Understanding psoriasis care costs and the impact of comorbidities: a time-driven activity-based costing analysis in an integrated practice unit

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ABSTRACT

Objectives The study aims to evaluate the cost of managing psoriasis and its comorbidities across multiple medical departments and to identify cost determinants based on patient, disease and treatment characteristics. Additionally, it compares the cost of care with reimbursements under the fee-for-service (FFS) system to assess how well they reflect patient-specific care needs.

Design Seven-step, time-driven activity-based costing (TD-ABC) analysis based on direct observations and interviews to generate patient-level cost estimates over the full cycle of care for participants prospectively enrolled in a clinical trial.

Setting An integrated practice unit (IPU) at a Belgian University Hospital, centred around the treatment of psoriasis, including the management of associated comorbidities.

Participants A total of 52 patients meeting the trial's inclusion criteria, enrolled between January 2023 and November 2023, undergoing treatment within the IPU.

Results The individual cost of care over a 6-month period ranged from €169.78 to €1454.97, highlighting significant variability. Major cost drivers included mental health status and disease severity. Additionally, the presence of one or more comorbidities had a substantial impact on care costs, affecting not only expenses directly related to comorbidity management but often also those associated with dermatological care. Finally, a comparison between the TD-ABC cost variability and reimbursement tariffs variability revealed disparities, indicating that current tariffs do not sufficiently account for patient-specific cost differences.

Conclusions Healthcare delivery and costing studies often adopt a fragmented approach, limiting cost insights into the full cycle of care for a medical condition. The TD-ABC methodology can address this gap by generating detailed, patient-level cost estimates for both primary illness management and related comorbidities. Our findings underscore the importance of including comorbidity-related costs when discussing a condition's overall economic burden while also revealing significant cost variability among patients with the same disease. Notably, these variations are not sufficiently addressed by the current FFS reimbursement system.

Trial registration number NCT05480917 (ClinicalTrials.gov).

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ A comprehensive seven-step, time-driven activity-based costing analysis within an Integrated Practice Unit.
⇒ The study provides individual care cost estimates for managing psoriasis patients, including costs related to comorbidities.
⇒ Performed a cost variation analysis using patient, disease and treatment characteristics, including comparisons with reimbursement variations under a fee-for-service system.
⇒ The relatively small sample size limits the ability to draw statistically significant conclusions.
⇒ Overhead costs were excluded from the calculated patient care costs.

INTRODUCTION

Healthcare is transitioning from treating isolated medical conditions to providing integrated care that addresses patients' comprehensive health needs.[1 2] The aim is to improve care quality while controlling costs by breaking down barriers between specialties and delivering care for primary illnesses alongside associated complications and comorbidities.[3] One way to achieve this is through Integrated Practice Units (IPUs), a healthcare delivery model developed within the Value-Based Healthcare (VBHC) framework. VBHC attempts to lower healthcare expenditures by encouraging patient-centred care and aligning costs more closely with health outcomes.[4] In this regard, IPUs transcend traditional departmental boundaries, enabling multidisciplinary teams to manage a medical condition or a group of closely related conditions over the full cycle of care, from prevention to rehabilitation.[5]

This holistic approach becomes especially essential for managing chronic conditions, which are often accompanied by other illnesses, resulting in complex, interacting

healthcare needs.[6] Additionally, the growing prevalence of chronic disease and multimorbidity imposes a heavy economic burden on patients and society while diminishing patients' quality of life, which underscores the need for efficient care models.[7–11]

In this context, this study aims to enhance transparency in the costs of treating patients with psoriasis within an IPU in Belgium,[12] by applying time-driven activity-based costing (TD-ABC). Psoriasis, a chronic skin disorder affecting 0.51% to 11.43% of the global population, often co-occurs with one or multiple comorbid diseases like hypertension, obesity and metabolic syndrome.[13 14] These comorbidities can affect the disease course. For instance, obesity, smoking and alcohol use trigger flares,[15] and severe psoriasis is associated with reduced life expectancy due to cardiovascular disease.[16] The high prevalence of psoriasis and the need to manage comorbidities, combined with the substantial medication costs of innovative drugs like biologics, contribute to its high financial strain, necessitating efficient holistic care tailored to psoriasis.[17]

A key component of achieving the VHBC objectives is understanding costs across the entire care pathway and their variability across patients, as this informs cost improvements and reimbursement design. Traditional costing systems, such as the ratio of cost to charges and relative value units, are often preferred to estimate costs for their ease of implementation.[18] However, these methods result in inaccurate patient-level cost estimations as they rely on organisational averages derived from charges and revenues.[18–20]

Instead, TD-ABC is recommended within VBHC for accurately measuring the cost of care.[21] The flexibility of a TD-ABC model, including its ability to be easily updated, capture complex health processes and incorporate time equations to reflect different patient scenarios, explains its growing use in healthcare.[21–24] As TD-ABC captures the actual resources and time consumed at each step of the care pathway, it makes costs explicit. This transparency allows inefficiencies to be identified and highlights opportunities for more efficient resource allocation and process redesign.[23]

Despite its increasing use, most TD-ABC analyses still adopt a fragmented healthcare perspective by evaluating healthcare delivery as a series of isolated stages managed by separate departments. Consequently, costs are often calculated for specific interventions or stages without accounting for the entire cycle of care.[23] Some recent studies have included complications and comorbidities in overall cost estimates,[19 25–27] with costs typically analysed per possible care trajectory. When cost disparities between patient populations were examined, only one or two characteristics were considered,[25] limiting detailed insight into cost drivers. Overall, efforts to estimate costs and understand cost variability over the full cycle of care remain limited, including in the context of psoriasis, where previous (TD-)ABC studies focused only on dermatology consultations.[28–30] Adopting a broader definition of the medical condition that captures all related costs would better reflect the total patient experience and, as a result, support value and cost improvements across the entire care pathway.

Aims

1. Extending TD-ABC analysis beyond dermatology: we use TD-ABC to examine psoriasis in relation to comorbidity management costs across multiple departments, providing a complete view of the economic implications of psoriasis over the full cycle of care.
2. Exploring cost variability within an IPU: we investigate how multiple patient, disease and treatment characteristics drive cost differences.
3. Comparing TD-ABC costs with reimbursement: we evaluate how well the fee-for-service (FFS) system accounts for patient-specific differences and reflects variations in the care provided.

METHODS

Study context

The study was conducted in an outpatient clinic at a University Hospital in Belgium, organised as an IPU. In the IPU under study, named PsoPlus,[12] patients visiting the outpatient dermatology clinic receive comprehensive management, addressing not only psoriasis but also 13 comorbidities associated with psoriasis. Based on the identified comorbidities and their severity, patients may easily be referred through reserved slots to one or more IPU team members within the multidisciplinary team, although the decision power to follow the clinician's advice remains with the patient. Moreover, in between consultations, virtual contact is foreseen, underscoring continuous care. The specific referral criteria and specialist selection details can be found in the work of Hilhorst *et al*.[12]

Data collection

For the purpose of this study, we included patients entering the IPU for the first time between January 2023 and November 2023. All patients are part of the prospective IRIS trial (ClinicalTrials.gov, NCT05480917), where treatment follows the principles of the VBHC framework, with additional details available in the publication.[31] Approval from the hospital's Ethical Committee was obtained and each patient gave their formal informed consent before inclusion.

Patients were not directly followed to their referral consults due to practical reasons. Instead, at their follow-up consult in the dermatology unit, they were asked about which referrals they attended and what interventions were performed throughout that consult. Moreover, this information was complemented by information that could be found in the medical file information transferred between specialists.

To understand the general clinical pathway in the referral departments, each specialist was interviewed, and if deemed necessary, direct observations in the hospital

were performed. All possible care pathways were outlined as detailed as possible. In the dermatology unit, time registrations were obtained using a custom-designed data-collection tool named Allie, and in the referral departments, average time estimates were made by the specialists themselves and afterwards validated with several time registrations directly measured by the clinical staff. The financial and resource capacity data was collected with the help of the financial and human resources department of the hospital.

Cost analysis

To calculate the cost of care per patient, we apply the 7-step framework constructed by Kaplan and Porter,[21] specifically designed to apply TD-ABC in health settings in a standardised way. The analysis results in a final cost for each patient within the sample, which we then further explore in terms of its variability and composition.

Using process maps, we can distinguish between costs directly associated with dermatological treatment and those arising from the management of comorbidities, which extend beyond dermatological care. To further analyse cost composition, we also separate costs from consultations with healthcare providers and those related to medical testing (eg, laboratory tests, medical imaging). The patient sample is then stratified based on various patient, disease and treatment characteristics selected for their potential impact on costs.

To assess how these costs compare to reimbursement under the Belgian payment model, we contrast the TD-ABC estimates with the corresponding reimbursement amounts. Belgium predominantly operates under a FFS payment model, where providers are compensated based on predefined tariffs.[32] For each patient in our sample, we calculate the total sum reimbursed to the healthcare providers, using publicly available data sourced from the National Institute for Health and Disability Insurance (NIHDI).

In addition to expenses for personnel, equipment and materials directly involved in patient care, the FFS tariffs received by the hospital are also intended to cover overhead costs, including those associated with the use of consultation rooms. Since our TD-ABC estimates include only patient care costs and exclude overhead, we additionally calculated a TD-ABC cost that incorporates traditional hospital overhead set at 20% of the direct costs, reflecting the hospital's standard cost allocation method. Given the impracticality of accurately assigning overhead costs to individual patients, the application of a flat rate remains a common approach in the literature.[23]

By comparing the variation in reimbursement amounts with that in TD-ABC costs, we evaluate the extent to which FFS tariffs capture patient-specific care needs and resource use. Specifically, we examine the association between individual TD-ABC costs and the ratio of reimbursed costs to TD-ABC costs using a Pearson correlation test, assessing whether higher TD-ABC estimates, which reflect increased care complexity, are associated with a lower reimbursement-to-cost ratio. However, it is important to note that this analysis will not examine whether the reimbursed amounts are sufficient to cover total care costs, as TD-ABC's calculated overhead expenses are excluded from this study.

Patient and disease characteristics

Through the use of medical literature and health expert knowledge, we identified different patient, disease and treatment characteristics that are used to assess cost variability. The following characteristics are selected because the literature or experts indicated that they can considerably impact patients' trajectory through the care pathway and, thus, patients' overall costs. The patient characteristics of interest are age,[33 34] gender,[35 36] social environment and support measured with the Oslo Social Support Scale,[37 38] mental health expressed by the Hospital Anxiety and Depression Scale (HADS),[39 40] and finally, the Dermatology Life Quality Index (DLQI).[33 34] The disease characteristics included in the study are age of onset,[41 42] the severity of psoriasis expressed by the Psoriasis Area and Severity Index (PASI),[43 44] disease duration[45 46] and the number and types of comorbidities identified. For treatment characteristics, we consider the distinction between topical, light, oral or biological therapy.[47 48] We acknowledge that other factors, like treatment adherence or flare frequency, may also affect costs, but for the purpose of this study, we prioritise the characteristics most strongly supported by expert opinion, leaving additional factors for future research.

Patient and public involvement

None.

RESULTS

Sample size and characteristics

The TD-ABC analysis is applied to a sample of 52 patients, who all met the trial's inclusion criteria, which required a diagnosis of psoriasis vulgaris, being between 18 and 75 years old, and having no prior visits to the IPU. Exclusions from the trial, and consequently our study, include patients with other subtypes of psoriasis and patients experiencing language barriers. Nevertheless, the patient population reflects variation in terms of patient, treatment and disease characteristics, as detailed later in table 1, table 2 and table 3.

Time-driven activity-based costing analysis

Step 1: select the medical condition

This study focuses on the medical condition psoriasis vulgaris, also referred to as plaque psoriasis, in conjunction with its associated comorbidities. Psoriasis vulgaris is the most prevalent form of psoriasis, found in more than 80% of psoriatic patients.[49] Given the chronic nature of the disease, a defined period needs to be determined for the care cycle. For our analysis, the care cycle starts with the initial consultation in the dermatology practice and

Table 1 TD-ABC cost (in €) according to patient characteristics at time of inclusion

Characteristic with subcategories	Number of patients (%)	Average cost (SD)	Average cost related to derma. care (SD)	Average cost related to comorbidity care (SD)	Average cost related to consultations (SD)	Average cost related to medical testing (SD)
Total	51	428.47 (261.37)	355.33 (167.22)	73.14 (179.57)	240.15 (176.93)	188.32 (168.82)
Age						
18–24	4 (7.8)	411.03 (249.55)	411.03 (249.55)	- (-)	181.47 (25.92)	229.56 (228.15)
25–39	18 (35.3)	409.01 (306.11)	328.92 (146.89)	80.10 (255.40)	248.19 (267.07)	160.82 (133.20)
40–54	15 (29.4)	435.49 (237.11)	367.42 (170.32)	68.07 (147.00)	237.96 (128.21)	197.53 (164.69)
55+	14 (27.5)	450.93 (253.13)	360.42 (177.77)	90.51 (115.68)	248.91 (89.66)	202.02 (208.15)
Sex						
Male	29 (56.9)	407.38 (218.36)	357.33 (165.55)	50.04 (107.93)	219.75 (97.75)	187.62 (166.87)
Female	22 (43.1)	456.27 (312.49)	352.69 (173.26)	103.57 (244.00)	267.03 (245.90)	189.24 (175.30)
Social support (OSSS-3)						
Poor (3–8)	10 (19.6)	383.93 (194.93)	361.04 (173.21)	22.89 (37.01)	210.54 (45.84)	173.39 (166.46)
Moderate (9–11)	23 (45.1)	479.27 (321.99)	377.62 (161.59)	101.64 (249.46)	280.92 (253.17)	198.35 (181.61)
Strong (12–14)	18 (35.3)	388.30 (200.67)	323.67 (175.55)	64.62 (104.48)	204.50 (62.49)	183.80 (161.82)
Mental health (HADS-A /HADS-D)						
No anxiety or depression (0–7)	27 (52.9)/ 39 (76.5)	387.47 (203.70)/ 376.56 (191.37)	354.56 (178.60)/ 332.05 (162.91)	32.91 (68.09)/ 44.52 (89.68)	197.30 (55.07)/ 199.49 (58.62)	190.16 (177.59)/ 177.07 (164.71)
Borderline anxiety or depression (8–10)	11 (21.6)/ 8 (15.7)	400.37 (234.59)/ 571.00 (264.51)	322.26 (142.26)/ 455.11 (199.56)	78.11 (170.32)/ 115.89 (191.58)	237.86 (154.24)/ 309.49 (170.35)	162.51 (146.05)/ 261.51 (219.81)
Case of anxiety or depression (11–21)	13 (25.5)/ 4 (7.8)	537.40 (362.65)/ 649.45 (539.18)	384.92 (169.07)/ 382.78 (48.31)	152.47 (299.42)/ 266.67 (533.33)	331.06 (301.58)/ 497.82 (563.35)	206.34 (177.98)/ 151.63 (30.45)
Quality of Life (DLQI)						
No effect (0–1)	4 (7.8)	328.43 (137.06)	275.90 (153.69)	52.53 (39.46)	197.65 (32.27)	130.78 (101.63)
Small effect (2–5)	8 (15.7)	413.61 (162.93)	335.99 (148.46)	77.62 (125.46)	212.81 (70.43)	200.80 (143.84)
Moderate effect (6–10)	14 (27.5)	361.75 (174.68)	325.44 (160.85)	36.31 (77.80)	208.39 (68.49)	153.35 (158.76)
Very large effect (11–20)	21 (41.2)	482.46 (332.92)	384.76 (181.44)	97.71 (254.82)	269.87 (261.43)	212.59 (187.64)
Extremely large effect (21–30)	3 (5.9)	578.35 (393.95)	465.46 (199.53)	112.89 (195.53)	302.39 (142.29)	275.95 (251.99)
Missing	1 (2.0)	297.98 (-)	297.98 (-)	- (-)	262.39 (-)	35.59 (-)

DLQI, Dermatology Life Quality Index; HADS, Hospital Anxiety and Depression Scale; OSSS, Oslo Social Support Scale.

Table 2 TD-ABC cost (in €) according to disease characteristics at time of inclusion

Characteristic with subcategories	Number of patients (%)	Average cost (SD)	Average cost related to derma. care (SD)	Average cost related to comorbidity care (SD)	Average cost related to consultations (SD)	Average cost related to medical testing (SD)
Total	51	428.47 (261.37)	355.33 (167.22)	73.14 (179.57)	240.15 (176.93)	188.32 (168.82)
Age of onset						
≤40 years old	40 (78.4)	418.72 (258.73)	355.60 (170.87)	63.13 (185.21)	227.76 (182.86)	190.97 (171.86)
>40 years old	11 (21.6)	463.89 (280.62)	354.37 (161.07)	109.53 (159.99)	285.20 (152.54)	178.70 (164.86)
Severity (PASI)						
Mild (PASI <5)	20 (39.2)	327.06 (156.85)	284.84 (114.26)	42.22 (93.32)	197.17 (53.64)	129.89 (125.32)
Moderate (5 ≤ PASI ≤ 10)	19 (37.3)	499.23 (347.51)	363.53 (179.50)	135.70 (266.99)	301.51 (276.28)	197.72 (185.90)
Severe (PASI >10)	12 (23.5)	485.43 (198.81)	459.83 (175.41)	25.60 (62.57)	214.60 (42.94)	270.83 (179.12)
Disease duration (18.2±12.5; median 16)						
1–8 years (Q1)	13 (25.49)	474.78 (279.06)	395.95 (181.53)	78.83 (156.58)	251.58 (151.75)	223.2 (174.98)
9–16 years (Q2)	14 (27.45)	356.22 (171.78)	324.85 (160.22)	31.37 (76.93)	200.25 (49.89)	155.98 (151.8)
17–27 years (Q3)	12 (23.53)	456.15 (383.06)	312.69 (192.59)	143.46 (306.33)	296.9 (321.89)	159.26 (182.19)
28–55 years (Q4)	12 (23.53)	434.89 (184.1)	389.53 (131.67)	45.36 (102.44)	217.56 (66.08)	217.33 (176.39)
Number of comorbidities						
0	8 (15.7)	342.98 (171.73)	342.98 (171.73)	- (-)	167.66 (15.00)	175.32 (160.02)
1–2	21 (41.2)	356.37 (168.62)	334.83 (157.72)	21.53 (63.31)	193.80 (44.87)	162.56 (140.42)
3–4	12 (23.5)	481.12 (378.51)	325.57 (191.10)	155.55 (304.95)	315.48 (318.96)	165.63 (188.60)
≥5	10 (19.6)	585.09 (262.13)	443.97 (146.53)	141.12 (177.25)	305.05 (151.65)	280.04 (198.48)
Type of comorbidities (present/absent)						
Hypertension present	12 (23.5)/ 39 (76.5)	427.32 (193.27)/ 428.82 (281.20)	360.63 (141.23)/ 353.70 (176.09)	66.69 (99.30)/ 75.12 (198.89)	229.38 (70.11)/ 243.46 (199.30)	197.94 (183.42)/ 185.36 (166.51)
Dyslipidaemia	26 (51.0)/ 25 (49.0)	468.71 (300.23)/ 386.61 (211.78)	344.77 (141.63)/ 366.31 (192.65)	123.94 (233.07)/ 20.30 (69.93)	286.92 (235.94)/ 191.50 (48.94)	181.79 (158.10)/ 195.11 (182.33)
Diabetes	5 (9.8)/ 46 (90.2)	498.13 (229.68)/ 420.89 (265.74)	327.13 (150.61)/ 358.40 (170.16)	171.00 (147.21)/ 62.50 (180.89)	243.19 (62.94)/ 239.81 (185.55)	254.94 (183.67)/ 181.08 (167.70)
Metabolic syndrome	12 (23.5)/ 39 (76.5)	515.27 (258.87)/ 401.76 (259.57)	400.22 (122.35)/ 341.52 (177.84)	115.05 (171.12)/ 60.24 (182.28)	300.50 (141.73)/ 221.57 (184.04)	214.77 (173.82)/ 180.18 (168.72)
Kidney disease	2 (3.9)/ 49 (96.1)	233.23 (7.70)/ 436.44 (263.64)	153.84 (13.93)/ 363.56 (165.42)	79.39 (21.63)/ 72.88 (183.24)	177.82 (4.23)/ 242.69 (180.11)	55.41 (3.47)/ 193.75 (170.06)
Obesity	15 (29.4)/ 36 (70.6)	598.44 (377.71)/ 357.64 (151.60)	405.67 (207.83)/ 334.36 (145.37)	192.77 (290.93)/ 23.29 (59.31)	347.78 (299.41)/ 195.30 (42.76)	250.66 (229.96)/ 162.35 (131.16)
Smoking	12 (23.5)/ 39 (76.5)	435.16 (218.60)/ 426.41 (275.74)	390.24 (204.06)/ 344.59 (155.68)	44.92 (97.48)/ 81.82 (198.37)	221.73 (55.29)/ 245.81 (200.41)	213.43 (188.48)/ 180.59 (164.19)

Continued

Table 2 Continued

Characteristic with subcategories	Number of patients (%)	Average cost (SD)	Average cost related to derma. care (SD)	Average cost related to comorbidity care (SD)	Average cost related to consultations (SD)	Average cost related to medical testing (SD)
Anxiety	24 (47.1)/ 27 (52.9)	474.59 (312.10)/ 387.47 (203.70)	356.20 (157.26)/ 354.56 (178.60)	118.39 (246.62)/ 32.91 (68.09)	288.34 (245.05)/ 197.30 (55.07)	186.25 (162.17)/ 190.16 (177.59)
Depression	12 (23.5)/ 39 (76.5)	597.15 (378.69)/ 376.56 (191.37)	431.00 (165.07)/ 332.05 (162.91)	166.15 (326.26)/ 44.52 (89.68)	372.27 (324.62)/ 199.49 (58.62)	224.88 (184.19)/ 177.07 (164.71)
Alcohol	8 (15.7)/ 43 (84.3)	507.94 (257.78)/ 413.68 (262.34)	450.70 (198.23)/ 337.59 (157.11)	57.24 (111.71)/ 76.09 (190.40)	214.72 (60.90)/ 244.88 (191.06)	293.23 (219.11)/ 168.80 (153.11)
Psoriatic Arthritis	5 (9.8)/ 46 (90.2)	478.39 (269.23)/ 423.04 (262.97)	315.92 (78.09)/ 359.61 (174.17)	162.47 (200.37)/ 63.43 (176.85)	331.76 (189.96)/ 230.19 (174.76)	146.63 (117.47)/ 192.85 (173.86)
Inflammatory Bowel Disease	2 (3.9)/ 49 (96.1)	727.55 (430.46)/ 416.26 (251.83)	558.22 (190.98)/ 347.05 (163.04)	169.33 (239.47)/ 69.21 (178.87)	373.26 (130.16)/ 234.71 (177.45)	354.29 (300.30)/ 181.55 (163.14)
Liver disease	7 (13.7)/ 44 (86.3)	673.74 (268.21)/ 389.45 (240.93)	489.39 (142.19)/ 334.00 (162.18)	184.34 (197.88)/ 55.44 (172.33)	319.85 (184.34)/ 227.47 (174.53)	353.89 (191.69)/ 161.98 (151.13)

PASI, Psoriasis Area and Severity Index.

Table 3 TD-ABC cost (in €) according to treatment characteristics

Characteristic with subcategories	Number of patients (%)	Average cost (SD)	Average cost related to derma. care (SD)	Average cost related to comorbidity care (SD)	Average cost related to consultations (SD)	Average cost related to medical testing (SD)
Total	51	428.47 (261.37)	355.33 (167.22)	73.14 (179.57)	240.15 (176.93)	188.32 (168.82)
Treatment initiated at t=0						
Topical therapy	21 (41.2)	350.96 (210.73)	266.03 (113.40)	84.93 (143.59)	221.57 (116.06)	129.39 (132.92)
Topical+oral therapy	18 (35.3)	488.86 (260.06)	458.71 (208.21)	30.16 (82.40)	210.47 (77.99)	278.40 (213.27)
Biological therapy	6 (11.8)	513.48 (426.37)	332.98 (43.86)	180.50 (397.59)	355.30 (419.66)	158.18 (57.99)
Oral therapy	2 (3.9)	443.36 (202.45)	373.33 (146.67)	70.04 (55.79)	218.73 (51.78)	224.63 (150.67)
Topical+phototherapy	1 (2.0)	396.42 (-)	396.42 (-)	- (-)	360.83 (-)	35.59 (-)
Topical+biological therapy	1 (2.0)	423.17 (-)	423.17 (-)	- (-)	281.23 (-)	141.95 (-)
Oral+biological therapy	1 (2.0)	381.38 (-)	381.38 (-)	- (-)	239.43 (-)	141.95 (-)

extends through the first 6 months, where treatment in both the dermatology practice and the referral departments is considered. We have opted to restrict the care cycle to a 6-month period, which is in line with the regular screening for comorbidities and subsequent referrals that occur throughout the initial consultation and again every 6 months. As a result, our focus centres on the initial phase within the patient care pathway, allowing us to capture and demonstrate cost transparency across a representative range of care processes within the IPU model.

Step 2: define the care delivery value chain

The care delivery value chain (CDVC), depicted in figure 1, displays all key activities in the care delivery process, along with their location. Starting from the monitoring and preventing of the disease up to the monitoring and managing of the disease, the CDVC provides an overview of all activities contributing to patient value.[4] It also highlights the added value of the IPU, exemplified by the different feedback mechanisms. An illustration is the monthly multidisciplinary meetings that are organised between specialists to discuss complex cases which require alignment in treatment strategies. The CDVC thus shows that in our setting the full cycle of care extends well beyond consultations with dermatologists.

Step 3: develop process maps for each activity in patient care delivery

The process maps described in this step are detailed versions of the activities displayed in the CDVC. The process maps for the dermatological consultations and potential referral consultations were developed based on observations within the clinic, interviews with clinical staff, or a combination of both and were constructed using the Business Process Model and Notation.

The process map in figure 2 shows the clinical pathway for a patient in the dermatology clinic. Patients consult a nurse and a dermatologist sequentially, and depending on the prescribed treatment, diverse pathways become possible thereafter. After the initial consult, the interval between follow-up consultations will be determined by the severity of the psoriasis. The activity's location and the resources involved can be derived from the legend. Additionally, activities marked with a '+' sign indicate the availability of separate, more detailed process maps. Examples, such as a consultation with the rheumatologist and a subsequent MRI scan, are provided for reference in figure 3. Online supplemental materials A include the full set of detailed process maps.

The process maps for referral departments reveal that these processes are highly standardised. All referral

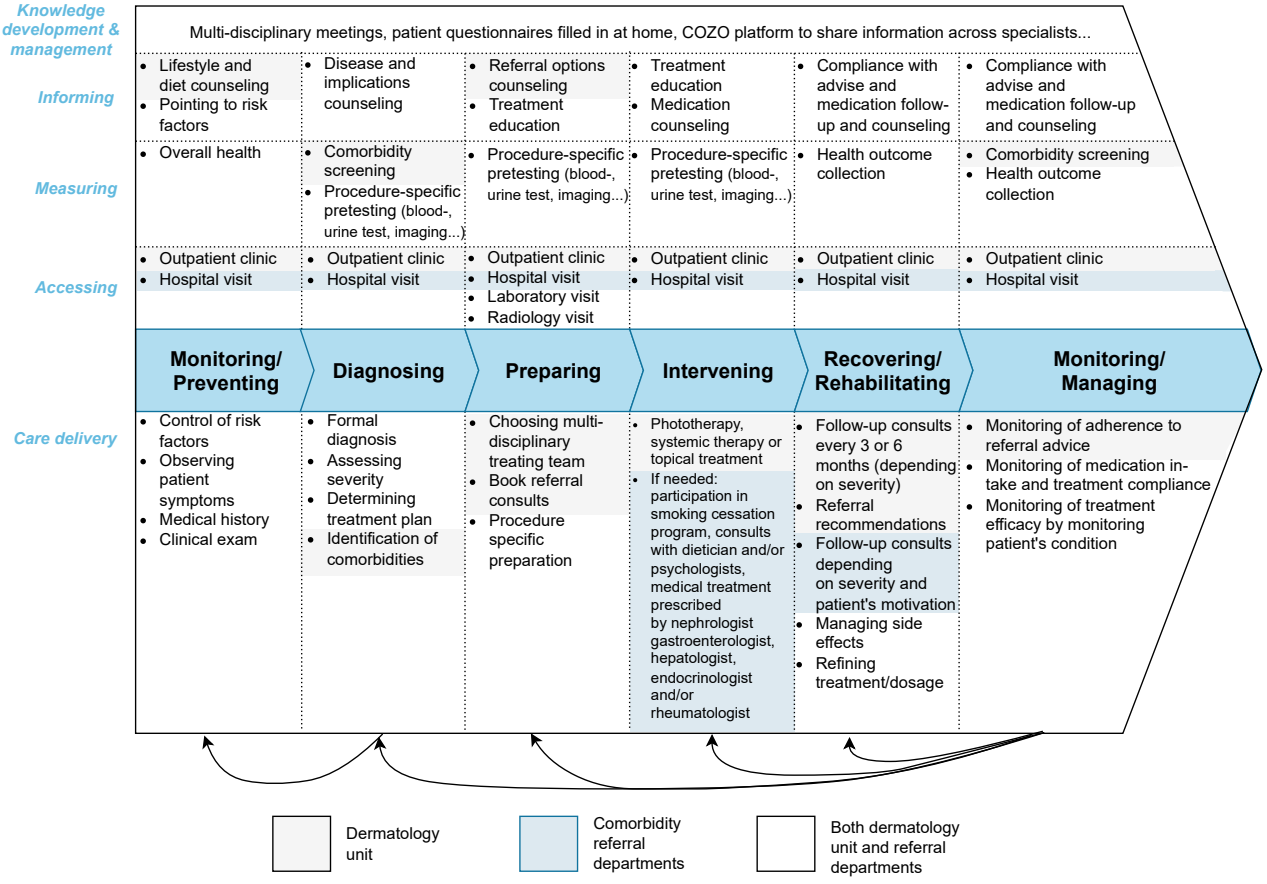

Figure 1 Care delivery value chain for integrated psoriasis treatment.

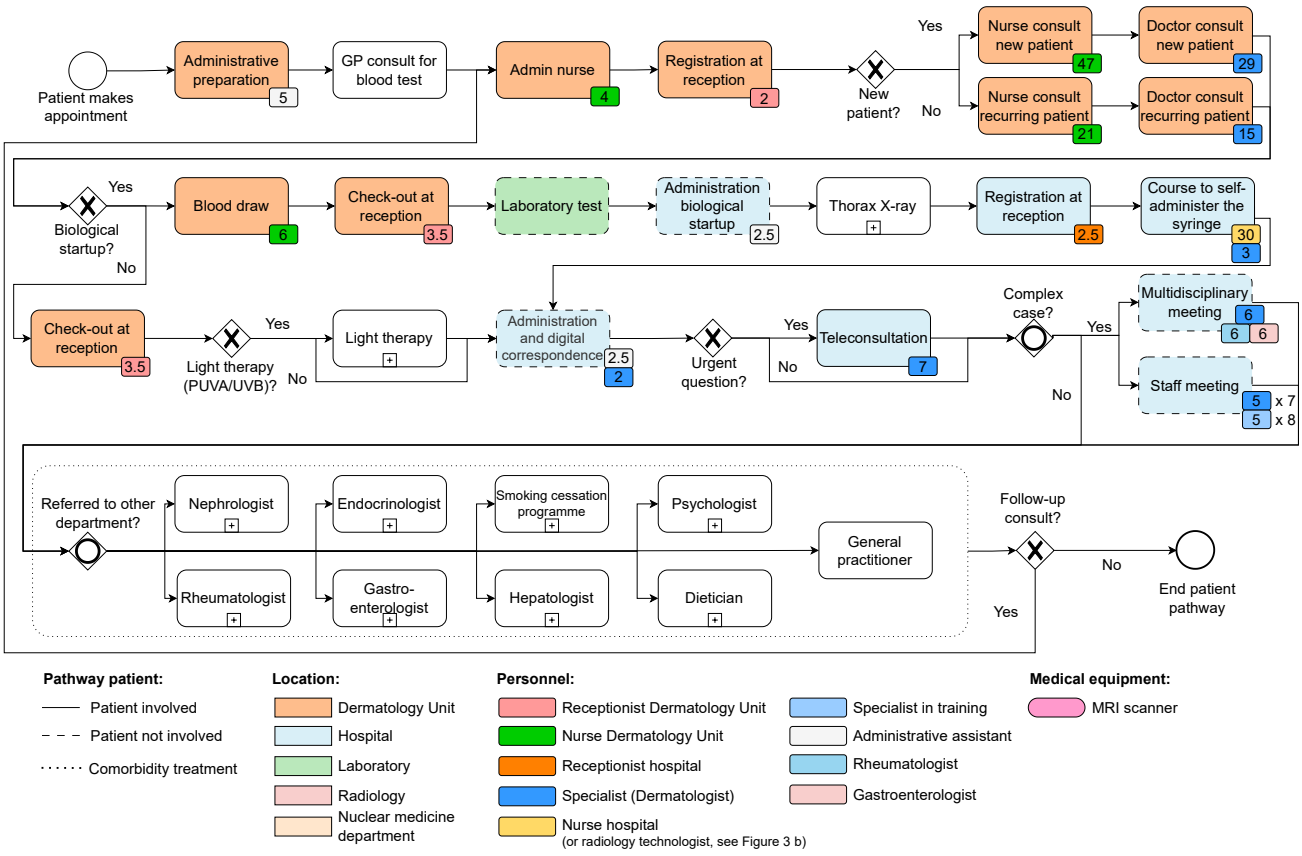

Figure 2 Process map for a visit to the dermatology department. The large, rounded rectangles display the activities. The colour indicates where the activity is taking place. A full line indicates that the patient is involved in the activity, whereas a dotted line means the patient is not involved. The colour of the rounded rectangles in the bottom right corner shows which medical personnel are involved, and the number equals the average minutes that this person is involved in that step of the process. A plus sign in a white rounded rectangle means a more detailed process map can be found in the online supplemental materials A or figure 3. GP, General Practitioner; PUVA, Psoralen plus Ultraviolet-A; UVB, Ultraviolet-B.

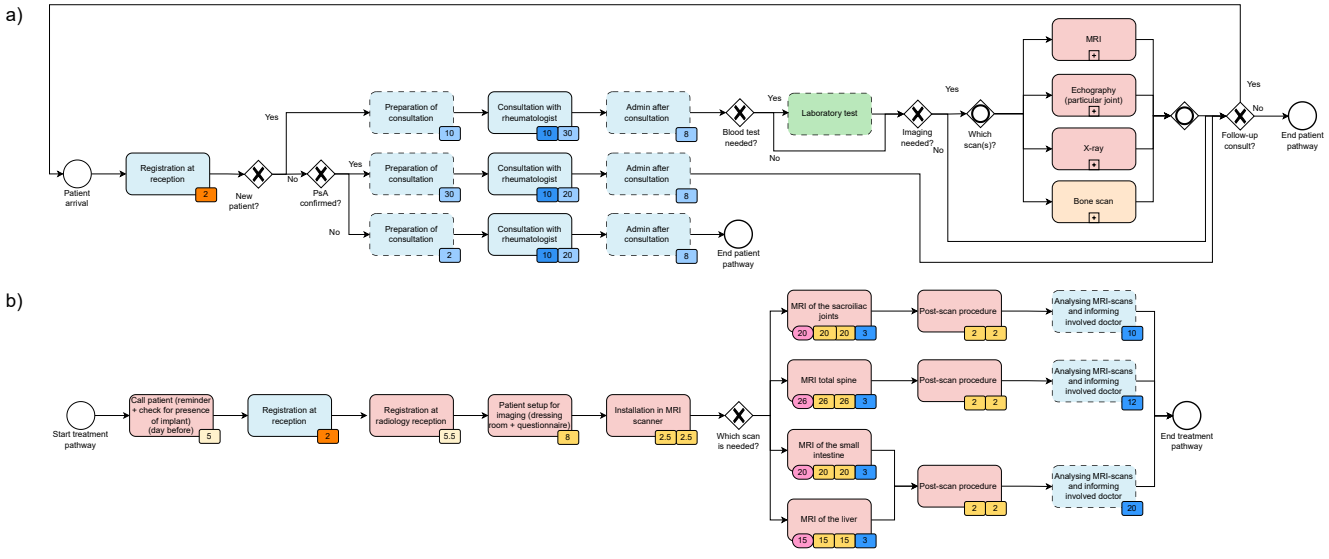

Figure 3 Process map for visit at (a) the rheumatologist and (b) the radiology department for an MRI scan. The notations in panels (a) and (b) are consistent with those used in figure 2. Specialist refers to (a) rheumatologist and (b) radiologist.

pathways consist of multiple consultations with the specialist, some of which require various tests, such as blood, urine, saliva or imaging, to diagnose and establish an appropriate medication plan. The frequency and time between follow-up consultations depend on the severity of the comorbidity and the patient's motivation.

It is important to note that the dermatologist refers patients to specialists within the multidisciplinary team at the University Hospital. However, patients may opt to seek comorbidity treatment outside the IPU based on personal preferences or practical considerations. Nevertheless, in computing the cost of a referral consultation, we use the information from the University Hospital as the standard reference point.

Step 4: obtain time estimates for each process

The average time estimates for each activity in the process map can be consulted in figures 2 and 3 in the boxes at the bottom right of each activity. For the activities taking place in the dermatology department, exact measurements per patient were made using a mobile app developed by the clinic. For less significant tasks, average durations were used based on the measurements made. However, for more complex tasks such as the consult with a nurse and dermatologist, exact time registrations were used for each patient in the sample, as high variation could be seen due to the presence of comorbidities, severity, etc.

For activities taking place outside the dermatology department, averages are used due to the difficulty of following each patient to their referral consult. These average time estimates were determined in close conversation with the medical staff involved and were, in case of doubt or impreciseness, validated with actual time measurements. In addition, patient characteristics, such as whether they are new or known patients, were incorporated as time drivers to accommodate significant variations in resource utilisation time between different types of patients.

Step 5: estimate the cost of supplying the resources

We included three different cost categories. First, we looked at the personnel cost of all personnel directly involved in patient care. For the personnel employed in the hospital, the cost was determined by the total compensation cost, received from the hospital's human resources department. The cost of a general practitioner consultation was estimated by its nomenclature number and corresponding fee, obtained from the NIHDI database. Second, to calculate the costs of medical machinery and equipment that are directly associated with individual patient treatments, we consulted the theoretical yearly depreciation and maintenance costs. Third, to include the costs of medical testing done in the hospital's laboratory (eg, blood test, saliva test), a cost per test was provided by the lab technicians, which accounted for all direct medical consumables, reagents, personnel, machinery and other infrastructure involved. All costs are reported in euros, adjusted to 2023 price levels.

We focused solely on costs directly related to providing care from the hospital's perspective, excluding medications taken outside the hospital and overhead costs related to the hospital's daily operations. As the goal of the study is to examine cost variability across patients, omitting overhead costs and focusing solely on patient care costs is justified, as argued by previous research.[50]

Step 6: estimate the capacity of each resource and calculate the capacity cost rate

The theoretical capacity for staff presents the time available that could theoretically be directed to the primary activity (eg, excluding vacation days) and was provided by the human resources department of the hospital. To arrive at the practical capacity, the theoretical capacity was multiplied by 80%, as proposed by Kaplan and Anderson[22] to account for breaks, arrival and departure processes, and other activities not contributing to the primary task.

To estimate the theoretical capacity of the medical machinery and equipment, the opening hours of the hospital or specific department were used. An adjustment of 85% was applied to obtain the practical capacity accounting for defects and malfunctions. Subsequently, a capacity cost rate (CCR) was calculated for each resource by dividing the calculated cost by its practical capacity. The CCR for each resource can be consulted in online supplemental materials B.

Step 7: calculate the total cost of patient care

The final cost per patient was calculated by multiplying the time duration of each step in the patient's treatment pathway with the CCRs of the different resources involved. Subsequently, all the activity costs are summed, and laboratory expenses are added to the total amount, as these are time independent.

The average cost over a 6-month period is €428.47, with costs ranging from €169.78 to €1454.97, as shown in table 4, along with other descriptive statistics. We identified one extreme outlier with notably high expenses (€3562.13), which was therefore excluded from our analysis. These costs were largely driven by frequent consultations with a psychologist as part of ongoing treatment prior to their engagement with the IPU. Although excluded here to avoid distorting the analysis of typical cost drivers, such high-cost cases remain highly relevant and require further investigation, as they may highlight

Table 4 Descriptive statistics of TD-ABC cost (in €)

Descriptive statistic	TD-ABC cost
Mean	428.47
SD	261.37
Minimum	169.78
Maximum	1454.97
Median	321.72
Quartiles	238.67 (Q1), 562.05 (Q3)

unique challenges for reimbursement reforms. Therefore, more detailed information about this outlier is provided in online supplementals material C.

Cost variability

This analysis reveals substantial variability in the costs of psoriasis care, as shown in table 1, table 2 and table 3. Table 1, which examines the patient characteristics, shows that older patients tend to incur higher overall costs, primarily due to increased comorbidity management. While no differences are observed between males and females regarding costs related to dermatological care (ie, the upper three lanes in figure 2), females exhibit higher comorbidity-related costs, with nearly half of these expenses attributable to psychological consultations. Mental health conditions, such as depression and anxiety, are associated with elevated costs across both dermatological and comorbidity-related care. Lower quality of life, measured by the DLQI, is similarly associated with increased costs, particularly for dermatological care.

For disease characteristics, as displayed in table 2, late-onset psoriasis patients, who develop psoriasis after the age of 40, have higher costs compared with early-onset cases, largely due to greater needs for comorbidity management. Moderate and severe psoriasis (PASI ≥5) are associated with higher costs, primarily due to the need for more intensive dermatological care. Severe disease (PASI >10), however, does not appear to impact the costs related to comorbidity management. The number of comorbidities is strongly associated with cost increases, as patients with one or two comorbidities allocate up to 6% of total costs to comorbidity management, while those with three or more comorbidities allocate over a quarter (27.8%). Most comorbidities increase both their own management costs and dermatological care costs, except for hypertension and kidney disease.

Finally, as can be seen in table 3, treatment modality contributes to variation in the cost structure, even when excluding the cost of medication, with topical therapies associated with the lowest costs.

TD-ABC estimates versus reimbursement rates

In figure 4, patients are arranged in ascending order of TD-ABC cost, with both the TD-ABC and reimbursed cost

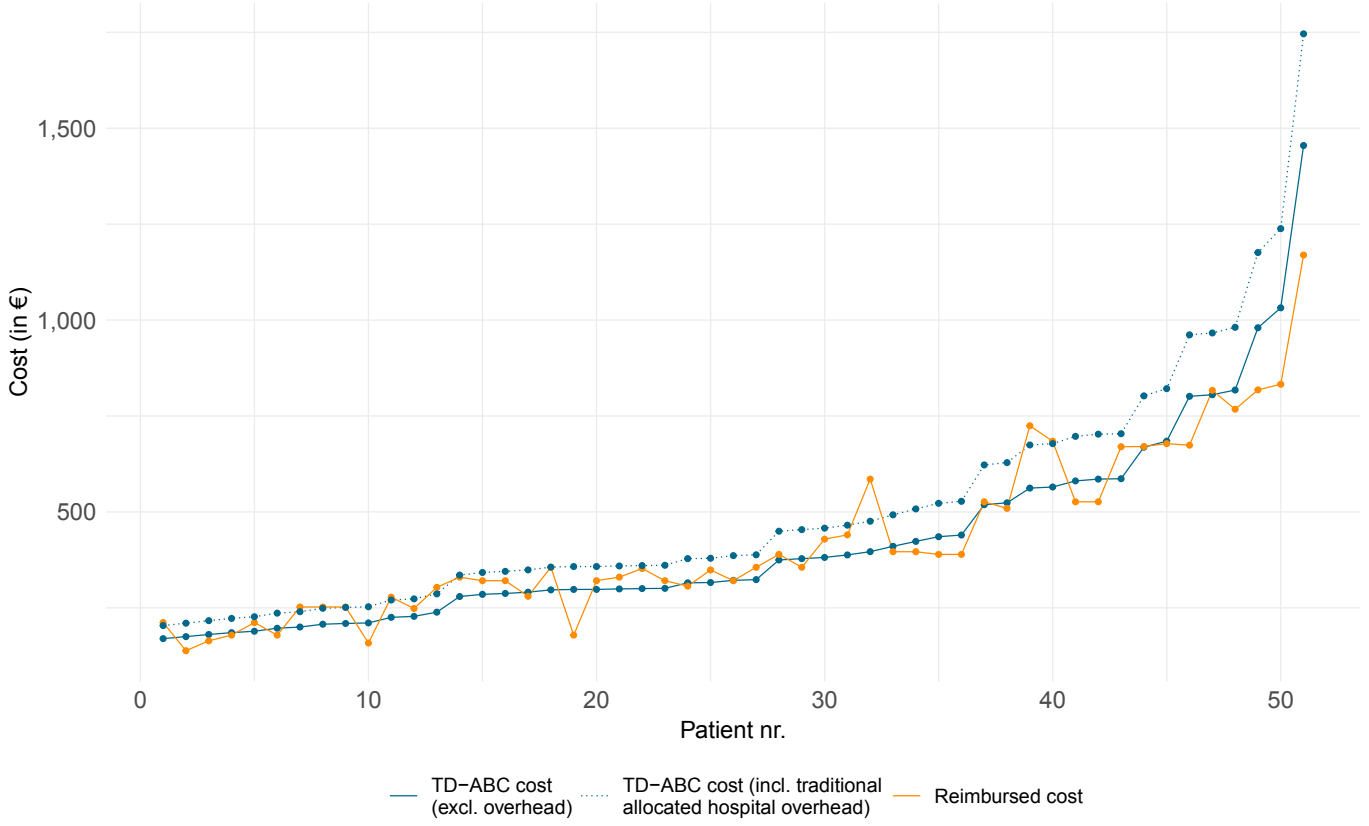

Figure 4 TD-ABC and reimbursed costs per patient. The x-axis displays patients ordered by ascending TD-ABC costs. The orange curve represents the reimbursements received under fee-for-service (FFS) tariffs, the solid blue line indicates the calculated TD-ABC cost excluding overhead, and the dotted blue line shows the TD-ABC costs including overhead, assuming a flat rate of 20% of the direct costs. A negative relationship can be observed between TD-ABC costs and the reimbursement-to-cost ratio (one-tailed Pearson correlation, r=−0.355, p=0.005). MRI scan costs have been excluded from the total TD-ABC and reimbursed costs in this graph, as these procedures are reimbursed through a separate system in Belgium rather than the FFS tariffs.

shown per patient. The analysis reveals notable disparities across the patient group in the ratio of the received compensations and the TD-ABC costs. Patients with comparable care costs frequently receive widely varying reimbursement amounts, and vice versa. For instance, treating patients 1, 13 and 32 each generated the same reimbursement of €178.86, yet their TD-ABC estimates (including overhead) were €222.42, €357.57 and €236.18, respectively. This translates into reimbursement-to-costs ratios ranging from 1.24 to 2.0. These great discrepancies arise from differences in resource intensity during the nurse and dermatologist consultations, which are variations that TD-ABC captures but flat compensation rates fail to reflect. Furthermore, we observe that higher TD-ABC costs are not matched by proportionally higher reimbursements, as evidenced by a statistically significant negative correlation between the TD-ABC costs and the ratio of reimbursed costs to TD-ABC costs, r=−0.355 (one-tailed t-test, p=0.005, df=49).

DISCUSSION

The TD-ABC results underscore the complex interplay between patient, disease and treatment characteristics in determining the cost of psoriasis care. Several of our findings align with existing literature and expectations, while others offer new perspectives compared with prior evidence. The higher costs among older patients reflect the increasing prevalence and complexity of comorbidities in this group,[33 34] confirming that multimorbidity escalates the need for additional medical interventions and thus constitutes a central cost driver. Importantly, comorbidities not only generate comorbidity-related costs but also increase dermatological care costs, underscoring the importance of economic evaluations to capture the broader health context rather than focusing solely on dermatological treatment.

Mental health emerged as another cost determinant, which reflects the well-understood relationship between mental health conditions and psoriasis.[39] The substantial share of psychological consultations among women aligns with the evidence of a greater psychosocial burden of psoriasis in females.[35 36] More broadly, mental health disorders such as depression and anxiety, as well as higher DLQI scores (indicating poorer quality of life), were associated with higher costs across both dermatological and comorbidity-related care. This suggests that untreated psychological distress, whether identified through HADS or reflected in diminished quality of life, may also drive greater use of dermatological services, supporting calls for integrated care models that embed mental health support within psoriasis management. Further in line with expectations, patients on topical treatments are associated with the lowest costs, reflecting their use in less severe cases requiring less intensive management.

Some of our findings, however, diverge from expectations or prior research. For instance, late-onset psoriasis was associated with higher costs, in contrast to earlier studies that emphasised the aggressive and sometimes more unpredictable course of early-onset disease, increasing costs.[41 42] Similarly, while prior research proposed sex-related differences in psoriasis treatment trajectories,[35 36] we observed no such effect on dermatological costs. We also found no evidence that very severe psoriasis (PASI >10) increases comorbidity-related costs, despite literature suggesting otherwise.[44] These discrepancies may reflect contextual differences in healthcare delivery, sample composition, or the more granular costing approach of TD-ABC compared with traditional methods. They underscore the importance of replicating cost analyses in diverse settings to refine our understanding of cost determinants in psoriasis.

Understanding these cost drivers is essential for designing more efficient and cost-effective care models for psoriasis patients, particularly as comorbidities and disease severity continue to play a central role in healthcare expenditures. Equally important is the alignment of reimbursement systems to accurately reflect the complexity of care required and incentivise comprehensive and patient-centred approaches. The findings from figure 4 suggested that the current FFS tariffs may not sufficiently take into account patient-specific factors and complexities, indicating that using revenues as a proxy for actual care costs can lead to biased conclusions.

The discrepancy found between actual costs and reimbursement can partly be attributed to the lack of compensation for several activities central to the IPU model, such as consultations with specialised nurses for comorbidity screening and multidisciplinary team meetings. As a result, patients with complex needs who require more integrated and resource-intensive care are inadequately compensated for compared with patients with lower care costs. This disparity creates a potential incentive for hospitals to prioritise patients who require less resource-intensive care, thereby risking inequities in the delivery of holistic care.

To address these issues, it is advisable to reconsider the existing, standardised tariffs and align them with specific cost determinants, so they can capture the different patient needs. By doing so, the reimbursements would more accurately reflect the variation in costs incurred for individual patients, leading to a fairer distribution of reimbursements across the patient population. FFS systems, however, still inherently carry the risk of incentivising overtreatment and penalising efficient care providers, as all interventions are reimbursed, regardless of the quality of care. As an alternative, value-based models such as bundled payments, proposed in VBHC, cover all multidisciplinary care for a specific disease over a defined period and tie reimbursement to outcomes, aligning financial incentives with patient interests.[51] For these bundles to be effective, they should: (1) Encompass the entire treatment pathway, (2) Be premised on positive outcomes, (3) Be risk-adjusted, (4) Ensure reasonable profitability and (5) Account for outliers.[51] TD-ABC analyses could support the design of such bundles by providing detailed

cost information and identifying these risk factors and outliers.

Despite the depth of our study and its initial insights into cost variability and its alignment with current reimbursement policies, it has limitations. First, it does not establish a direct link between costs and patient outcomes, limiting the ability to assess how the costs relate to the quality of care delivered. Second, the study sample size is relatively small, which limits the generalisability and hinders statistical inference regarding the impact of different characteristics on costs. Third, the exclusion of TB-ABC calculated overhead costs limits the ability to directly compare reimbursement tariffs with TD-ABC cost estimates in absolute terms, making it challenging to determine whether the current FFS tariffs are sufficiently high to cover the incurred costs. Next, a period of 6 months may not capture the full range of cost variations that could emerge over a longer timeframe.

Finally, while we studied cost variation based on patient, disease and treatment characteristics, we did not include institutional characteristics such as geographic location, facility type and size. Our analysis was conducted in a single integrated academic unit, but the TD-ABC methodology itself is flexible and could be adapted to other healthcare settings. Moreover, we focused on a fully integrated care model, an IPU, but some studies have highlighted alternative approaches, such as dermatologists directly managing selected comorbidities (eg, cardiovascular risk through statin prescribing).[52 53] This could lead to different patterns of care and associated costs. Future research should, therefore, consider multi-centre studies to examine the impact of institutional factors and the generalisability of our findings across diverse health systems, providing a more comprehensive understanding of cost variability.

CONCLUSION

Growing pressure to balance quality and costs makes accurate cost measurement essential. Yet traditional methods often overlook the complexity of chronic disease management. This study demonstrates that applying TD-ABC to integrated psoriasis care captures patient-level cost variability in detail, with comorbidity-related costs being crucial to assess the full economic impact. Key drivers of higher costs include older age, mental health burden, lower quality of life, late-onset psoriasis, presence of comorbidities and greater disease severity. While the findings offer valuable insights, further statistical validation using larger samples across multiple healthcare settings is needed to strengthen these conclusions. Further, our comparison with reimbursement data shows that current FFS tariffs do not adequately reflect this variability, underscoring the limitations of using reimbursement rates as proxies for actual costs. Overall, our study supports the use of TD-ABC for more accurate cost estimation and highlights the need for reimbursement systems that better align compensation with patient-specific care needs.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

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REFERENCES

1 World Health Organization RO for E. Roadmap: strengthening people-centred health systems in the WHO European region: a Framework for Action towards Coordinated/Integrated Health Services Delivery (CIHSD). 2013.
2 Strandberg-Larsen M, Krasnik A. Measurement of integrated healthcare delivery: a systematic review of methods and future research directions. *Int J Integr Care* 2009;9:e01.
3 Leijten FRM, Struckmann V, van Ginneken E, *et al*. The SELFIE framework for integrated care for multi-morbidity: Development and description. *Health Policy* 2018;122:12–22.
4 Porter ME, Teisberg EO. *Redefining health care: creating value-based competition on results*. Harvard Business Press, 2006.
5 Porter ME, Lee TH. The strategy that will fix health care. *Harv Bus Rev* 2013;91:50–70.

6 Reuben DB, Tinetti ME. Goal-oriented patient care--an alternative health outcomes paradigm. *N Engl J Med* 2012;366:777–9.
7 Fortin M, Bravo G, Hudon C, *et al*. Relationship between multimorbidity and health-related quality of life of patients in primary care. *Qual Life Res* 2006;15:83–91.
8 Ellen N, Martin M. *Caring for people with chronic conditions: a health system perspective*. UK: McGraw-Hill Education, 2008.
9 Glynn LG, Valderas JM, Healy P, *et al*. The prevalence of multimorbidity in primary care and its effect on health care utilization and cost. *Fam Pract* 2011;28:516–23.
10 McPhail S. Multimorbidity in chronic disease: impact on health care resources and costs. *RMHP* 2016;9:143–56.
11 Whitty CJM, MacEwen C, Goddard A, *et al*. Rising to the challenge of multimorbidity. *BMJ* 2020;368:l6964.
12 Hilhorst N, Deprez E, Roman E, *et al*. PsoPlus: An Integrated Practice Unit for Psoriasis. *Dermatology* 2023;239:334–44.
13 Michalek IM, Loring B, John SM. A systematic review of worldwide epidemiology of psoriasis. *Acad Dermatol Venereol* 2017;31:205–12.
14 Takeshita J, Grewal S, Langan SM, *et al*. Psoriasis and comorbid diseases: Epidemiology. *J Am Acad Dermatol* 2017;76:377–90.
15 Griffiths CEM, Armstrong AW, Gudjonsson JE, *et al*. Psoriasis. *The Lancet* 2021;397:1301–15.
16 Abuabara K, Azfar RS, Shin DB, *et al*. Cause-specific mortality in patients with severe psoriasis: a population-based cohort study in the U.K.: Cause-specific mortality in patients with severe psoriasis. *Br J Dermatol* 2010;163:586–92.
17 Feldman SR, Burudpakdee C, Gala S, *et al*. The economic burden of psoriasis: a systematic literature review. Expert Rev Pharmacoecon Outcomes Res 2014;14:685–705.
18 Yun BJ, Prabhakar AM, Warsh J, *et al*. Time-Driven Activity-Based Costing in Emergency Medicine. *Ann Emerg Med* 2016;67:765–72.
19 Jayakumar P, Mills Z, Triana B, *et al*. A Model for Evaluating Total Costs of Care and Cost Savings of Specialty Condition-Based Care for Hip and Knee Osteoarthritis in an Integrated Practice Unit. *Value Health* 2023;26:1363–71.
20 Koolmees D, Bernstein DN, Makhni EC. Time-Driven Activity-Based Costing Provides a Lower and More Accurate Assessment of Costs in the Field of Orthopaedic Surgery Compared With Traditional Accounting Methods. Arthroscopy 2021;37:1620–7.
21 Kaplan RS, Porter ME. How to solve the cost crisis in health care. *Harv Bus Rev* 2011;89:2011–3.
22 Kaplan RS, Anderson SR. Time-Driven Activity-Based Costing. *SSRN Journal* 2004.
23 Keel G, Savage C, Rafiq M, *et al*. Time-driven activity-based costing in health care: A systematic review of the literature. *Health Policy* 2017;121:755–63.
24 Niñerola A, Hernández-Lara A-B, Sánchez-Rebull M-V. Is Time-Driven Activity-Based Costing Coming out on Top? A Comparison with Activity-Based Costing in the Health Field. *Healthcare (Basel)* 2021;9:1113.
25 Garcia JA, Mistry B, Hardy S, *et al*. Time-driven activity-based costing to estimate cost of care at multidisciplinary aerodigestive centers. *Laryngoscope* 2017;127:2152–8.
26 Keel G, Muhammad R, Savage C, *et al*. Time-driven activity-based costing for patients with multiple chronic conditions: a mixed-method study to cost care in a multidisciplinary and integrated care delivery centre at a university-affiliated tertiary teaching hospital in Stockholm, Sweden. *BMJ Open* 2020;10:e032573.
27 Nagra NS, Tsangaris E, Means J, *et al*. Time-Driven Activity-Based Costing in Breast Cancer Care Delivery. *Ann Surg Oncol* 2022;29:510–21.
28 Demeere N, Stouthuysen K, Roodhooft F. Time-driven activity-based costing in an outpatient clinic environment: development, relevance and managerial impact. *Health Policy* 2009;92:296–304.
29 Papadaki Š, Popesko B. Cost Analysis of Selected Patient Categories Within A Dermatology Department Using an ABC Approach. *GJHS* 2016;8:234.
30 Popesko B, Papadaki Š, Novák P. Cost and reimbursement analysis of selected hospital diagnoses via activity-based costing. *E+M* 2015;18:50–61.
31 Hilhorst N, Roman E, Borzée J, *et al*. Value in psoriasis (IRIS) trial: implementing value-based healthcare in psoriasis management - a 1-year prospective clinical study to evaluate feasibility and value creation. *BMJ Open* 2023;13:e067504.
32 Danhieux K, Martens M, Colman E, *et al*. What Makes Integration of Chronic Care so Difficult? A Macro-Level Analysis of Barriers and Facilitators in Belgium. *Int J Integr Care* 2021;21:8.
33 López-Estebaranz JL, Sánchez-Carazo JL, Sulleiro S. Effect of a family history of psoriasis and age on comorbidities and quality of life in patients with moderate to severe psoriasis: Results from the ARIZONA study. *J Dermatol* 2016;43:395–401.
34 Trettel A, Spehr C, Körber A, *et al*. The impact of age on psoriasis health care in Germany. *Acad Dermatol Venereol* 2017;31:870–5.
35 Böhm D, Stock Gissendanner S, Bangemann K, *et al*. Perceived relationships between severity of psoriasis symptoms, gender, stigmatization and quality of life. *J Eur Acad Dermatol Venereol* 2013;27:220–6.
36 Napolitano M, Mastroeni S, Fania L, *et al*. Sex- and gender-associated clinical and psychosocial characteristics of patients with psoriasis. *Clin Exp Dermatol* 2020;45:705–11.
37 Janowski K, Steuden S, Pietrzak A, *et al*. Social support and adaptation to the disease in men and women with psoriasis. *Arch Dermatol Res* 2012;304:421–32.
38 Kocalevent R-D, Berg L, Beutel ME, *et al*. Social support in the general population: standardization of the Oslo social support scale (OSSS-3). *BMC Psychol* 2018;6:31.
39 Hedemann TL, Liu X, Kang CN, *et al*. Associations between psoriasis and mental illness: an update for clinicians. *Gen Hosp Psychiatry* 2022;75:30–7.
40 Gisondi P, Geat D, Bellinato F, *et al*. Psychological Stress and Salivary Cortisol Levels in Patients with Plaque Psoriasis. *J Pers Med* 2021;11:1069.
41 Di Lernia V, Ficarelli E. Current therapeutic approaches of psoriasis are affected by age at disease onset. *J Dermatolog Treat* 2014;25:15–7.
42 Henseler T, Christophers E. Psoriasis of early and late onset: characterization of two types of psoriasis vulgaris. *J Am Acad Dermatol* 1985;13:450–6.
43 Neimann AL, Shin DB, Wang X, *et al*. Prevalence of cardiovascular risk factors in patients with psoriasis. *J Am Acad Dermatol* 2006;55:829–35.
44 Yeung H, Takeshita J, Mehta NN, *et al*. Psoriasis severity and the prevalence of major medical comorbidity: a population-based study. *JAMA Dermatol* 2013;149:1173–9.
45 Egeberg A, Skov L, Joshi AA, *et al*. The relationship between duration of psoriasis, vascular inflammation, and cardiovascular events. *J Am Acad Dermatol* 2017;77:650–6.
46 Gisondi P, Fantin F, Del Giglio M, *et al*. Chronic Plaque Psoriasis Is Associated with Increased Arterial Stiffness. *Dermatology* 2009;218:110–3.
47 Lebwohl M, Ting PT, Koo JYM. Psoriasis treatment: traditional therapy. *Ann Rheum Dis* 2005;64:ii83–6.
48 Rapalli VK, Singhvi G, Dubey SK, *et al*. Emerging landscape in psoriasis management: From topical application to targeting biomolecules. Biomed Pharmacother 2018;106:707–13.
49 Menter A, Gottlieb A, Feldman SR, *et al*. Guidelines of care for the management of psoriasis and psoriatic arthritis. *J Am Acad Dermatol* 2008;58:826–50.
50 Jacobs K, Roman E, Lambert J, *et al*. Variability drivers of treatment costs in hospitals: A systematic review. *Health Policy* 2022;126:75–86.
51 Porter ME, Kaplan RS. How to Pay for Health Care. *Harv Bus Rev* 2016;94:88–98.
52 Barbieri JS, Beidas RS, Gondo GC, *et al*. Analysis of Specialist and Patient Perspectives on Strategies to Improve Cardiovascular Disease Prevention Among Persons With Psoriatic Disease. *JAMA Dermatol* 2022;158:252–9.
53 Berna-Rico E, Abbad-Jaime de Aragon C, Garcia-Aparicio A, *et al*. Cardiovascular Screening Practices and Statin Prescription Habits in Patients with Psoriasis among Dermatologists, Rheumatologists and Primary Care Physicians. *Acta Derm Venereol* 2023;103:5087.