatol. 2009;160(5):999-1005.

124.   APPGS. Report on the dermatological training for health professionals. London: APPGS; 2004. Available from: https://www.appgs.co.uk/publication/view/dermatological-training-for-health-professionals-2004/. (Last accessed 14 May 2022).

125.   Tran H, Chen K, Lim AC, Jabbour J, Shumack S. Assessing diagnostic skill in dermatology: a comparison between general practitioners and dermatologists. Australas J Dermatol. 2005;46(4):230-4.

126.   Schofield J, Fleming D, Grindlay D, Williams H. Skin conditions are the commonest new reason people present to general practitioners in England and Wales. Br J Dermatol. 2011;165(5):1044-50.

127.   Raphael K. Recall bias: a proposal for assessment and control. Int J Epidemiol. 1987;16(2):167-70.

128.   Brenninkmeijer E, Schram M, Leeflang M, Bos J, Spuls PI. Diagnostic criteria for atopic dermatitis: a systematic review. Br J Dermatol. 2008;158(4):754-65.

129.   Davatchi F, Sadeghi Abdollahi B, Chams-Davatchi C, Shahram F, Shams H, Nadji A, et al The saga of diagnostic/classification criteria in Behcet's disease. Int. J. Rheum. Dis. 2015;18(6):594-605.

130.   Kaufman BP, Alexis AF. Psoriasis in skin of color: insights into the epidemiology, clinical presentation, genetics, quality-of-life impact and treatment of psoriasis in non-white racial/ethnic groups. Am J Clin Dermatol. 2018;19(3):405-23.

131.   Tucker R, Patel M, Layton AM, Walton S. An examination of the comparative ability of primary care health professionals in the recognition and treatment of a range of dermatological conditions. Self Care. 2013;4(4):87-9.

132.   Tucker R, Patel M, Layton AL, Walton S. An exploratory study demonstrating the diagnostic ability of healthcare professionals in primary care using online case studies for common skin conditions. Int J Pharm Pract. 2014;22(2):119-24.

133.   Tucker R, Patel M, Layton AM, Walton S. An evaluation of a dermatology vignette website:what users thought. Selfcare. 2014;5(2):33-44.

134.   Chisholm A, Nelson P, Pearce C, Littlewood A, Kane K, Henry A, et al Motivational interviewing-based training enhances clinicians' skills and knowledge in psoriasis: findings from the Pso Well® study. Br J Dermatol. 2017;176(3):677-86.

135.   Griffiths CEM, Taylor H, Collins S, Hobson J, Collier P, Chalmers R, et al The impact of psoriasis guidelines on appropriateness of referral from primary to secondary care: a randomized controlled trial. Br J Dermatol. 2006;155(2):393-400.

136.   Federman DG, Concato J, Kirsner RS. Comparison of dermatologic diagnoses by primary care practitioners and dermatologists: a review of the literature. Arch Fam Med. 1999;8(2):170.

137.   Abo-Tabik M, Parisi R, Willis S, Griffiths CEM, Ashcroft D, Atlas GP. Development of clinical diagnostic criteria for chronic plaque psoriasis: an international e-Delphi study. Br J Dermatol. 2021; 185(2):455-6.

138.   Kurtti A, Austin E, Jagdeo J. Representation of skin color in dermatology-related Google image searches. J Am Acad Dermatol. 2022;86(3):705-8.

139.   Majeed-Ariss R, McPhee M, McAteer H, Griffiths CEM, Young H. The top 10 research priorities for psoriasis in the UK: results of a James Lind Alliance psoriasis Priority Setting Partnership. Br J Dermatol. 2019;181(4):871-3.

140.   GPA. Annual report. UK:GPA; 2020-2021. Available from: https://www.globalpsoriasisatlas.org/uploads/attachments/cknrlwgij0hxiyojna6dk5cn2-gpa-annual-report-2020-2021-v2.pdf. (Last accessed 13 May 2022).

141.   Auker L, Cordingley L, Pye S, Griffiths CEM, Young H. What are the barriers to physical activity in patients with chronic plaque psoriasis?. Br J Dermatol. 2020;183(6):1094-102.

142.   Reid C, Griffiths CEM. Psoriasis and Treatment: Past, Present and Future Aspects. Acta Derm Venereol. 2020; 100: adv00032.

143.   Haroon M, Gallagher P, FitzGerald O. Diagnostic delay of more than 6 months contributes to poor radiographic and functional outcome in psoriatic arthritis. Ann Rheum Dis. 2015;74(6):1045-50.

144.   Saraceno R, Griffiths CEM. A European perspective on the challenges of managing psoriasis. J Am Acad Dermatol. 2006;54(3):S81-S4.

145.   Griffiths CEM, Van Der Walt J, Ashcroft D, Flohr C, Naldi L, Nijsten T, et al The global state of psoriasis disease epidemiology: a workshop report. Br J Dermatol. 2017; 177(1):e4-e7.

146.   Liu Y, Jain A, Eng C, Way DH, Lee K, Bui P, et al. A deep learning system for differential diagnosis of skin diseases. Nat. Med. 2020;26(6):900-8.

147   Akins RB, Tolson H, Cole BR. Stability of response characteristics of a Delphi panel: application of bootstrap data expansion. BMC Med. Res. Methodol. 2005;5(1):1-2.

148   Sousa VD, Zauszniewski JA, Musil CM. How to determine whether a convenience sample represents the population. Appl Nurs Res. 2004;17(2):130-3.

149   Courtenay M, Carey N and Burke J. Independent extended nurse prescribing for patients with skin conditions: a national questionnaire survey. J Clin Nurs. 2007; 16: 1247–1255.

150   Tucker R. Community pharmacists' perceptions of the skin conditions they encounter and how they view their role in dermatological care. Int J Pharm Pract. 2012; 20(5).

151   Seminara NM, Abuabara K, Shin DB, Langan SM, Kimmel SE, Margolis D, et al. Validity of The Health Improvement Network (THIN) for the study of psoriasis. British Journal of Dermatology. 2011 Mar;164(3):602-9.

152   Cordingley L, Nelson PA, Davies L, Ashcroft D, Bundy C, Chew-Graham C, et al. Identifying and managing psoriasis-associated comorbidities: the IMPACT research programme. Available from: https://www.ncbi.nlm.nih.gov/books/NBK579288/ (Last accessed 20/11/2022).

Appendices

Appendix 1- First round questionnaire

The University of Manchester

Developing clinical examination-based diagnostic criteria for psoriasis in adults

Electronic Delphi Consensus Exercise
Round 1 Questionnaire

The aim of this Delphi consensus exercise is to reach agreement on clinical examination-based diagnostic criteria for psoriasis in adults. This will help in the conduct of future epidemiological studies in psoriasis.
A defined set of criteria will also help physicians in the early recognition of psoriasis and thus lead to a better management plan.

The 'Delphi' method being used for this consensus study will be run over three rounds. This is the first round questionnaire. It is important that you answer all of the questions even if you need to respond 'not sure'.

It is also important that you make every effort to complete all three rounds. Each round should take no more than 20 minutes to complete.

You will be asked for your name as part of the consent for participation in this study. Only the study administrator will see your name and it will be deleted once the study is complete.

Many thanks in advance for your consideration of this project, please let me know if you require further information.

Maha Abo-Tabik
Doctoral Research Student|Stopford Building1.823|Division of Musculoskeletal and Dermatological Sciences|School of Biological Sciences|Faculty of Biology, Medicine and Health|The University of Manchester|M13 9PG|
E-mail: maha.abo-tabik@postgrad.manchester.ac.uk

Developing clinical examination-based diagnostic criteria for psoriasis in adults

Consent

If you are happy to participate please respond to the following statements:

1. I have read the attached information sheet (Version 02, Date 01/2019) for the above study and have had the opportunity to consider the information and ask questions and had these answered satisfactorily.

   ○ I confirm.

2. I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving a reason and without detriment to myself. I understand that it v possible to remove my data from the project once it has been anonymised and forms part of the dataset.
   I agree to take part on this basis.
   ○ I confirm.

3. I agree that any data collected may be published in anonymous form in peer-reviewed academic journals, conference presentation and thesis/ dissertation.
   ○ I confirm.

4. I agree that the researchers may retain my contact details in order to contact me to take part in future rounds of data collection for this study.
   ○ I confirm.

5. I agree to take part in this study.
   ○ I confirm.

Data protection

The personal information we collect and use to conduct this research will be processed in accordance with data protection law explained in the Participant Information Sheet and the Privacy Notice for Research Participants [https://outlook.manchester.ac.uk/owa/redir.aspx?
C=0GPciuCFdH3ojJYImf1DoDmgLtvH3OXAYWz7pxNz0EeP5CXR1CMzVCA..&URL=http%3a%2f%2fdocuments.manchester.ac.uk%2fdisplay.aspx%3fDocID%:

Data will be anonymised once downloaded from the online survey and stored using a unique identifier.

6. Name of participant

   [   ]

7. Please, provide your e-mail address to send you next round questionnaire.

   [   ]

8. Date

   [   ]
   [javascript:calendar_window=window.open('calendar.aspx?
   formname=frmSurvey,QID268299&culture=en','calendar_window','width=225,height=195');calendar_window.focus()]
   dd/mm/yyyy

9. Would you like to be acknowledged in the final publication for contributing in this Delphi study?
   ○ Yes ○ No

Developing clinical examination-based diagnostic criteria for psoriasis in adults

Demographic information

1. Please indicate your clinical grade:*
   ○ Consultant Dermatologist
   ○ Resident/Specialist registrar
   ○ Other, please specify

2. Please indicate if you manage adults (18 years and above) with psoriasis in your clinical practice?

   *

   ○ Yes ○ No

3. Please indicate how long have you been practising dermatology?*
   ○ 5 years or less
   ○ 6-10 years
   ○ 11-15 years
   ○ 16-20 years
   ○ more than 20 years

4. Please indicate your country of practice:*

5. Please indicate your gender:*
   ○ Male
   ○ Female

Developing clinical examination-based diagnostic criteria for psoriasis in adults

Clinical examination criteria

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant------------ (5) not sure ------------ (9) extremely important >

Lesion morphology

1.

	1	2	3	4	5	6	7	8	9
Well-demarcated lesion(s).	○	○	○	○	○	○	○	○	○

2.

	1	2	3	4	5	6	7	8	9
Lesion(s) are pink to red in colour.	○	○	○	○	○	○	○	○	○

3.

	1	2	3	4	5	6	7	8	9
In deeply pigmented skin, lesions are grey in colour.	○	○	○	○	○	○	○	○	○

4.

	1	2	3	4	5	6	7	8	9
Lesions vary in size.	○	○	○	○	○	○	○	○	○

5.

	1	2	3	4	5	6	7	8	9
Lesions are covered by silvery/ white scales.	○	○	○	○	○	○	○	○	○

6.

	1	2	3	4	5	6	7	8	9
Palpable lesion(s).	○	○	○	○	○	○	○	○	○

7. Are there any additional morphological criteria that you perceive to be important in diagnosing psoriasis in adults? (Please list)

Developing clinical examination-based diagnostic criteria for psoriasis in adults

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant----------- (5) not sure ----------- (9) extremely important >

Distribution

1. *

	1	2	3	4	5	6	7	8	9
Symmetrically distributed lesions.	○	○	○	○	○	○	○	○	○

2. *

	1	2	3	4	5	6	7	8	9
Lesions affecting the scalp are asymmetrical.	○	○	○	○	○	○	○	○	○

3. *

	1	2	3	4	5	6	7	8	9
Lesions affecting palms and soles are asymmetrical.	○	○	○	○	○	○	○	○	○

4. Are there any additional distribution criteria that you perceive to be important in diagnosing psoriasis in adults? (please list)

Developing clinical examination-based diagnostic criteria for psoriasis in adults

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant----------- (5) not sure ----------- (9) extremely important >

Physical signs

1.

	1	2	3	4	5	6	7	8	9
Presence of Woronoff's ring.	○	○	○	○	○	○	○	○	○

2.

	1	2	3	4	5	6	7	8	9
Positive Auspitz sign.	○	○	○	○	○	○	○	○	○

3.

	1	2	3	4	5	6	7	8	9
Positive Koebner phenomenon.	○	○	○	○	○	○	○	○	○

4.

	1	2	3	4	5	6	7	8	9
Scaling can be induced by light scratching.	○	○	○	○	○	○	○	○	○

5. Are there any additional physical signs that you perceive to be important in diagnosing psoriasis in adults? (Please list)

MANCHESTER
1824

The University of Manchester

Developing clinical examination-based diagnostic criteria for psoriasis in adults

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant--------- (5) not sure --------- (9) extremely important >

Clinical History

1.

	1	2	3	4	5	6	7	8	9
Family history of psoriasis in first degree relatives.	○	○	○	○	○	○	○	○	○

2.

	1	2	3	4	5	6	7	8	9
Preceded by group A streptococcal pharyngitis or tonsillitis.	○	○	○	○	○	○	○	○	○

3. Are there any additional clinical history criteria that you perceive to be important in diagnosing psoriasis in adults? (Please list)

The University of Manchester

Developing clinical examination-based diagnostic criteria for psoriasis in adults

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant------------ (5) not sure ------------ (9) extremely important >

Associated features

1.

	1	2	3	4	5	6	7	8	9
Overall dry skin and cracking.	○	○	○	○	○	○	○	○	○

2.

	1	2	3	4	5	6	7	8	9
Itching.	○	○	○	○	○	○	○	○	○

3.

	1	2	3	4	5	6	7	8	9
Sore/ painful skin.	○	○	○	○	○	○	○	○	○

4.

	1	2	3	4	5	6	7	8	9
Oozing and/or bleeding from the lesions.	○	○	○	○	○	○	○	○	○

5.

	1	2	3	4	5	6	7	8	9
Nail involvement.	○	○	○	○	○	○	○	○	○

6.

	1	2	3	4	5	6	7	8	9
Joint pain and/or stiffness.	○	○	○	○	○	○	○	○	○

7. Are there any additional associated features that you perceive to be important in diagnosing psoriasis in adults? (Please list)

[   ]

Appendix 2- Second round questionnaire

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 2

Electronic Delphi Consensus Exercise
Round 2 Questionnaire

Welcome to the second round questionnaire on: "Developing clinical examination based diagnostic criteria for psoriasis in adults".

Thank you for your participation in the first round of our Delphi study. The Global Psoriasis Atlas hereby invites you to continue to share your expertise as a panel member in the second round of this study. Your continuing input is crucial to help us better standardize psoriasis case definition for future epidemiological studies.
In light of responses received to Round 1, the questionnaire has been modified. Some wording has been amended and five new items have been added. We are now asking you to complete the modified questionnaire. This should take less than 20 minutes to complete.

In this round, we kindly ask you to rate the items on the same nine-point Likert scale used in round 1. You will find above each item your previous response, the median score and the interquartile range (IQR) of the panel responses. You will have the chance to reconsider your rating in light of the group responses.
We will also ask you to indicate if you consider the item as a definitive or supportive criterion when making a clinical diagnosis for psoriasis. If you think it is neither, please tick the box 'neither'.

When making these judgements, please consider the following definitions:

'Definitive' means that a diagnostic item MUST be present to make the diagnosis;

'Supportive' means that the feature does not have to be present, but that its presence, in conjunction with other diagnostic criteria supports a diagnosis of psoriasis.

Please note that this Delphi study aims to reach consensus on diagnostic criteria for psoriasis in adults, based upon clinical examination alone. At the moment we are not aiming to classify different types of psoriasis, which is why the items that we are suggesting do not include details on specific phenotypes of psoriasis.

Please also note that the second round survey will close in four weeks' time.

We will send the third and final round questionnaire as soon as we have completed the data analysis of the second round.

Thank you for your participation.

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 2

The University of Manchester

MANCHESTER
1824

We will start this questionnaire with a proposed definition for psoriasis using lay language.
This is because we aim to implement the outcomes of this international Delphi study in future epidemiological studies for psoriasis and these studies may involve non-medical professions who are unfamiliar with medical terminology.
We will also define all diagnostic items that reach consensus on the final round of the study.

The following is a definition of psoriasis. Please read it and answer the questions that follow.

Psoriasis is a long term disease of the skin that can occur on any area of the body and it often affects extensor surfaces of the limbs (especially elbows and knees), the trunk, around the umbilicus, over the lower back (sacrum), on the scalp and areas in skin folds (flexures) such as the armpits, between the buttocks, genitals and under the breasts. Different types of psoriasis tend to affect different parts of the body.

Please indicate if you agree or disagree with the definition of psoriasis stated above?*

☐ Agree   ☐ Disagree   ☐ Not sure

Are there any problems with this definition? If so, what are they?

Are there any modifications/changes that you think should be made to improve this definition? If so, what are they?

210

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 2

Clinical examination criteria

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant------------ (5) not sure ------------ (9) extremely important >

Lesion morphology

In the previous round, panel response to the statement "Well demarcated lesion(s)" was: 8, The interquartile range (IQR) was: 7-9 and your response was:8. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
well demarcated lesion(s).	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Lesion(s) are pink to red in colour" was: 8, The interquartile range (IQR) was: 7-8 and your response was:7. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Lesion(s) are pink to red in colour.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "In deeply pigmented skin, lesion(s) are grey in colour" was:6, The interquartile range (IQR) was: 5-7 and your response was:7. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
In deeply pigmented skin, lesions are grey in colour.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Lesions vary in size" was: 7, The interquartile range (IQR) was: 5-8 and your response was:5. This statement has been modified according to panel suggestion. According to this information, please rate the new statement.

	1	2	3	4	5	6	7	8	9
Patient's lesions vary in size.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Lesion(s) are covered by silvery/ white scales" was: 8, The interquartile range (IQR) was: 7-9 and your response was:8. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Lesions are covered by silvery/ white scales.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Palpable lesion(S)" was: 7, The interquartile range (IQR) was: 6-8 and your response was:7. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Palpable lesion(s).	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

	1	2	3	4	5	6	7	8	9
Non-scaring lesion (This is a new item suggested by panel members).	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

Are there any additional morphological criteria that you perceive to be important in diagnosing psoriasis in adults? (Please list)

[   ]

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 2

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant------------ (5) not sure ------------ (9) extremely important >

Distribution

In the previous round, panel response to the statement "Symmetrically distributed lesions" was: 7, The interquartile range (IQR) was: 6-7 and your response was:6. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Symmetrically distributed lesions.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Lesions affecting the scalp are asymmetrical" was: 5, The interquartile range (IQR) was: 4-6 and your response was:7. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Lesions affecting the scalp are asymmetrical.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Lesions affecting palms and soles are asymmetrical" was: 5, The interquartile range (IQR) was: 4-6 and your response was:6. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Lesions affecting palms and soles are asymmetrical.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

Are there any additional distribution criteria that you perceive to be important in diagnosing psoriasis in adults? (please list)

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 2

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant------------ (5) not sure ------------ (9) extremely important >

Physical signs

In the previous round, panel response to the statement "Presence of Woronoff's ring" was: 5, The Interquartile range (IQR) was: 3-6 and your response was:5. Based on the given Information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Presence of Woronoff's ring.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Positive Auspitz sign" was: 6, The Interquartile range (IQR) was: 3-7 and your response was:7. Based on the given Information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Positive Auspitz sign.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Positive Koebner phenomenon" was: 6, The Interquartile range (IQR) was: 4-8 and your response was:5. Based on the given Information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Positive Koebner phenomenon.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Scaling can be induced by light scratching" was: 6, The Interquartile range (IQR) was: 4-8 and your response was:6. Based on the given Information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Scaling can be induced by light scratching.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

214

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 2

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant------------ (5) not sure ------------ (9) extremely important >

Physical signs

In the previous round, panel response to the statement "Presence of Woronoff's ring" was: 5, The Interquartile range (IQR) was: 3-6 and your response was:5. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Presence of Woronoff's ring.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Positive Auspitz sign" was: 6, The Interquartile range (IQR) was: 3-7 and your response was:7. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Positive Auspitz sign.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Positive Koebner phenomenon" was: 6, The Interquartile range (IQR) was: 4-8 and your response was:5. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Positive Koebner phenomenon.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Scaling can be induced by light scratching" was: 6, The Interquartile range (IQR) was: 4-8 and your response was:6. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Scaling can be induced by light scratching.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 2

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant------------ (5) not sure ------------ (9) extremely important >

Clinical History

In the previous round, panel response to the statement "Family history of psoriasis in first degree relatives" was: 7, The interquartile range (IQR) was: 6-8 and your response was:8. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Family history of psoriasis in first degree relatives.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Preceded by group A streptococcal pharyngitis or tonsillitis" was: 6, The interquartile range (IQR) was: 4-7 and your response was:6. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Preceded by group A streptococcal pharyngitis or tonsillitis.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

	1	2	3	4	5	6	7	8	9
Persistent dandruff (This is a new item suggested by panel members)	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

	1	2	3	4	5	6	7	8	9
Recurrent skin infection (This is a new item suggested by panel members)	○	○	○	○	○	○	○	○	○

216

‐ Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.
☐ Definitive ☐ Supportive ☐ Neither

‐
	1	2	3	4	5	6	7	8	9
Skin lesion(s) resistant to topical steroid treatment (This is a new item suggested by panel members)	○	○	○	○	○	○	○	○	○

‐ Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.
☐ Definitive ☐ Supportive ☐ Neither

‐
	1	2	3	4	5	6	7	8	9
stressful life events (This is a new item suggested by panel members)	○	○	○	○	○	○	○	○	○

‐ Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.
☐ Definitive ☐ Supportive ☐ Neither

‐ Are there any additional clinical history criteria that you perceive to be important in diagnosing psoriasis in adults? (Please list)

[text box]

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 2

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant------------ (5) not sure ------------ (9) extremely important >

Associated features

In the previous round, panel response to the statement "Overall dry skin and cracking" was: 4, The interquartile range (IQR) was: 3-6 and your response was:2. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Overall dry skin and cracking.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Itching" was: 6, The interquartile range (IQR) was: 4-7 and your response was:7. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Itching.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Sore/painful skin" was: 6, The interquartile range (IQR) was: 4-6 and your response was:5. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Sore/ painful skin.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive   ☐ Supportive   ☐ Neither

In the previous round, panel response to the statement "Oozing and/or bleeding from the lesions" was: 4, The interquartile range (IQR) was: 3-5 and your response was:3. This statement has been modified according to panel suggestion. According to this information, please rate the new statement.

	1	2	3	4	5	6	7	8	9
Non-oozing, dry lesion(s).	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive ☐ Supportive ☐ Neither

In the previous round, panel response to the statement "Nail Involvement" was: 8, The interquartile range (IQR) was: 6-9 and your response was:9. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Nail involvement.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive ☐ Supportive ☐ Neither

In the previous round, panel response to the statement "Joint pain and/or stiffness" was: 7, The interquartile range (IQR) was: 5-8 and your response was:8. Based on the given information, please rerate this diagnostic item.

	1	2	3	4	5	6	7	8	9
Joint pain and/or stiffness.	○	○	○	○	○	○	○	○	○

Please state whether you believe the diagnostic item above is 'Definitive' or 'supportive' to make the diagnosis.

☐ Definitive ☐ Supportive ☐ Neither

Are there any additional associated features that you perceive to be important in diagnosing psoriasis in adults? (Please list)

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 3(Final Round).

Electronic Delphi Consensus Exercise

Round 3-Questionnaire

Dear colleague,

Welcome to the third round questionnaire on "Developing clinical examination-based diagnostic criteria for psoriasis in adults"

Thank you for your participation in the previous rounds. In light of responses to rounds 1 and 2 of this Delphi exercise, the questionnaire has been modified. We have taken into account your suggestions and additional comments as much as possible.

When answering this final questionnaire, please bear in mind that we are trying to develop through consensus a set of diagnostic items for psoriasis in adults based upon clinical examination alone. It is anticipated that this tool will be helpful in identifying different types of psoriasis; with the exception of erythrodermic psoriasis given that is a life threatening, rarely occurring variant of the disease which requires emergency medical intervention.

In trying to reach consensus in this round, we are asking you to give your expert opinion about the following:

- The proposed definition of psoriasis that has been amended based on the feedback you gave in previous rounds.
- A set of potential diagnostic items that may be used to further support a clinical diagnosis of psoriasis.

We also wish to establish your opinion on the minimum number of supportive diagnostic criteria that should accompany the essential criteria in the final diagnostic dataset.

Thank you for your continuous input into this project.

Maha Abo-Tabik
Doctoral Research Student|Stopford Building1.823|Division of Musculoskeletal and Dermatological Sciences|School of Biological Sciences|Faculty of Biology, Medicine and Health|The University of Manchester|M13 9PG|

E-mail: maha.abo-tabik@postgrad.manchester.ac.uk [mailto:maha.abo-tabik@postgrad.manchester.ac.uk]

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 3(Final Round).

Psoriasis definition.

3. The following is a suggested definition of psoriasis. Please read it carefully and answer the questions that follow.

Psoriasis is a chronic, inflammatory disease that predominately affects the skin. Skin lesions can occur on any part of the body and particularly affects extensor surfaces of the limbs. Other common sites for psoriasis to appear include the trunk, around the umbilicus, over the lower back (sacrum), on the scalp involving the hairline, skin inside and behind the ears, the palms of the hands, soles of the feet and nails. Skin folds (flexures) such as armpits, between the buttocks, genitals and under the breast may also be affected. Different types of psoriasis tend to affect different parts of the body. Erythrodermic psoriasis is not covered in this definition.

Please indicate if you agree or disagree with the definition of psoriasis stated above?*

○ Agree   ○ Disagree   ○ Not sure

4. Are there any modifications/changes that you think should be made to improve this definition? If so, what are they?

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 3(Final Round).

Clinical diagnostic criteria.

In your opinion, how important are the following statements in the diagnosis of psoriasis in adults?

< (1) extremely unimportant----------- (5) not sure ----------- (9) extremely important >

5. In the previous round, the statement "In deeply pigmented skin, lesions are grey in colour" had a median score of 6, the interquartile range (IQR) was: 6-7. The wording of this statement has been slightly changed. Based on the given information, please rate this diagnostic item again.

	1	2	3	4	5	6	7	8	9
In deeply pigmented skin, lesions maybe grey in colour	○	○	○	○	○	○	○	○	○

6. In the previous round, the statement "Positive Koebener phenomenon" had a median score of 6, the interquartile range (IQR) was: 6-8. Based on the given information, please rate this diagnostic item again.

	1	2	3	4	5	6	7	8	9
Positive Koebener phenomenon	○	○	○	○	○	○	○	○	○

7. In the previous round, the statement "Preceded by group A streptococcal pharyngitis or tonsilitis" had a median score of 6, the interquartile range (IQR) was: 5-7. Based on the given information, please rate this diagnostic item again.

	1	2	3	4	5	6	7	8	9
Preceded by group A streptococcal pharyngitis or tonsilitis.	○	○	○	○	○	○	○	○	○

8. In the previous round, the statement "Persistent dandruff" had a median score of 6, the interquartile range (IQR) was: 5-7. Based on the given information, please rate this diagnostic item again.

	1	2	3	4	5	6	7	8	9
Persistent dandruff.	○	○	○	○	○	○	○	○	○

9. In the previous round, the statement "Itching" had a median score of 6, the interquartile range (IQR) was: 6-7. Based on the given information, please rate this diagnostic item again.

	1	2	3	4	5	6	7	8	9
Itching.	○	○	○	○	○	○	○	○	○

10. Please provide comments below on the suitability of any of the above statements to support a clinical diagnosis of psoriasis if you wish.

Developing clinical examination-based diagnostic criteria for psoriasis in adults-Round 3(Final Round).

Final diagnostic dataset.

The final diagnostic tool will include the final agreed definition of psoriasis, one essential criterion and a list of supportive criteria.

In the previous Delphi rounds, panel members reached consensus that "Well demarcated lesion(s) with or without silvery white scales" is an essential diagnostic criterion that needs to be present to make the diagnosis of psoriasis.

In addition to this essential criterion, we would like you to review the following list of potentially supportive diagnostic items and answer the questions that follows.

- Lesions are pink to red in colour
- In deeply pigmented skin, lesions are grey in colour Lesions vary in size
- Lesions vary in size
- Lesions are palpable
- Lesions are symmetrically distributed
- Family history of psoriasis in first degree relatives
- Nail involvement (such as pitting, onycholysis and subungual hyperkeratosis of the nails)
- Joint pain and/or stiffness
- Positive Koebener phenomenon
- Preceded by group A streptococcal pharyngitis or tonsillitis
- Persistent dandruff
- Itching

11. In addition to the ESSENTIAL criterion, what do you consider to be the MINIMUM number of SUPPORTIVEcriteria that should be present to make a clinical diagnosis of psoriasis in adults?*

    --Please Select-- ∨

12. If you have any further comments on the final diagnostic dataset, please provide them here.

Appendix 4- Training tool

Eligibility questionnaire

training
t●● | for chronic plaque psoriasis

A training tool for the diagnosis of chronic plaque psoriasis

Do you already have a participant ID? *
○ Yes ✔ No

Eligibility

Are you a primary healthcare professional (General practitioner, nurse or pharmacist)?

✔ Yes, I meet these requirements. ○ No, I don't meet these requirements.

Have you completed any specific postgraduate dermatology training (e.g Diploma, MSc)? *
○ Yes ✔ No

Take part in this study ✔

‹ Previous Page

G P A
Global Psoriasis Atlas

MANCHESTER
1824
The University of Manchester

IFPA

ILDS

IPC

INTERNATIONAL
PSORIASIS
COUNCIL

www.globalpsoriasisatlas.org   🐦 📘 📷 in

training tool

for chronic plaque psoriasis

A training tool for the diagnosis of chronic plaque psoriasis

Do you already have a participant ID?

● Yes ○ No

Login ✔

Introduction

training tool for chronic plaque psoriasis

Introduction

- An estimated 60 million people have psoriasis worldwide.
- Misdiagnosis is common, and access to medical care is limited in many countries.
- Research into the epidemiology of psoriasis is faced with a multitude of challenges, one of which is the lack of a clinical diagnostic tool for psoriasis.
- The global psoriasis atlas (GPA) has conducted an e-Delphi consensus study to develop clinical examination-based diagnostic criteria for chronic plaque psoriasis (CPP).
- This has been used to develop an e-learning resource (training tool) for primary care professionals.
- This study aims to test the effectiveness of the training tool in improving diagnostic abilities of primary care professionals of psoriasis.
- Further information on the study is found in the participant information sheet.

Instructions

- To optimize your experience, we recommend you use a large screen. The platform is fully compatible with both PC and Mac but avoid using phones.
- You are encouraged to complete all tasks in a single sitting. However, if you logged out of the website due to a technical problem (e.g., laptop is out of charge) you will be allowed to sign-in again within only 24 hours of your first log-in attempt.
- After reading the participant information sheet, if you decided to take part in the study, please click "Start" below.

Start ✔

www.globalpsoriasisatlas.org

Consent form

training
tool for chronic plaque psoriasis

Development and evaluation of a training tool for healthcare professionals to support their diagnostic skills of psoriasis

Consent Form

If you are happy to participate, please tick the box for each of the statements below:

	Activities	
1	I confirm that I have read the attached information sheet (Version 02, Date 20/12/2021) for the above study and have had the opportunity to consider the information and ask questions and had these answered satisfactorily.	☐
2	I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving a reason and without detriment to myself. I understand that it will not be possible to remove my data from the project once it has been anonymised and forms part of the data set. I agree to take part on this basis.	☐
3	I agree that any data collected may be included in anonymous form in publications/conference presentations.	☐
4	I understand that data collected during the study may be looked at by individuals from The University of Manchester or regulatory authorities, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data.	☐
5	I agree to take part in this study.	☐

Data Protection

The personal information we collect and use to conduct this research will be processed in accordance with UK data protection law as explained in the Participant Information Sheet and the Privacy Notice for Research Participants.

Participant ID
[   ]

Date
[Mar ▾] * / [14] * / [2022] *

Please make note of your participant ID to avoid starting over in case you need to logout and login again.

[Confirm ✔]

Demographic questionnaire

Your ID

Demographic questionnaire

What is your gender? *

◯ Female ◯ Male ◯ Other

What is your profession? *

◯ General practitioner
◯ Nurse
◯ Pharmacist

How many years of working in general practice do you have? *

Next Page ❯

Your ID

Demographic questionnaire

Please estimate how many patients with psoriasis you see per month? *

◯ Less than 5 patients
◯ 6-10 patients
◯ 11-15 patients
◯ 16-20 patients
◯ More than 20 patients

How confident are you with making a diagnosis of Chronic Plaque Psoriasis? *

◯ Not confident at all
◯ Slightly confident
◯ Not sure
◯ Fairly confident
◯ Completely confident

❮ Previous Page

Confirm ✔

Pre-training

training
tool

Your ID

Pre-training — Training — Post-training

Pre-training

The pre-training test aims to test your pre-existing knowledge of chronic plaque psoriasis diagnosis.

Case 1

A 38-year-old male presented with a red rash on his arms and trunk for the last 8 months. The rash was slightly itchy. The patient described the rash as irritating and had a rough texture. The patient reported worsening of his symptoms with exercise and in warmer weather. The patient has no significant medical history, however he reported previous allergic reaction to erythromycin. The patient reported using an emollient cream which helped slightly with irritation. No family history of similar skin condition.

What is the most likely diagnosis? *

○ Contact dermatitis.
○ Chronic plaque psoriasis.
○ Tinea corporis.
○ Adverse drug reaction.
○ Not sure.

1/2

Next Page >

training tool
for chronic plaque psoriasis

Your ID

✓ ──── ○ ──── ○
Pre-training   Training   Post-training

Pre-training

The pre-training test aims to test your pre-existing knowledge of chronic plaque psoriasis diagnosis.

Case 1

A 38-year-old male presented with a red rash on his arms and trunk for the last 8 months. The rash was slightly itchy. The patient described the rash as irritating and had a rough texture. The patient reported worsening of his symptoms with exercise and in warmer weather. The patient has no significant medical history, however he reported previous allergic reaction to erythromycin. The patient reported using an emollient cream which helped slightly with irritation. No family history of similar skin condition.

What is the most likely diagnosis? *

○ Contact dermatitis.
○ Chronic plaque psoriasis.
○ Tinea corporis.
○ Adverse drug reaction.
○ Not sure.

2/2

Next Page >

Your ID

Pre-training — Training — Post-training

Case 2

A 31-year-old Afro-Caribbean male presented to you with an itchy, hyperpigmented rash over the trunk. He first noticed the rash on his chest and upper back 10 days ago, which then gradually spread over the abdomen, arms and legs. He complains of a low grade fever, headache and fatigue. He had visited the local pharmacist when he first noticed the rash and has been prescribed antihistamine (Benadryl), Betnovate cream. The patient has also been advised to apply moisturizer once or twice a day over the rash. The itching has improved but the rash still present.

What is the most likely diagnosis? "

◯ Tinea versicolor.
◯ Atopic dermatitis.
◯ Chronic plaque psoriasis.
◯ Pityriasis Rosea.
◯ Not sure.

Next Page >

234

Pre-training — Training — Post-training

Case 3

A 40-year-old male presented to the GP clinic with a several months history of deeply pigmented scaly plaques and papules on both of his upper extremities and chest. He first noticed similar but smaller lesions on the back of his right hand. At first lesions improved by applying moisturiser and a topical corticosteroids cream (Dermovate cream). The lesions now are more widespread and not responding very well to the usual medication. He has no family history of similar skin condition. Patient is otherwise healthy.

On examination: lesions were scaly, rough textured and symmetrically distributed on both upper extremities and across his chest. You also noticed pin-sized depressions on his fingernails.

What is the most likely diagnosis? *

○ Discoid lupus erythematosus.
○ Nummular eczema.
○ Chronic plaque psoriasis.
○ Lichen planus.
○ Not sure.

SFS

1/2

Next Page >

Your ID

Pre-training — Training — Post-training

Case 3

A 40-year-old male presented to the GP clinic with a several months history of deeply pigmented scaly plaques and papules on both of his upper extremities and chest. He first noticed similar but smaller lesions on the back of his right hand. At first lesions improved by applying moisturiser and a topical corticosteroids cream (Dermovate cream). The lesions now are more widespread and not responding very well to the usual medication. He has no family history of similar skin condition. Patient is otherwise healthy.

On examination: lesions were scaly, rough textured and symmetrically distributed on both upper extremities and across his chest. You also noticed pin-sized depressions on his fingernails.

What is the most likely diagnosis? *

○ Discoid lupus erythematosus.
○ Nummular eczema.
○ Chronic plaque psoriasis.
○ Lichen planus.
○ Not sure.

2/2

Next Page >

Your ID

Pre-training — Training — Post-training

Case 4

A 35-year-old woman presented with red scaly patches on her face. Thick scaly plaques and papules were also found on the scalp and the skin inside and behind her ears as shown in the image. The patient also complained of itchy scalp. The patient had milder outbreaks of the rash before which usually responded to coal-tar shampoo for the scalp rash and moisturizer with a topical Calcineurin inhibitor (Tacrolimus 0.03 ointment) for the facial rash. She also reported that her brother had been diagnosed with psoriasis 10 years ago. The patient has no other medical concern.

What is the most likely diagnosis? *

○ Chronic plaque psoriasis.
○ Tinea capitis.
○ Seborrheic dermatitis.
○ Atopic dermatitis.
○ Not sure.

Next Page >

Pre-training — Training — Post-training

Case 5

A 32-years-old female presented with an itchy skin rash. The rash started as shiny blotches over the flexural surface of her wrists (see image) and within 3 weeks spread to both arms. She also reported a burning sensation in the mouth and few mouth blisters which she attributed to having a spicy meal. The woman also complained of a mild fever. This is the first episode of such a skin rash. She had used over the counter 1% hydrocortisone cream and an emollient lotion, but her condition did not improve.

What is the most likely diagnosis? *

○ Scabies.
○ Lichen simplex chronicus.
○ Chronic plaque psoriasis.
○ Lichen planus.
○ Not sure.

Next Page >

training tool for chronic plaque psoriasis

Your ID

☑ Pre-training ──── ◯ Training ──── ◯ Post-training

Case 6

A 26-year-old female with no past medical history, presented with a pink/red rash on the nape of her neck that had been present for 3 weeks. When it first appeared, the rash was raised and the patient's entire neck, beyond the site of the rash, was extremely itchy. The itching over the neck had resolved with the use of a moisturiser and over the counter topical corticosteroid cream (1% hydrocortisone) but the rash itself remained itchy. The patient then applied mupirocin ointment (topical antibiotic) for 3–4 days as prescribed by a community pharmacist, but it did not help. The patient felt otherwise well.

What is the most likely diagnosis? *

◯ Chronic plaque psoriasis.

◯ Lichen simplex.

◯ Atopic dermatitis.

◯ Contact dermatitis.

◯ Not sure.

Next Page >

239

training tool for chronic plaque psoriasis

✓ Pre-training ——— ◯ Training ——— ◯ Post-training

Case 7

A 50-year-old male presented with well-demarcated red scaly annular plaques, scattered on his trunk, face and scalp. The man reported fingernails discolouration as shown in the image. He also complained of pain and swelling of his fingers. No family history of psoriasis.

What is the most likely diagnosis? *

◯ Lichen planus.
◯ Chronic plaque psoriasis.
◯ Pityriasis lichenoides.
◯ Atopic dermatitis.
◯ Not sure.

1/2

Next Page >

Your ID

Pre-training — Training — Post-training

Case 7

A 50-year-old male presented with well-demarcated red scaly annular plaques, scattered on his trunk, face and scalp. The man reported fingernails discolouration as shown in the image. He also complained of pain and swelling of his fingers. No family history of psoriasis.

What is the most likely diagnosis? *

○ Lichen planus.
○ Chronic plaque psoriasis.
○ Pityriasis lichenoides.
○ Atopic dermatitis.
○ Not sure.

p/2

Next Page >

training tool for chronic plaque psoriasis

Pre-training — Training — Post-training

Case 8

A 40-year-old female presented with a red, itchy rash on her face; present for the last 10 days. The rash started on the left nasal and cheek area. The initial rash on the left side had improved by applying tea tree oil, but 5 days later a similar rash appeared on her right cheek, nasal area, the skin behind the ears and her chin. The rash progressively worsened since then. She reported having similar episodes in the past that usually resolved by applying tea tree oil or apple cider compresses. For the present rash, the patient tried the same remedies with no benefit. She also tried one application of mild potency topical corticosteroid (hydrocortisone 1%) which only helped slightly. The patient was otherwise healthy.

What is the most likely diagnosis? *

○ Impetigo.
○ Subacute lupus erythematosus.
○ Chronic plaque psoriasis.
○ Seborrheic dermatitis.
○ Not sure.

1/2

Next Page >

242

training tool for chronic plaque psoriasis

✓ Pre-training ———— ○ Training ———— ○ Post-training

Case 8

A 40-year-old female presented with a red, itchy rash on her face; present for the last 10 days. The rash started on the left nasal and cheek area. The initial rash on the left side had improved by applying tea tree oil, but 5 days later a similar rash appeared on her right cheek, nasal area, the skin behind the ears and her chin. The rash progressively worsened since then. She reported having similar episodes in the past that usually resolved by applying tea tree oil or apple cider compresses. For the present rash, the patient tried the same remedies with no benefit. She also tried one application of mild potency topical corticosteroid (hydrocortisone 1%) which only helped slightly. The patient was otherwise healthy.

What is the most likely diagnosis? *

○ Impetigo.
○ Subacute lupus erythematosus.
○ Chronic plaque psoriasis.
○ Seborrheic dermatitis.
○ Not sure.

2/2

Next Page >

GPA Global Psoriasis Atlas | MANCHESTER 1824 The University of Manchester | IFPA | ILDS | IPC INTERNATIONAL PSORIASIS COUNCIL

www.globalpsoriasisatlas.org

Pre-training · Training · Post-training

Case 9

A 30-year-old lady presented to the GP clinic with grey coloured plaques on her limbs and forehead as shown in the images. These first appeared on her knees and elbows several months ago. However, the lesions have increased in size and cover a larger surface area. She also complained of itching and dandruff. She used emollient cream and topical corticosteroids (Betnovate cream) for the lesions on her limbs. She also used a topical calcineurin inhibitor (tacrolimus ointment) for her facial rash, and an over-the-counter coal tar shampoo for her scalp. She reported that her condition is worsening and not responding well to her current medications. The lady has no other significant medical history. On examination, you notice well-circumscribed, raised grey plaques covered by silvery/ white scale.

What is the most likely diagnosis? *

◯ Discoid Eczema.
◯ Chronic plaque psoriasis.
◯ Secondary syphilis.
◯ Lichen planus.
◯ Not sure.

1/3

Next Page >

Your ID

Pre-training — Training — Post-training

Case 9

A 30-year-old lady presented to the GP clinic with grey coloured plaques on her limbs and forehead as shown in the images. These first appeared on her knees and elbows several months ago. However, the lesions have increased in size and cover a larger surface area. She also complained of itching and dandruff. She used emollient cream and topical corticosteroids (Betnovate cream) for the lesions on her limbs. She also used a topical calcineurin inhibitor (tacrolimus ointment) for her facial rash, and an over-the-counter coal tar shampoo for her scalp. She reported that her condition is worsening and not responding well to her current medications. The lady has no other significant medical history. On examination, you notice well-circumscribed, raised grey plaques covered by silvery/ white scale.

What is the most likely diagnosis? *

◯ Discoid Eczema.
◯ Chronic plaque psoriasis.
◯ Secondary syphilis.
◯ Lichen planus.
◯ Not sure.

2/3

Next Page >

Pre-training — Training — Post-training

Case 9

A 30-year-old lady presented to the GP clinic with grey coloured plaques on her limbs and forehead as shown in the images. These first appeared on her knees and elbows several months ago. However, the lesions have increased in size and cover a larger surface area. She also complained of itching and dandruff. She used emollient cream and topical corticosteroids (Betnovate cream) for the lesions on her limbs. She also used a topical calcineurin inhibitor (tacrolimus ointment) for her facial rash, and an over-the-counter coal tar shampoo for her scalp. She reported that her condition is worsening and not responding well to her current medications. The lady has no other significant medical history. On examination, you notice well-circumscribed, raised grey plaques covered by silvery/ white scale.

3/3

What is the most likely diagnosis? *

○ Discoid Eczema.
○ Chronic plaque psoriasis.
○ Secondary syphilis.
○ Lichen planus.
○ Not sure.

Next Page >

Your ID

○──────○──────○
Pre-training Training Post-training

Case 10

A 30-year-old male presented to the clinic with pink/red rash on the extensor elbows and knees present for the last 12 months. On examination, you noticed sharply demarcated red plaques with silvery scales on those locations. He mentioned that the rash improved by applying emollient cream and fluocinonide ointment (A potent topical corticosteroid). The man has no other medical concern. His father had similar skin lesions over his elbows. The patient has penicillin allergy.

What is the most likely diagnosis? *

○ Allergic contact dermatitis.
○ Atopic dermatitis.
○ Chronic plaque psoriasis.
○ Secondary syphilis.
○ Seborrheic dermatitis.

1/2

Submit ✔

training
tool for chronic plaque psoriasis

Your ID

Pre-training — Training — Post-training

Case 10

A 30-year-old male presented to the clinic with pink/red rash on the extensor elbows and knees present for the last 12 months. On examination, you noticed sharply demarcated red plaques with silvery scales on those locations. He mentioned that the rash improved by applying emollient cream and fluocinonide ointment (A potent topical corticosteroid). The man has no other medical concern. His father had similar skin lesions over his elbows. The patient has penicillin allergy.

What is the most likely diagnosis? *

- ⃝ Allergic contact dermatitis.
- ⃝ Atopic dermatitis.
- ⃝ Chronic plaque psoriasis.
- ⃝ Secondary syphilis.
- ⃝ Seborrheic dermatitis.

2/2

Submit ✔

GPA Global Psoriasis Atlas | MANCHESTER 1824 The University of Manchester | IFPA | ILDS | IPC INTERNATIONAL PSORIASIS COUNCIL

www.globalpsoriasisatlas.org

Training

training
tool for chronic plaque psoriasis

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical image

Your ID

Pre-training — Training — Post-training

Identifying clinical signs of psoriasis using consensus agreed clinical diagnostic criteria for CPP in adults

➤ What follows?

➤ Background

➤ The diagnostic criteria

➤ Hints and tips

- What follows is the training part which consists of visual illustration of each diagnostic criterion with a plain language explanation.
- This aims to improve your diagnostic skills for chronic plaque psoriasis.
- Following the training there will be a test to check your understanding of the material.

Next Page ❯

Global Psoriasis Atlas   MANCHESTER 1824 The University of Manchester   IFPA   ILDS   IPC   INTERNATIONAL PSORIASIS COUNCIL

www.globalpsoriasisatlas.org

training
tool for chronic plaque psoriasis

Intro First: What do psoriasis lesion look like? Second: most commonly affected body parts Third: Nail changes Fourth: key clinical information Example clinical image

Your ID

Pre-training — Training — Post-training

Identifying clinical signs of psoriasis using consensus agreed clinical diagnostic criteria for CPP in adults

► What follows?

► Background

► The diagnostic criteria

► Hints and tips

- The diagnostic criteria were developed through an international consensus exercise with a group of psoriasis experts from around the world.
- The consensus agreed diagnostic criteria consist of chronic plaque psoriasis definition, one essential criterion and eight supportive criteria

Next Page >

training
tool for chronic plaque psoriasis

Intro First: What do psoriasis lesion look like? Second: most commonly affected body parts Third: Nail changes Fourth: key clinical information Example clinical image

Your ID

Pre-training — Training — Post-training

Identifying clinical signs of psoriasis using consensus agreed clinical diagnostic criteria for CPP in adults

► What follows?

► Background

► The diagnostic criteria

► Hints and tips

Definition: Chronic plaque psoriasis is systemic, inflammatory disease that predominately affects the skin. Skin lesions can occur on any part of the body and particularly affects extensor surfaces of the limbs especially elbows and knees. Other common sites for psoriasis to appear include the trunk, the umbilicus, over the lower back (sacrum), on the scalp involving the hairline, skin inside and behind the ears, the palms of the hands, soles of the feet and nails. Skin folds such as armpits, between the buttocks, genitals and under the breast may also be affected.

Essential clinical diagnostic criterion: Well-demarcated lesion with or without silvery/white scales.

Supportive clinical diagnostic criteria:

- Lesions are pink to red in colour. In deeply pigmented skin, lesions may be grey in colour
- Lesions vary in size
- Lesions are palpable.
- Lesions are symmetrically distributed.
- Family history of psoriasis in first degree relatives.
- Nail involvement (such as pitting, onycholysis and subungual hyperkeratosis of the nails)
- Joint pain and/or stiffness.
- Itching

Next Page >

training
tool for chronic plaque psoriasis

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical image

Your ID

Pre-training — Training — Post-training

Identifying clinical signs of psoriasis using consensus agreed clinical diagnostic criteria for CPP in adults

► What follows?

► Background

► The diagnostic criteria

► Hints and tips

- The definition highlights the most commonly affected body parts with psoriasis. Remember to examine these parts carefully for psoriasis lesions.
- You have got to have the essential criterion plus some of the supportive criteria to make a diagnosis of chronic plaque psoriasis.
- You can navigate through the training part. However, once you click on "Next. To the post-training test" you will not be able to go back.

Next Page >

training
tool for chronic plaque psoriasis

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical image

Your ID

Pre-training — Training — Post-training

First: What do psoriasis lesion look like?

1. "Well demarcated lesion with or without silvery white scales"

- Well demarcated (Well circumscribed) means that there is a distinct demarcation between involved and uninvolved skin.
- A scale is a visible accumulation of keratin, forming a flat plate or flake.

Hints and tips

- If you are looking to see if the lesion (i.e., rash) is well-demarcated, imagine yourself holding a pen and trying to trace the outline.
- If you are looking to see if the lesion/rash is covered with scales (i.e., flaky rash), gently rub the surface of the skin lesion to see if any flakes of skin come away.

► See distinct lesion borders

► See silvery/white scales

2. "Lesions vary in size"

This means that for the same patient, the size of a single chronic plaque psoriasis lesion can vary from a pinhead up to a diameter of few centimetres.

► See varying lesions sizes

training
tool | for chronic | plaque psoriasis

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical image

Your ID

Pre-training   Training   Post-training

First: What do psoriasis lesion look like?

1. "Well demarcated lesion with or without silvery white scales"

- Well demarcated (Well circumscribed) means that there is a distinct demarcation between involved and uninvolved skin.
- A scale is a visible accumulation of keratin, forming a flat plate or flake.

Hints and tips

- If you are looking to see if the lesion (i.e., rash) is well-demarcated, imagine yourself holding a pen and trying to trace the outline.
- If you are looking to see if the lesion/rash is covered with scales (i.e., flaky rash), gently rub the surface of the skin lesion to see if any flakes of skin come away.

➤ See distinct lesion borders

➤ See silvery/white scales

2. "Lesions vary in size"

This means that for the same patient, the size of a single chronic plaque psoriasis lesion can vary from a pinhead up to a diameter of few centimetres.

➤ See varying lesions sizes

3. "Lesions are symmetrically distributed"

Symmetrical distribution refers to lesions or pattern with symmetry along an axis (e.g., the midline).

Hints and tips

- If you are looking to see if a skin lesion/rash is symmetrically distributed across the midline, imagine a vertical line dividing the body of the individual into a right and left parts.
- Symmetrically distributed, means the location of the lesions are similar on both sides (e.g., rash found on both arms, and/or both elbows). The rash does not need to have exactly the same size or have the same number of lesions.

1/2

4. "Lesions are pink to red in colour, in deeply pigmented skin, lesions may be grey in colour"

Hints and tips

- Remember that lesions' colour varies according to the patient's skin tone from pink/red lesions on lighter skin to grey lesions on deeply pigmented skin.

1/2

253

training
tool

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical images

3. "Lesions are symmetrically distributed"

Symmetrical distribution refers to lesions or pattern with symmetry along an axis (e.g., the midline).

Hints and tips

- If you are looking to see if a skin lesion/rash is symmetrically distributed across the midline, imagine a vertical line dividing the body of the individual into a right and left parts.
- Symmetrically distributed, means the location of the lesions are similar on both sides (e.g., rash found on both arms, and/or both elbows). The rash does not need to have exactly the same size or have the same number of lesions.

2/2

4. "Lesions are pink to red in colour, in deeply pigmented skin, lesions may be grey in colour"

Hints and tips

- Remember that lesions' colour varies according to the patient's skin tone from pink/red lesions on lighter skin to grey lesions on deeply pigmented skin.
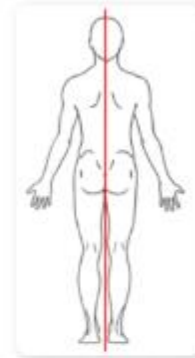

2/2

5. "Lesions are palpable"

This means that lesions can be slightly raised, not flat skin lesion (i.e., able to be touched or felt)

Hints and tips

- If you are looking to see if the lesion is palpable, try to feel the skin.

< Previous Page   **Next Page >**

training
tool

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical image

Your ID

Pre-training — Training — Post-training

Second: most commonly affected body parts

Chronic plaque psoriasis can affect any part of the body, however, always remember to examine the following body sites:

1. Extensor surfaces (of extremities): the area of skin on the outside of a joint. Examples of an extensor surface include the front of the knee and the back of the elbow or forearm.
2. Scalp involving the hairline.
3. Skin inside and behind the ears.
4. Trunk (the central part of the human body from which extend the neck and limbs. This includes all or any parts of the chest, abdomen and/or back. Do not forget to examine the umbilicus (belly button) and lower back (sacrum).
5. The palms of the hands.
6. Soles of the feet.
7. Skin folds such as armpits, the area of skin between the buttocks (gluteal cleft), genitals and skin under the breast.
8. Nails.

< Previous Page

Next Page >

training tool for chronic plaque psoriasis

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical image

Your ID

Pre-training — Training — Post-training
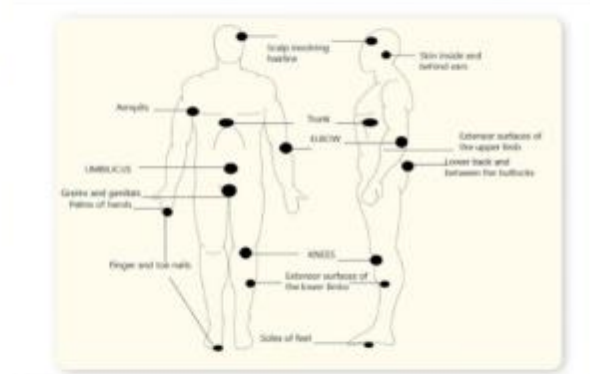
Third: Nail changes

Nail involvement (such as pitting, onycholysis, and subungual hyperkeratosis of the nails)

Nail pitting: pin-point depressions in the nail

Onycholysis: Detachment of the nail from the nail bed. (i.e., lifting of the nail edge so it has separated from the skin below).

Subungual hyperkeratosis of the nails: thickening of the underside of the nail or the nail itself (build-up of skin under the nail).

Hints and tips

- Remember to look at the nails of fingers and toes.
- Nail changes only need to affect one (or more) fingernail(s)/toenail(s).

< Previous Page   Next Page >

training tool for chronic plaque psoriasis

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third. Nail changes   **Fourth: key clinical information**   Example clinical images

Your ID

Pre-training ✓ ———— Training ✓ ———— Post-training ○

Fourth: key clinical information

✓ Family history of psoriasis in a first degree relative

✓ Joint pain and/or stiffness

✓ Itching

< Previous Page   Next Page >

training tool for chronic plaque psoriasis

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third. Nail changes   Fourth: key clinical information   **Example clinical images**

Your ID

Pre-training ✓ ———— Training ✓ ———— Post-training ○

Example clinical images

Please view these additional images to support your understanding

Chronic plaque psoriasis ▼

Psoriasis on skin of colour ▼

Scalp psoriasis ▼

Nail psoriasis ▼

< Previous Page   Next: To the post-training test ✓

training tool for chronic plaque psoriasis

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical images

Your ID

Pre-training — Training — Post-training
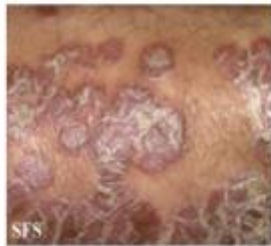
Example clinical images

Please view these additional images to support your understanding

Chronic plaque psoriasis ▾

Psoriasis on skin of colour ▾

Scalp psoriasis ▾

Nail psoriasis ▾

< Previous Page

Next: To the post-training test ✔

www.globalpsoriasisatlas.org

258

training

Intro   First: What do psoriasis lesion look like?   Second: most commonly affected body parts   Third: Nail changes   Fourth: key clinical information   Example clinical images

Your ID

◉ ——— ◉ ——— ○
Pre-training   Training   Post-training

Example clinical images

Please view these additional images to support your understanding

Chronic plaque psoriasis ▼

Psoriasis on skin of colour ▼

Scalp psoriasis ▼

Nail psoriasis ▼

< Previous Page

Next: To the post-training test ✔

GPA — Global Psoriasis Atlas   MANCHESTER 1824 The University of Manchester   IFPA   ILDS   IPC INTERNATIONAL PSORIASIS COUNCIL

www.globalpsoriasisatlas.org   🐦 ⓕ 📷 in

259

Your ID

Pre-training ✓ ——— Training ✓ ——— Post-training ○

Example clinical images

Please view these additional images to support your understanding

Chronic plaque psoriasis ▼

Psoriasis on skin of colour ▼

Scalp psoriasis ▼

Nail psoriasis ▼

< Previous Page

Next: To the post-training test ✓

Post-training

training
tool

Your ID

○───────○───────○
Pre-training   Training   Post-training

Pre-training

The pre-training test aims to test your pre-existing knowledge of chronic plaque psoriasis diagnosis.

Case 1

A 38-year-old male presented with a red rash on his arms and trunk for the last 8 months. The rash was slightly itchy. The patient described the rash as irritating and had a rough texture. The patient reported worsening of his symptoms with exercise and in warmer weather. The patient has no significant medical history, however he reported previous allergic reaction to erythromycin. The patient reported using an emollient cream which helped slightly with irritation. No family history of similar skin condition.

What is the most likely diagnosis? *

○ Contact dermatitis.
○ Chronic plaque psoriasis.
○ Tinea corporis.
○ Adverse drug reaction.
○ Not sure.

1/2

Next Page >

training tool
for chronic plaque psoriasis

Your ID

○ Pre-training ── ○ Training ── ○ Post-training

Pre-training

The pre-training test aims to test your pre-existing knowledge of chronic plaque psoriasis diagnosis.

Case 1

A 38-year-old male presented with a red rash on his arms and trunk for the last 8 months. The rash was slightly itchy. The patient described the rash as irritating and had a rough texture. The patient reported worsening of his symptoms with exercise and in warmer weather. The patient has no significant medical history, however he reported previous allergic reaction to erythromycin. The patient reported using an emollient cream which helped slightly with irritation. No family history of similar skin condition.

What is the most likely diagnosis? *

○ Contact dermatitis.
○ Chronic plaque psoriasis.
○ Tinea corporis.
○ Adverse drug reaction.
○ Not sure.

2/2

Next Page >

263

Your ID

Pre-training — Training — Post-training

Case 2

A 31-year-old Afro-Caribbean male presented to you with an itchy, hyperpigmented rash over the trunk. He first noticed the rash on his chest and upper back 10 days ago, which then gradually spread over the abdomen, arms and legs. He complains of a low grade fever, headache and fatigue. He had visited the local pharmacist when he first noticed the rash and has been prescribed antihistamine (Benadryl), Betnovate cream. The patient has also been advised to apply moisturizer once or twice a day over the rash. The itching has improved but the rash still present.

What is the most likely diagnosis? "

○ Tinea versicolor.
○ Atopic dermatitis.
○ Chronic plaque psoriasis.
○ Pityriasis Rosea.
○ Not sure.

Next Page >

Your ID

Pre-training — Training — Post-training

Case 3

A 40-year-old male presented to the GP clinic with a several months history of deeply pigmented scaly plaques and papules on both of his upper extremities and chest. He first noticed similar but smaller lesions on the back of his right hand. At first lesions improved by applying moisturiser and a topical corticosteroids cream (Dermovate cream). The lesions now are more widespread and not responding very well to the usual medication. He has no family history of similar skin condition. Patient is otherwise healthy.

On examination: lesions were scaly, rough textured and symmetrically distributed on both upper extremities and across his chest. You also noticed pin-sized depressions on his fingernails.

What is the most likely diagnosis? *

○ Discoid lupus erythematosus.
○ Nummular eczema.
○ Chronic plaque psoriasis.
○ Lichen planus.
○ Not sure.

SFS

1/2

Next Page >

Your ID

Pre-training — Training — Post-training

Case 3

A 40-year-old male presented to the GP clinic with a several months history of deeply pigmented scaly plaques and papules on both of his upper extremities and chest. He first noticed similar but smaller lesions on the back of his right hand. At first lesions improved by applying moisturiser and a topical corticosteroids cream (Dermovate cream). The lesions now are more widespread and not responding very well to the usual medication. He has no family history of similar skin condition. Patient is otherwise healthy.

On examination: lesions were scaly, rough textured and symmetrically distributed on both upper extremities and across his chest. You also noticed pin-sized depressions on his fingernails.

What is the most likely diagnosis? *

○ Discoid lupus erythematosus.
○ Nummular eczema.
○ Chronic plaque psoriasis.
○ Lichen planus.
○ Not sure.

2/2

Next Page >

Your ID

Pre-training — Training — Post-training

Case 4

A 35-year-old woman presented with red scaly patches on her face. Thick scaly plaques and papules were also found on the scalp and the skin inside and behind her ears as shown in the image. The patient also complained of itchy scalp. The patient had milder outbreaks of the rash before which usually responded to coal-tar shampoo for the scalp rash and moisturizer with a topical Calcineurin inhibitor (Tacrolimus 0.03 ointment) for the facial rash. She also reported that her brother had been diagnosed with psoriasis 10 years ago. The patient has no other medical concern.

What is the most likely diagnosis? *

○ Chronic plaque psoriasis.
○ Tinea capitis.
○ Seborrheic dermatitis.
○ Atopic dermatitis.
○ Not sure.

Next Page >

www.globalpsoriasisatlas.org

Pre-training   Training   Post-training

Case 5

A 32-years-old female presented with an itchy skin rash. The rash started as shiny blotches over the flexural surface of her wrists (see image) and within 3 weeks spread to both arms. She also reported a burning sensation in the mouth and few mouth blisters which she attributed to having a spicy meal. The woman also complained of a mild fever. This is the first episode of such a skin rash. She had used over the counter 1% hydrocortisone cream and an emollient lotion, but her condition did not improve.

What is the most likely diagnosis? *

○ Scabies.
○ Lichen simplex chronicus.
○ Chronic plaque psoriasis.
○ Lichen planus.
○ Not sure.

Next Page >

Your ID

✓ Pre-training ○ Training ○ Post-training

Case 6

A 26-year-old female with no past medical history, presented with a pink/red rash on the nape of her neck that had been present for 3 weeks. When it first appeared, the rash was raised and the patient's entire neck, beyond the site of the rash, was extremely itchy. The itching over the neck had resolved with the use of a moisturiser and over the counter topical corticosteroid cream (1% hydrocortisone) but the rash itself remained itchy. The patient then applied mupirocin ointment (topical antibiotic) for 3–4 days as prescribed by a community pharmacist, but it did not help. The patient felt otherwise well.

What is the most likely diagnosis? *

○ Chronic plaque psoriasis.
○ Lichen simplex.
○ Atopic dermatitis.
○ Contact dermatitis.
○ Not sure.

Next Page ❯

training
tool for chronic plaque psoriasis

Your ID

✓ Pre-training ——— ◯ Training ——— ◯ Post-training

Case 7

A 50-year-old male presented with well-demarcated red scaly annular plaques, scattered on his trunk, face and scalp. The man reported fingernails discolouration as shown in the image. He also complained of pain and swelling of his fingers. No family history of psoriasis.

What is the most likely diagnosis? *

◯ Lichen planus.
◯ Chronic plaque psoriasis.
◯ Pityriasis lichenoides.
◯ Atopic dermatitis.
◯ Not sure.

1/2

Next Page >

270

Your ID

Pre-training — Training — Post-training

Case 7

A 50-year-old male presented with well-demarcated red scaly annular plaques, scattered on his trunk, face and scalp. The man reported fingernails discolouration as shown in the image. He also complained of pain and swelling of his fingers. No family history of psoriasis.

What is the most likely diagnosis? *

○ Lichen planus.
○ Chronic plaque psoriasis.
○ Pityriasis lichenoides.
○ Atopic dermatitis.
○ Not sure.

2/2

Next Page >

Pre-training — Training — Post-training

Case 8

A 40-year-old female presented with a red, itchy rash on her face; present for the last 10 days. The rash started on the left nasal and cheek area. The initial rash on the left side had improved by applying tea tree oil, but 5 days later a similar rash appeared on her right cheek, nasal area, the skin behind the ears and her chin. The rash progressively worsened since then. She reported having similar episodes in the past that usually resolved by applying tea tree oil or apple cider compresses. For the present rash, the patient tried the same remedies with no benefit. She also tried one application of mild potency topical corticosteroid (hydrocortisone 1%) which only helped slightly. The patient was otherwise healthy.

What is the most likely diagnosis? *

- ◯ Impetigo.
- ◯ Subacute lupus erythematosus.
- ◯ Chronic plaque psoriasis.
- ◯ Seborrheic dermatitis.
- ◯ Not sure.

1/2

Next Page >

training

Your ID

✓ Pre-training ——— ○ Training ——— ○ Post-training

Case 8

A 40-year-old female presented with a red, itchy rash on her face; present for the last 10 days. The rash started on the left nasal and cheek area. The initial rash on the left side had improved by applying tea tree oil, but 5 days later a similar rash appeared on her right cheek, nasal area, the skin behind the ears and her chin. The rash progressively worsened since then. She reported having similar episodes in the past that usually resolved by applying tea tree oil or apple cider compresses. For the present rash, the patient tried the same remedies with no benefit. She also tried one application of mild potency topical corticosteroid (hydrocortisone 1%) which only helped slightly. The patient was otherwise healthy.

What is the most likely diagnosis? *

○ Impetigo.
○ Subacute lupus erythematosus.
○ Chronic plaque psoriasis.
○ Seborrheic dermatitis.
○ Not sure.

2/2

Next Page >

273

Pre-training Training Post-training

Case 9

A 30-year-old lady presented to the GP clinic with grey coloured plaques on her limbs and forehead as shown in the images. These first appeared on her knees and elbows several months ago. However, the lesions have increased in size and cover a larger surface area. She also complained of itching and dandruff. She used emollient cream and topical corticosteroids (Betnovate cream) for the lesions on her limbs. She also used a topical calcineurin inhibitor (tacrolimus ointment) for her facial rash, and an over-the-counter coal tar shampoo for her scalp. She reported that her condition is worsening and not responding well to her current medications. The lady has no other significant medical history. On examination, you notice well-circumscribed, raised grey plaques covered by silvery/ white scale.

What is the most likely diagnosis? *

○ Discoid Eczema.
○ Chronic plaque psoriasis.
○ Secondary syphilis.
○ Lichen planus.
○ Not sure.

1/3

Next Page >

Your ID

Pre-training — Training — Post-training

Case 9

A 30-year-old lady presented to the GP clinic with grey coloured plaques on her limbs and forehead as shown in the images. These first appeared on her knees and elbows several months ago. However, the lesions have increased in size and cover a larger surface area. She also complained of itching and dandruff. She used emollient cream and topical corticosteroids (Betnovate cream) for the lesions on her limbs. She also used a topical calcineurin inhibitor (tacrolimus ointment) for her facial rash, and an over-the-counter coal tar shampoo for her scalp. She reported that her condition is worsening and not responding well to her current medications. The lady has no other significant medical history. On examination, you notice well-circumscribed, raised grey plaques covered by silvery/ white scale.

What is the most likely diagnosis? *

○ Discoid Eczema.
○ Chronic plaque psoriasis.
○ Secondary syphilis.
○ Lichen planus.
○ Not sure.

2/3

Next Page >

training
tool | by chronic plaque psoriasis

Your ID

Pre-training — Training — Post-training

Case 9

A 30-year-old lady presented to the GP clinic with grey coloured plaques on her limbs and forehead as shown in the images. These first appeared on her knees and elbows several months ago. However, the lesions have increased in size and cover a larger surface area. She also complained of itching and dandruff. She used emollient cream and topical corticosteroids (Betnovate cream) for the lesions on her limbs. She also used a topical calcineurin inhibitor (tacrolimus ointment) for her facial rash, and an over-the-counter coal tar shampoo for her scalp. She reported that her condition is worsening and not responding well to her current medications. The lady has no other significant medical history. On examination, you notice well-circumscribed, raised grey plaques covered by silvery/ white scale.

What is the most likely diagnosis? *

◯ Discoid Eczema.
◯ Chronic plaque psoriasis.
◯ Secondary syphilis.
◯ Lichen planus.
◯ Not sure.

3/3

Next Page >

G P A
Global Psoriasis Atlas

MANCHESTER
1824
The University of Manchester

IFPA

ILDS

IPC

INTERNATIONAL
PSORIASIS
COUNCIL

www.globalpsoriasisatlas.org

Your ID

Pre-training — Training — Post-training

Case 10

A 30-year-old male presented to the clinic with pink/red rash on the extensor elbows and knees present for the last 12 months. On examination, you noticed sharply demarcated red plaques with silvery scales on those locations. He mentioned that the rash improved by applying emollient cream and fluocinonide ointment (A potent topical corticosteroid). The man has no other medical concern. His father had similar skin lesions over his elbows. The patient has penicillin allergy.

What is the most likely diagnosis? *

- ○ Allergic contact dermatitis.
- ○ Atopic dermatitis.
- ○ Chronic plaque psoriasis.
- ○ Secondary syphilis.
- ○ Seborrheic dermatitis.

1/2

Submit ✓

277

training
to**ol** for chronic plaque psoriasis

Your ID

Pre-training — Training — Post-training

Case 10

A 30-year-old male presented to the clinic with pink/red rash on the extensor elbows and knees present for the last 12 months. On examination, you noticed sharply demarcated red plaques with silvery scales on those locations. He mentioned that the rash improved by applying emollient cream and fluocinonide ointment (A potent topical corticosteroid). The man has no other medical concern. His father had similar skin lesions over his elbows. The patient has penicillin allergy.

What is the most likely diagnosis? *

◯ Allergic contact dermatitis.
◯ Atopic dermatitis.
◯ Chronic plaque psoriasis.
◯ Secondary syphilis.
◯ Seborrheic dermatitis.

2/2

Submit ✔

GPA Global Psoriasis Atlas | MANCHESTER 1824 The University of Manchester | IFPA | ILDS | IPC INTERNATIONAL PSORIASIS COUNCIL

www.globalpsoriasisatlas.org   🐦 📘 📷 in

Results

training
tool | for chronic plaque psoriasis

Case 1

Your answer from pre-training test:	Your answer from post-training test:	The correct answer
○ Contact dermatitis.	○ Contact dermatitis.	**Tinea corporis**
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	
○ Tinea corporis.	○ Tinea corporis.	
○ Adverse drug reaction.	○ Adverse drug reaction.	
○ Not sure.	○ Not sure.	

Features to support the most favourable diagnosis: Ringworm infections thrive in humid and hot environment. The patient reported his symptoms exacerbate in warmer weather and with exercise which is suggestive of Tinea corporis. Itching further supports the diagnosis.

Case 2

Your answer from pre-training test:	Your answer from post-training test:	The correct answer
○ Tinea versicolor.	○ Tinea versicolor.	**Pityriasis Rosea**
○ Atopic dermatitis.	○ Atopic dermatitis.	
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	
○ Pityriasis Rosea.	○ Pityriasis Rosea.	
○ Not sure.	○ Not sure.	

Features to support the most favourable diagnosis: Pityriasis Rosea is a self-limiting rash; most commonly affecting people aged 10-35 years. Pityriasis Rosea is the most likely diagnosis here due to the widespread, eczematous popular appearance of the rash as shown in the clinical image.

Case 3

Your answer from pre-training test:	Your answer from post-training test:	The correct answer:
○ Discoid lupus erythematosus.	○ Discoid lupus erythematosus.	**Chronic plaque psoriasis**
○ Nummular eczema.	○ Nummular eczema.	
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	
○ Lichen planus.	○ Lichen planus.	
○ Not sure.	○ Not sure.	

The following clinical features support the diagnosis of chronic plaque psoriasis:
- Well-demarcated lesion covered with silvery scales which is an essential diagnostic criterion for chronic plaque psoriasis.
- Lesions are grey in colour.
- Lesions vary in size.
- Lesions are symmetrically distributed on both upper extremities and across the chest.
- Nail involvement (nail pitting).

Case 4

Your answer from pre-training test:	Your answer from post-training test:	The correct answer:
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	**Chronic plaque psoriasis**
○ Tinea capitis.	○ Tinea capitis.	
○ Seborrheic dermatitis.	○ Seborrheic dermatitis.	
○ Atopic dermatitis.	○ Atopic dermatitis.	
○ Not sure.	○ Not sure.	

The following clinical features support the diagnosis of chronic plaque psoriasis:
- Well-demarcated lesions covered with silvery scales which is an essential diagnostic criterion for chronic plaque psoriasis.
- Lesions are pink to red in colour.
- Lesions vary in size.
- Itching.
- Family history of psoriasis.

Also, lesion distribution on the scalp and skin inside and behind her ears, further support the diagnosis.

Case 5

Your answer from pre-training test:	Your answer from post-training test:	The correct answer:
○ Scabies.	○ Scabies.	**Lichen planus**
○ Lichen simplex chronicus.	○ Lichen simplex chronicus.	
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	
○ Lichen planus.	○ Lichen planus.	
○ Not sure.	○ Not sure.	

Features to support the most favourable diagnosis: Lichen planus is an inflammatory skin condition characterised by an itchy rash. In this case scenario, the most likely feature to support the diagnosis is the shiny multiple, small, flat topped erythematous blotches over the flexural surface of the wrist. Also, the clinical history of burning sensation and blisters in the mouth with mild constitutional symptoms (fever) further support the diagnosis.

Case 6

Your answer from pre-training test:	Your answer from post-training test:	The correct answer:
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	**Lichen simplex**
○ Lichen simplex.	○ Lichen simplex.	
○ Atopic dermatitis.	○ Atopic dermatitis.	
○ Contact dermatitis.	○ Contact dermatitis.	
○ Not sure.	○ Not sure.	

Features to support the most favourable diagnosis: In this case, the most favoured diagnosis is Lichen simplex because of the thickened, elevated appearance of the skin lesions and the clinical history of persistent, local itching.

Case 7

Your answer from pre-training test:	Your answer from post-training test:	The correct answer:
○ Lichen planus.	○ Lichen planus.	**Chronic plaque psoriasis**
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	
○ Pityriasis lichenoides.	○ Pityriasis lichenoides.	
○ Atopic dermatitis.	○ Atopic dermatitis.	
○ Not sure.	○ Not sure.	

Chronic plaque psoriasis is the most favoured diagnosis here because:
- The lesions are well-demarcated and covered by silvery/white scales.
- Lesions are pink to red in colour.
- Lesions vary in size.
- Nail involvement (nail onycholysis with oil spot sign).
- Joint pain and swelling.

Lesion distribution over the trunk further support the diagnosis.

Case 8

Your answer from pre-training test:	Your answer from post-training test:	The correct answer:
○ Impetigo.	○ Impetigo.	**Seborrheic dermatitis**
○ Subacute lupus erythematosus.	○ Subacute lupus erythematosus.	
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	
○ Seborrheic dermatitis.	○ Seborrheic dermatitis.	
○ Not sure.	○ Not sure.	

Features to support the most favourable diagnosis: Given the appearance and distribution of the skin rash, the most favoured diagnosis here is Seborrheic dermatitis. The lesions behind the ear show signs of superadded bacterial skin infection. Seborrheic dermatitis may be misdiagnosed with facial psoriasis because of their clinical presentations' resemblance. However, in this case, the ill-demarcated erythematous rash favours the diagnosis of Seborrheic dermatitis. According to the consensus agreed diagnostic criteria of CPP, lesion must be well-demarcated with or without silvery white scales.

Case 9

Your answer from pre-training test:	Your answer from post-training test:	The correct answer:
○ Discoid Eczema.	○ Discoid Eczema.	**Chronic plaque psoriasis**
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	
○ Secondary syphilis.	○ Secondary syphilis.	
○ Lichen planus.	○ Lichen planus.	
○ Not sure.	○ Not sure.	

Chronic plaque psoriasis is the most favoured diagnosis here because:
- The lesions are well-demarcated and covered by silvery/white scales.
- Lesions are grey in colour.
- Lesions vary in size.
- Lesions are symmetrically distributed.
- Itching.

Case 10

Your answer from pre-training test:	Your answer from post-training test:	The correct answer:
○ Allergic contact dermatitis.	○ Allergic contact dermatitis.	**Chronic plaque psoriasis**
○ Atopic dermatitis.	○ Atopic dermatitis.	
○ Chronic plaque psoriasis.	○ Chronic plaque psoriasis.	
○ Secondary syphilis.	○ Secondary syphilis.	
○ Seborrheic dermatitis.	○ Seborrheic dermatitis.	

Chronic plaque psoriasis is the most favoured diagnosis here because:
- The lesions are well-demarcated and covered by silvery/white scales.
- Lesions are grey in colour.
- Lesions vary in size.
- Palpable lesions.
- Itching.
- The lesions are symmetrically distributed across the midline.

Also, the lesions distribution over the extensor surfaces of the limbs, forehead, and the scalp involving hairline favours chronic plaque psoriasis diagnosis.

282

Total score - Pre-training test	Total score - Post-training test
0	**0**

Confirm ✔

Feedback questionnaire

training tool for chronic plaque psoriasis

Feedback questionnaire

Your ID

Please rate the following aspects of the training tool on a scale of 1-5.
(1 being poor and 5 being excellent).

1. This course provided a good introduction to the clinical diagnostic criteria of chronic plaque psoriasis. *
☆☆☆☆☆

2. The learning objectives set for this training course are met by studying the material. *
☆☆☆☆☆

3. The training material were helpful. *
☆☆☆☆☆

4. The training course contained the right amount of detail. *
☆☆☆☆☆

5. The content was at the right level for me. *
☆☆☆☆☆

6. The written training material for this course was clear and easy to understand. *
☆☆☆☆☆

283

7. The use of illustrations was helpful to improve my understanding. *

★★★★★

8. The use of clinical images was helpful to improve my understanding. *

★★★★★

9. In the clinical case scenarios, there were enough information to make clinical diagnosis of chronic plaque psoriasis or to roll out its diagnosis. *

★★★★★

10. There were enough illustrations to learn about each diagnostic criterion. *

★★★★★

11. I would find it useful to have access to this training course as a resource for future reference. *

★★★★★

12. I feel more confident with my chronic plaque psoriasis diagnostic skills. *

★★★★★

Next Page >

Feedback questionnaire

Your ID

How confident are you in making a diagnosis of chronic plaque psoriasis after training ? *

○ Not confident at all
○ Slightly confident
○ Not sure
○ Fairly confident
○ Completely confident

Next Page >

training tool
for chronic plaque psoriasis

Feedback questionnaire

Please answer the following questions:

1. Did you like the design of the training course? *
◯ Yes ◯ No

2. Did you experience any technical difficulties while using the e-learning course? *
◯ Yes ◯ No

3. Did you enjoy working through the course? *
◯ Yes ◯ No

4. The length of time took me to complete the training course was acceptable. *
◯ Yes ◯ No

5. Approximately, how long did it take to complete the course? *

If you have any other comments or suggestions, please provide details below:

Copyright note

‹ Previous Page   **Confirm ✔**