Automatic Generalized Pustular Psoriasis Physician Global Assessment (AGPPGA)

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Abstract

❏ Generalized Pustular Psoriasis (GPP) is a rare, chronic, and severe inflammatory skin disorder characterized by sudden eruption of sterile pustules, often accompanied by systemic inflammation.

❏ **The GPPGA scoring system is limited** by subjectivity, inter-observer variability, lack of patient-reported outcomes, insufficient emphasis on systemic symptoms, acute versus chronic assessment issues, standardisation problems, sensitivity to change, and the need for specialised training.

❏ This study introduces AGPPGA, a novel framework for the **automatic evaluation of GPP severity** using computer vision. AGPPGA overcomes the limitations of manual evaluation, providing a more objective and efficient method, and helping standardise GPP assessment protocols by automatically assessing the 4-point scale system of severity.

Introduction and objective

Generalised pustular psoriasis (GPP) is a severe, rare form of psoriasis with life-threatening risks if untreated. Its rarity and the subjectivity and slowness of manual evaluation have led to the lack of standardised severity assessment criteria.

To address these issues, this work has put to the test **Legit.Health's Automatic Generalised Pustular Psoriasis Physician Global Assessment (AGPPGA)**. Using deep learning and computer vision techniques, AGPPGA efficiently assesses the severity of pustules, erythema, and scaling.

Materials and methods

The Generalised Pustular Psoriasis Physician Global Assessment (GPPGA) is a clinical severity assessment system for GPP, using a 4-point scale to assess the severity of pustules, erythema, and scaling. Each component is scored from 0 to 4: clear (0), almost clear (1), mild (2), moderate (3), and severe (4).

The final GPPGA score is the mean of the three component scores:

$$GPPGA = \frac{pustules + erythema + scaling}{3}$$

Figure 1. Visualization of the GPPGA scoring system.

Note: Burden, A. D., Bachelez, H., Choon, S. E., Marrakchi, S., Tsai, T. F., Turki, H., ... & Duffin, K. C. (2023). The Generalized Pustular Psoriasis Physician Global Assessment (GPPGA) score: online assessment and validation study of a specific measure of GPP disease activity. British Journal of Dermatology, 189(1), 138-140.

The AGPPGA framework consists of a novel multi-task computer vision model, underlined: based on convolutions, attention, and mixture of experts, and optimized for the joint calculation of the three GPPGA visual signs. AGPPGA results are delivered with high efficiency and accuracy, serving as a support tool both for primary care specialists and dermatologists, in healthcare centres and the pharmacy industry.

Dataset

We used a dataset of 231 images of pustular psoriasis from public sources and open dermatology atlases. The images from this dataset captured solely the lesion of interest excluding the patient's body.

Compiled images were annotated by 3 different dermatologists with expertise in generalized pustular psoriasis. The consensus of all dermatologists was used to train and evaluate AGPPGA.

Results

Our study shows that the Automatic Generalised Pustular Psoriasis Physician Global Assessment **(AGPPGA) framework effectively assesses pustule severity, erythema, and scaling** in patients with generalised pustular psoriasis (GPP).

The deep learning model, trained on diverse, expertly labelled datasets, performs well in severity assessments. AGPPGA reduces inter-observer variability and **improves assessment efficiency, producing results comparable to experienced dermatologists.** Its simplicity and accessibility make it a valuable tool for primary care doctors, dermatologists, and patients, with potential benefits for clinical practices and the pharmaceutical industry.

Table 1. Evaluation of the proposed AGPPGA framework

	Pustules		Erythema		Scaling		Aggregated results		GPPGA scoring
	Acc.	Ck.	Acc.	Ck.	Acc.	Ck.	Acc.	Ck.	MAE
AGPPGA	50%	75%	75%	76%	70%	61%	65%	71%	0.28
Annotators	69%	80%	75%	75%	71%	73%	72%	76%	0.31

Note: We evaluate the performance (in terms of accuracy and Cohen's Kappa) of each annotator with respect to their consensus. This approach quantifies inter-rater agreement relative to the annotators' consensus and enables us to compare the AGPPGA model's performance against that of experienced dermatologists.

Figure 2. Visualization of Legit.Health medical device
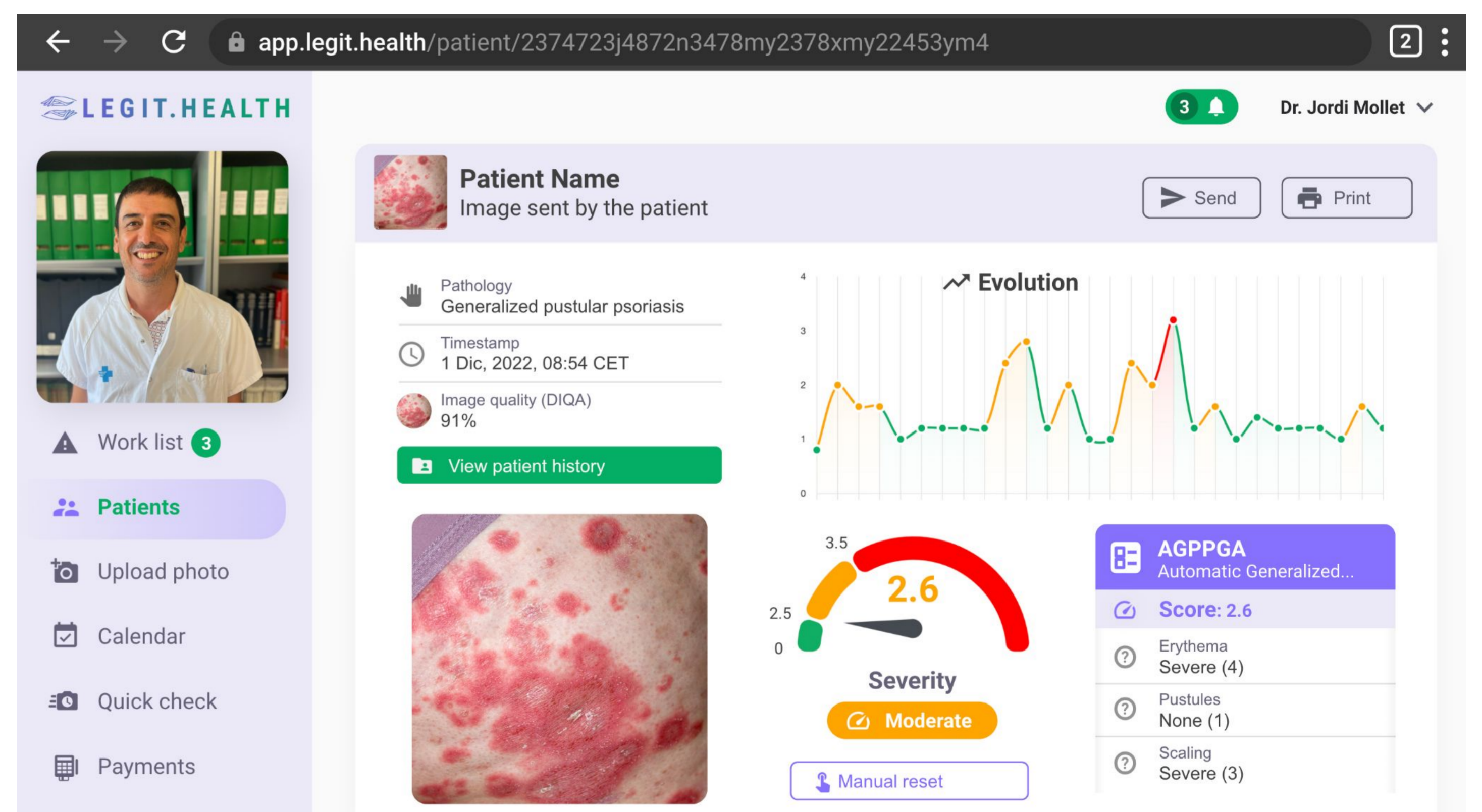
Note: The AGPPGA framework, is integrated it into a CE-marked medical device called Legit.Health. The device is accessible through a web application. The medical device evaluates the severity of a GPP lesion through three stages: uploading an image of the lesion, processing the image, and reporting the AGPPGA results.

Conclusion

The AGPPGA framework demonstrates potential advantages over manual GPPGA assessments by providing a more objective, efficient, and accurate evaluation of GPP severity. However, the quality of AI assessments is contingent on the quality of input images, necessitating well-captured photographs to ensure precise evaluations. Future research will focus on evaluating the framework's applicability to a more diverse population sample to enhance its generalizability beyond the primarily Caucasian subjects used in this study. The AGPPGA framework holds promise for improving the diagnosis and management of rare conditions like GPP in various healthcare settings.

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