ONTARIO HEALTH TECHNOLOGY ASSESSMENT SERIES

Home Narrowband Ultraviolet B Phototherapy for Photoresponsive Skin Conditions: A Health Technology Assessment

KEY MESSAGES

What Is This Health Technology Assessment About?

Skin conditions are photoresponsive if they can be partially or completely treated by ultraviolet radiation (these conditions are not cured—if the treatment stops, the condition may return). The most common photoresponsive skin conditions are psoriasis, vitiligo, eczema, and cutaneous T-cell lymphoma (a type of skin cancer).

Treatment with ultraviolet radiation is called ultraviolet phototherapy. It involves exposing the affected person to ultraviolet radiation, usually delivered using a special type of fluorescent light bulb. The most commonly used type of ultraviolet phototherapy is called narrowband ultraviolet B phototherapy. It is generally more effective than broadband ultraviolet B phototherapy and safer than psoralen-plus-ultraviolet A phototherapy. It is also well tolerated (narrowband phototherapy has fewer side effects than broadband and requires fewer weekly treatments). Narrowband ultraviolet B phototherapy treatment is usually done in an outpatient setting, such as a clinic or doctor's office. Narrowband ultraviolet B phototherapy performed in the home by the person being treated or by a family member or other carer may be a viable option for people with difficulty accessing treatment in an outpatient setting.

This health technology assessment looked at how safe, effective, and cost-effective home narrowband ultraviolet B phototherapy is for people with some photoresponsive skin conditions. It looked at the budget impact of publicly funding home narrowband ultraviolet B phototherapy. It also looked at the experiences, preferences, and values of people with photoresponsive skin conditions.

What Did This Health Technology Assessment Find?

Home narrowband ultraviolet B phototherapy is at least as effective as narrowband ultraviolet B phototherapy performed in a clinic for the treatment of mild to severe psoriasis. We did not identify any studies assessing this treatment for skin conditions other than psoriasis. Because of the small number of events, we are uncertain if side effects happen more or less often with home narrowband ultraviolet B phototherapy than with clinic-based narrowband ultraviolet B phototherapy. However, the same side effects were reported in both treatment groups, and range from mild erythema to blistering of the skin.

Home narrowband ultraviolet B phototherapy is moderately likely (77% likely) to be cost-effective compared to clinic-based narrowband ultraviolet B phototherapy. Publicly funding home narrowband ultraviolet B phototherapy in Ontario will result in additional annual costs of $0.7 million for people with psoriasis and around $1.3 million for people with photoresponsive skin conditions. People with photoresponsive skin conditions with whom we spoke viewed home narrowband ultraviolet B phototherapy as beneficial for those with health conditions that make it difficult to travel, for those with busy schedules, and for those who may not have the means to pay for travel to clinics.

Published
Volume 19, Number TBA

Ontario

ACKNOWLEDGMENTS

This report was developed by a multidisciplinary team from Health Quality Ontario. The clinical epidemiologist was Conrad Kabali, the primary health economist was Lucia Cheng, the secondary health economist was Chunmei Li, the patient and public partnership analyst was Arshia Ali, and the medical librarian was Melissa Walter.

The medical editors were Kara Cowan and Tim Maguire. Others involved in the development and production of this report were Merissa Mohamed, Caroline Higgins, Claude Soulodre, Elisabeth Smitko, Kathryn Schwarz, Sarah McDowell, Vivian Ng, Andrée Mitchell, Amy Lang, Nancy Sikich, and Irfan Dhalla.

We would like to thank the following individuals and organizations for lending their expertise to the development of this report:

- Amanda Cresswell-Melville, Eczema Society of Canada
- Jean-Pierre DesGroseilliers, Élisabeth Bruyère Hospital
- Lyne Giroux, Sudbury Skin Clinique
- Steven Glassman, Élisabeth Bruyère Hospital
- Cheryl Rosen, University Health Network
- Neil Shear, Sunnybrook Health Sciences Centre
- Gary Sibbald, Women's College Hospital
- Daavlin
- Solarc Systems Inc

We also thank our lived experience participants, who generously gave their time to share their stories with us for this report.

The statements, conclusions, and views expressed in this report do not necessarily represent the views of those we consulted.

Citation

TBA

ABSTRACT

Background

Skin conditions are photoresponsive if they respond to ultraviolet (UV) radiation with partial or complete clearing. Ultraviolet phototherapy is performed by exposing the skin to UV radiation on a regular basis under medical supervision. Three types of UV radiation are used to treat photoresponsive skin conditions: broadband ultraviolet B (BB-UVB), psoralen plus ultraviolet A (PUVA), and narrowband ultraviolet B (NB-UVB). Narrowband UVB phototherapy is generally more effective than BB-UVB and safer than PUVA in the management of several photoresponsive skin conditions. While typically performed in an outpatient clinic setting, home NB-UVB phototherapy may be a viable option for people with limited access to outpatient treatment. We conducted a health technology assessment of home NB-UVB phototherapy for people with photoresponsive skin conditions that included an evaluation of the effectiveness, safety, cost-effectiveness, and budget impact of publicly funding home NB-UVB phototherapy, and patient preferences and values.

Methods

We performed a systematic literature search of the clinical evidence. We assessed the risk of bias of each included study using version 2 of the Cochrane risk-of-bias tool for randomized studies, and we assessed the quality of the body of evidence according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Working Group criteria. We performed a systematic economic literature search and conducted a cost–utility analysis with a 10-year horizon from a public payer perspective. The cost–utility analysis was conducted for psoriasis based on the available clinical evidence. We also analyzed the budget impact of publicly funding home NB-UVB phototherapy in people with photoresponsive skin conditions in Ontario. To contextualize the potential value of NB-UVB phototherapy, we spoke with people with photoresponsive skin conditions.

Results

We included one randomized controlled trial in the clinical evidence review. We found that home NB-UVB phototherapy is at least as effective as outpatient clinic NB-UVB phototherapy for the treatment of mild to severe psoriasis (the only photoresponsive skin condition investigated in the included study). In the included study, 82% of participants were treated at home, compared with 79% treated in an outpatient clinic setting (many participants had experience with both treatment settings). They demonstrated an improvement in baseline Psoriasis Area and Severity Index 50 (mean difference 2.8%, 95% confidence interval −8.6% to 14.2%), with the mean difference exceeding the preset noninferiority margin of −15%. Similar results were observed for other psoriasis area and severity indices (GRADE: Moderate). Episodes of mild erythema, burning sensation, severe erythema, and blistering were reported in both treatment groups, but were too few to allow a comparative safety assessment (GRADE: Low).

The primary economic evaluation showed that home NB-UVB phototherapy is more costly (incremental cost $4,509) and has higher quality-adjusted life-years (QALYs; incremental QALY 0.29) than outpatient clinic NB-UVB. Our best estimate of the incremental cost-effectiveness ratio of home NB-UVB compared with outpatient clinic NB-UVB is $15,675 per QALY gained. The probability of home NB-UVB being cost-effective versus outpatient clinic NB-UVB is 77% at a willingness-to-pay of $50,000 per QALY gained. Publicly funding home NB-UVB phototherapy in the psoriasis population would lead to about $0.7 million each year and a total 5-year net budget impact of about $3.3 million. Publicly funding home treatment for people with photoresponsive skin conditions would lead to about $1.3 million each year and a total 5-year

net budget impact of $6.3 million; however, this scenario accounted for the cost of phototherapy only (it did not include treatment-specific medical costs for conditions other than psoriasis).

People with photoresponsive skin conditions with whom we spoke viewed home NB-UVB phototherapy as beneficial for those with health conditions that make it difficult to travel, for those with busy schedules, and for those who may not have the means to pay for travel to clinics.

Conclusions

Home NB-UVB phototherapy is at least as effective as outpatient clinic NB-UVB phototherapy for the treatment of mild to severe psoriasis (GRADE: Moderate). We are uncertain if adverse events happen more often or less often with home NB-UVB phototherapy than outpatient clinic NB-UVB phototherapy (GRADE: Low).

Home NB-UVB phototherapy has an ICER of $15,675 per QALY gained, and the probability of home NB-UVB phototherapy being cost-effective is 77% at a willingness-to-pay of $50,000 per QALY gained. When accounting for the cost of phototherapy and other psoriasis-specific treatment costs (e.g., physician visits and adjuvant treatments), publicly funding home NB-UVB phototherapy in the psoriasis population would lead to a total 5-year net budget impact of about $3.3 million. Funding home NB-UVB phototherapy to people with photoresponsive skin conditions would lead to a total 5-year net budget impact of $6.3 million.

People with photoresponsive skin conditions with whom we spoke viewed both outpatient clinic and home NB-UVB phototherapy to be effective treatment options.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

OBJECTIVE

This health technology assessment evaluates the effectiveness, safety, and cost-effectiveness of home narrowband ultraviolet B (NB-UVB) phototherapy compared with outpatient clinic NB-UVB phototherapy for people with photoresponsive skin conditions. It also evaluates the budget impact of publicly funding home NB-UVB phototherapy and the experiences, preferences, and values of people with photoresponsive skin conditions.

BACKGROUND

Health Condition

Photoresponsive skin conditions are skin conditions that respond with partial or complete clearing to ultraviolet (UV) radiation exposure.[1] There are more than 40 conditions that can be treated with UV radiation. Among the most common are psoriasis, vitiligo, eczema, and cutaneous T-cell lymphoma.

Psoriasis

Psoriasis is a chronic immune condition that causes a rapid buildup of skin cells.[2] It is associated with an increased risk of psoriatic arthritis, Crohn's disease, and uveitis.[3] It has also been associated with other conditions, including obesity and inflammatory bowel disease. Psoriasis is caused by an abnormal interaction among the cells of the immune system, keratinocytes (skin cells), and several chemicals that mediate an inflammatory reaction.[4] Disease onset may occur at any age but typically occurs in adulthood. Prevalence in adults varies globally, with higher rates observed in Western countries and countries at higher latitudes.[5] Limited data suggest that prevalence may be lower in non-Caucasian populations.[5] The prevalence of psoriasis in Ontario is estimated at 2.5%.[6]

Plaque psoriasis, also known as psoriasis vulgaris or chronic stationary psoriasis, is the most common type, affecting 85% to 90% of all people with psoriasis.[7] Plaque psoriasis is also generally the most photoresponsive type (Solarc Systems Inc, phone communication, February 12, 2019).

A diagnosis of psoriasis is usually made through visual inspection (skin appearance). A biopsy may be performed to confirm the diagnosis and to rule out other conditions. Treatments for psoriasis include topical agents (e.g., corticosteroids),[8] phototherapy, and biologic and systemic agents (e.g., methotrexate).[9] Mild disease is often managed with topical agents, whereas moderate to severe disease may require phototherapy or biologic and systemic agents.[9]

Vitiligo

Vitiligo is a chronic skin condition that involves the progressive destruction of skin pigment; it is characterized by patchy areas of depigmented skin.[10,11] There are two major classes of vitiligo: segmental (limited to a specific area) and nonsegmental (can be generalized on the body and may grow over time). Nonsegmental vitiligo is the most common type, accounting for 85% to 90% of all cases.[12] The occurrence of vitiligo has been associated with immune disorders such as Hashimoto's thyroiditis and pernicious anemia.[11] The exact cause of vitiligo is unknown. However, it has been suggested to have immune, autocytotoxic (in which the host immune system destroys its own cells), or neurohumoral (chemicals formed in a neuron that are able to activate or modify the function of a neighboring neuron, muscle, or gland) origins.[13] Vitiligo can

occur at any age and affects males and females equally.[13] The global prevalence of vitiligo ranges from 0.2% to 1.8%.[14]

Ultraviolet radiation can be used to diagnose early stages of vitiligo, as the affected area of skin will glow when exposed to UV radiation. A skin biopsy may be taken to confirm the diagnosis. Topical agents are the first-line treatment for vitiligo, while UV phototherapy is considered a second-line option.[10] Vitiligo often requires lengthy courses of treatment with UV phototherapy (S. Glassman, email communication, February 3, 2019).

Eczema

Eczema is a chronic inflammatory skin condition characterized by dry skin and red patches that are intensely itchy.[14] It is a pruritic (itchy) inflammatory skin condition of unknown origin that usually develops in early infancy, but it also affects a substantial number of adults.[15,16] Most people with eczema have a personal or family history of allergies or asthma.[17] Environmental factors, including inhaled antigens, microbial antigens, food antigens, and contact sensitizers, as well as pruritus and stress, may contribute to the development of eczematous skin lesions.[17] Atopic dermatitis is the most common, affecting an estimated 10% to 20% of Canadians.[18]

The diagnosis of eczema is usually based on a physical examination and review of patient history.[19] In certain cases, a skin biopsy may be performed to confirm the diagnosis.[19] Treatment includes moisturizing agents, lifestyle changes, oral medications (e.g., corticosteroids, immunosuppressants), biologics, and UV phototherapy.[20]

Cutaneous T-Cell Lymphoma

Cutaneous T-cell lymphoma is a class of non-Hodgkin lymphoma, a type of cancer of the immune system that affects the skin.[21] T cells are a type of white blood cell involved in the adaptive immune response. In cutaneous T-cell lymphoma, these cells become abnormal and attack the skin. The clinical presentation, prognosis, and treatment vary according to the type of cutaneous T-cell lymphoma, with only mycosis fungoides, Sézary syndrome, and lymphomatoid papulosis being responsive to UV phototherapy.[21] Mycosis fungoides is the most common form of cutaneous T-cell lymphoma, accounting for 65% of cases.[21] Mycosis fungoides rarely affects people before the age of 20. The prevalence of mycosis fungoides in Canada is unknown. However, between 1992 and 2010, 6,685 Canadians were affected with cutaneous T-cell lymphoma (incidence rate: 11.32 cases per million individuals per year).[22]

Mycosis fungoides is typically diagnosed based on clinical features and skin biopsy. Treatments include sunlight, UV phototherapy, topical steroids, topical and systemic chemotherapies, local superficial radiotherapy, the histone deacetylase inhibitor vorinostat, total skin electron radiation, photopheresis, systemic agents (e.g., interferons, retinoids, rexinoids), and biologics.[23]

Current Treatment Options

Ultraviolet phototherapy is indicated for the treatment of various photoresponsive skin conditions when topical treatment becomes insufficient. Treatment involves repeated exposure of the skin to UV radiation.[24] There are three options for UV phototherapy: (1) psoralen plus ultraviolet A (PUVA, wavelength 320–400 nm), in which psoralen (a drug taken orally or applied topically) is used to sensitize the skin to UVA radiation; (2) NB-UVB phototherapy, wavelength 311–313 nm); and (3) broadband UVB (BB-UVB; wavelength 290–315 nm). Since NB-UVB is mainly confined to the “therapeutic” region of the UVB spectrum,[25] it has largely replaced BB-UVB for the treatment of most photoresponsive skin conditions.[26] For example, approximately

99% of the devices sold by Solarc Systems Inc are NB-UVB (Solarc Systems Inc, email communication, June 8, 2019). Nonetheless, there is a small proportion of people who do not tolerate NB-UVB but respond well to BB-UVB.[26] Also, for certain conditions, PUVA may be the preferred treatment option.[27] Ultraviolet phototherapy is generally offered in an outpatient clinic, which requires patients to travel two or three times a week for treatment.[28]

The mechanisms by which UV radiation may be effective for treating photoresponsive skin conditions vary by type of disorder. For instance, in psoriasis, UV radiation can destroy infiltrating T cells and keratinocytes, alter the profile of proinflammatory chemicals, and promote the migration of Langerhans cells (antigen-presenting immune cells in the skin) out of the epidermis (the outer layer of the skin).[24] In vitiligo, UV radiation works by destroying infiltrating T cells and promoting the migration of melanocytes (cells that produce skin pigment) from the outer root sheath of the hair follicle (where they are typically unaffected by immune destruction) to the outer layer of the skin.[29] In eczema, UV radiation works by destroying infiltrating T cells, altering the profile of proinflammatory chemicals, inhibiting the function of Langerhans cells, thickening the stratum corneum (the outermost layer of the skin), and preventing skin colonization by the bacterium *Staphylococcus aureus* and the fungus *Pityrosporum orbiculare*.[30] In cutaneous T-cell lymphoma, UV radiation works by inducing apoptosis (cell death) and interrupting the chronic stimulation of malignant T cells.[31]

Several UV phototherapy devices exist. They vary in cost, efficiency, and safety features.[32] Full-body cabinets are the most expensive, but require the shortest treatment time. Multipanel three-dimensional units are less expensive but may require body repositioning during treatment to ensure the skin is uniformly illuminated. Single-panel units require longer treatment times owing to their use of low-output power, and their use also requires body repositioning. Small handheld devices are used for difficult-to-treat localized conditions and for areas that are not easily illuminated by the larger units. However, these smaller devices may cause more burns than larger devices, as people may inadvertently over-radiate the affected areas (C. Rosen, phone communication, June 22, 2019). Specialized brush lamps are available for the scalp; they typically deliver UV radiation to areas covering less than 100 cm^2.[32]

Health Technology Under Review

Home UV phototherapy may be a viable option for people with limited access to outpatient clinic UV phototherapy. People with photoresponsive skin conditions may find it inconvenient to receive UV treatment in an outpatient clinic setting because of the need to travel to a clinic two to three times a week, the time required to attend outpatient treatment, clinic hours that may interfere with work schedules, the limited number of clinics available in Ontario, and the cost of parking (G. Sibbald, phone communication, January 18, 2019). Home UV phototherapy typically requires a short exposure to UV radiation (usually a few minutes) every other day. Narrowband UVB is generally recommended for home therapy because of its excellent safety profile and because its efficacy is superior to that of BB-UVB and almost equal to that of PUVA (based primarily on studies that focussed on psoriasis).[32] Narrowband UVB is also recommended for home therapy because of its convenience, as spectral dosimetry (the measurement of the minimum UV radiation dose that can cause a burn) is not required.[32] The UV radiation dosage used varies by the type and severity of a person's skin condition.

However, concerns exist regarding the potential overuse, underuse, or inappropriate use of home UV phototherapy due to the absence of adequate clinician supervision (S. Glassman, email communication, February 3, 2019). To address these concerns, some manufacturers have added a built-in timer to their units (Solarc Systems Inc, email communication, June 8,

2019). There are some people for whom home UV phototherapy is not suitable. Ultraviolet phototherapy is not intended to replace outpatient clinic UV phototherapy, but rather to provide people with more options. The focus of this health technology assessment is home NB-UVB phototherapy.

Regulatory Information

Several NB-UVB phototherapy devices have been approved by Health Canada as Class II medical devices.[33] The manufacturers of these devices include Daavlin and Solarc Systems Inc. Health Canada does not specify an approved treatment setting (i.e., clinic vs. home), but some approved devices are available for home use. For example, the devices within Solarc Systems Inc's SolRx line of device families have been specifically designed for home use. The replaceable bulbs used within these devices are approved by Health Canada as Class I medical devices. [33]

Solarc Systems Inc has a Health Canada licence to market their UV phototherapy units for four conditions: psoriasis, vitiligo, eczema, and vitamin D deficiency (Solarc Systems Inc, email communication, June 8, 2019). It is unclear if marketing restrictions also apply to devices manufactured by other companies.

Ontario, Canadian, and International Context

In 2009, the Medical Advisory Secretariat of Ontario's Ministry of Health and Long-Term Care conducted an evidence-based analysis of UV phototherapy for the management of moderate to severe plaque psoriasis. Based on one high-quality study, but limited evidence, the report concluded that home NB-UVB phototherapy was not inferior to outpatient clinic NB-UVB phototherapy.[34] Subsequently, the Ontario Health Technology Advisory Committee recommended that access to UV phototherapy should be supported and encouraged for people with moderate to severe plaque psoriasis. However, the committee did not make a specific recommendation regarding the use of home NB-UVB phototherapy.[34]

There is an Ontario Schedule of Benefits fee code for UV phototherapy (G470).[35] However, the code does not address treatment in the home setting and has a maximum reimbursement of $7.85 per patient per day. The G470 code is an insured service payable at nil if rendered in a hospital or physiotherapy clinic. In Ontario, only dermatologists can refer patients to outpatient clinic UV phototherapy, and the wait time to see a dermatologist can be as long as 6 months (J.-P. DesGroseillers, phone communication, December 14, 2018). Once a patient has seen a dermatologist, the wait time for treatment at a UV phototherapy clinic is usually only a few weeks (J.-P. DesGroseillers, phone communication, December 14, 2018). According to the Dermatology Association of Ontario, there are at least 36 clinics in Ontario that provide UV phototherapy, 13 of which are located in the Greater Toronto Area.[36]

In Canada, public funding for outpatient clinic UV phototherapy is also available in Alberta,[37] Saskatchewan,[38] Manitoba,[39] New Brunswick,[40] and Prince Edward Island.[41] According to Solarc Systems Inc, home UV phototherapy is not publicly funded anywhere in Canada.

In the United States, the Medicare program reimburses 80% of the cost of UV panels to qualified patients; these panels may be purchased or rented.[42] In the United Kingdom, the National Institute for Health and Care Excellence recommends NB-UVB phototherapy for people with plaque or guttate-pattern psoriasis that cannot be controlled with topical treatments alone.[43]

Expert Consultation

We engaged with experts in the specialty areas of dermatology and UV phototherapy to help inform our understanding of aspects of the health technology and our methodologies and to contextualize the evidence.

PROSPERO Registration

This health technology assessment has been registered in PROSPERO, the international prospective register of systematic reviews (CRD #42019130419), available at https://www.crd.york.ac.uk/PROSPERO.

CLINICAL EVIDENCE

Research Question

What are the effectiveness and safety of home NB-UVB phototherapy compared with outpatient clinic NB-UVB phototherapy for the treatment of people with photoresponsive skin conditions?

Methods

Clinical Literature Search

We performed a clinical literature search on February 8, 2019, to retrieve studies published from database inception until the search date. We used the Ovid interface in the following databases: MEDLINE, Embase, the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews, the Health Technology Assessment database, and the National Health Service Economic Evaluation Database (NHS EED). We used the EBSCOhost interface to search the Cumulative Index to Nursing & Allied Health Literature (CINAHL).

A medical librarian developed the search strategies using controlled vocabulary (e.g., Medical Subject Headings) and relevant keywords. The final search strategy was peer-reviewed using the PRESS Checklist.[44]

We created database auto-alerts in MEDLINE, Embase, and CINAHL and monitored them for the duration of the assessment period. We also performed a targeted grey literature search of health technology assessment agency websites as well as clinical trial and systematic review registries. See Appendix 1 for our literature search strategies, including all search terms.

Eligibility Criteria

Studies

Inclusion Criteria

- English-language full-text publications
- Studies published from database inception until February 8, 2019
- Randomized controlled trials and cohort studies

Exclusion Criteria

- Animal and in vitro studies
- Nonsystematic reviews, systematic reviews, health technology assessments, narrative reviews, abstracts, editorials, letters, case reports, and commentaries

Participants

- Any people diagnosed with a photoresponsive skin condition

Intervention

- NB-UVB phototherapy provided in the home ("home NB-UVB phototherapy")

Comparator

- NB-UVB phototherapy provided in an outpatient clinic setting ("outpatient NB-UVB phototherapy"; e.g., clinic or physician's office)

Outcome Measures

- Area and severity of disease
  - Eczema: Eczema Area and Severity Index
  - Psoriasis: Psoriasis Area and Severity Indices
  - Vitiligo: Vitiligo Area Scoring Index, Vitiligo Disease Activity Index, Vitiligo Extent Tensity Index, Vitiligo Impact Patient Scale
  - Other photoresponsive skin conditions: indices reported in the literature
- Quality of life
  - Eczema: Dermatology Life Quality Index, Quality-of-Life Index for Atopic Dermatitis
  - Psoriasis: 36-Item Short-Form Survey (SF-36), Dermatology Life Quality Index, EuroQol–Five Dimensions (EQ-5D), Psoriasis Disability Index
  - Vitiligo: Dermatology Life Quality Index, Vitiligo Quality of Life Index
  - Other photoresponsive skin conditions: SF-36, other indices reported in the literature
- Adverse effects: altered skin pigmentation (for vitiligo), blistering, photoaging, photocarcinogenesis, pruritus, skin erythema, xerosis

Literature Screening

A single reviewer conducted an initial screening of titles and abstracts using Covidence[45] and then obtained the full texts of studies that appeared eligible for review according to the inclusion criteria. A single reviewer then examined the full-text articles and selected studies eligible for inclusion. The reviewer also examined reference lists for any additional relevant studies not identified through the search.

Data Extraction

We extracted relevant data on study characteristics and risk-of-bias items using a data form to collect information on the following:

- Source (e.g., citation information, study type)
- Methods (e.g., study design, study duration and years, participant allocation, allocation sequence concealment, blinding, reporting of missing data, reporting of outcomes, whether the study compared two or more groups)
- Outcomes (e.g., outcomes measured, number of participants for each outcome, number of participants missing for each outcome, outcome definition and source of information, unit of measurement, upper and lower limits [for scales], time points at which the outcomes were assessed)

Statistical Analysis

Only one study was eligible for this review (Figure 1).[28] A noninferiority threshold of −15% was pre-set in the eligible study and adopted in this review. We regarded the effectiveness of home NB-UVB phototherapy as noninferior if the lower limit of the 95% confidence interval was equal to or greater than the noninferiority threshold. We interpreted the findings as uncertain if the confidence interval contained values consistent with both the noninferiority and inferiority hypotheses of the effectiveness of home NB-UVB phototherapy. Methods for synthesizing evidence from multiple studies were not applicable.

Critical Appraisal of Evidence

We assessed risk of bias using version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2.0).[46]

We evaluated the quality of the body of evidence for each outcome according to the *Grading of Recommendations Assessment, Development, and Evaluation* (GRADE) *Handbook*.[47] The body of evidence was assessed based on the following considerations: risk of bias, inconsistency, indirectness, imprecision, and publication bias. The overall rating reflects our certainty in the evidence.

Results

Clinical Literature Search

The database search of the clinical literature yielded 865 citations published from database inception until February 8, 2019. One additional record was identified through grey literature searching, for a total of 491 after removing duplicates. We identified one randomized controlled trial that met our inclusion criteria. Figure 1 presents the modified Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram for the clinical literature search.

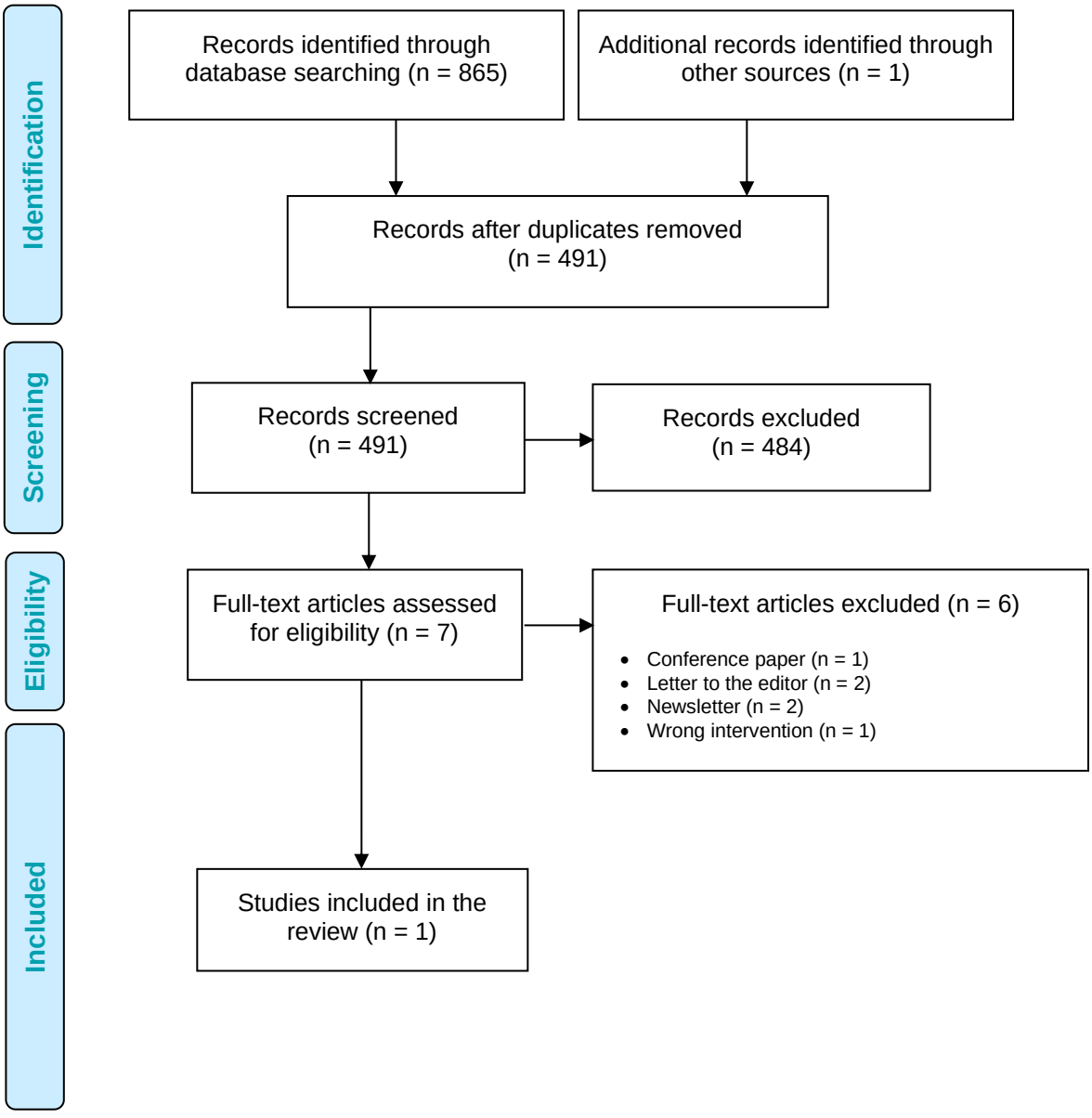

Figure 1: Modified PRISMA Flow Diagram—Clinical Search Strategy

Source: Adapted from Moher et al.[48]

Characteristics of the Included Study

We identified one study eligible for this review: the PLUTO study conducted in the Netherlands by Koek et al.[28] This study was a pragmatic, multicentre, single-blinded randomized controlled noninferiority trial comparing the effectiveness of home versus outpatient clinic NB-UVB phototherapy for mild to severe psoriasis. The noninferiority margin for the primary outcome was set at −15%. The pragmatic design was chosen so that the two interventions could be compared under the conditions in which they would be applied in daily practice.[49] The study, which was conducted from 2002 through 2005, enrolled 196 people with psoriasis from the dermatology departments of 14 hospitals in the Netherlands.

Disease severity was measured using the Self-Administered Psoriasis Area and Severity Index (SAPASI) and the Psoriasis Area and Severity Index (PASI). The primary outcome measure was an improvement of 50% or more over participants' baseline SAPASI or PASI scores (SAPASI 50 and PASI 50, respectively). Secondary outcome measures included an improvement of 75% or more over baseline SAPASI and PASI scores (SAPASI 75 and PASI 75, respectively), an improvement of 90% or more over baseline SAPASI and PASI scores (SAPASI 90 and PASI 90, respectively), and quality of life as measured by the Psoriasis Disability Index (PDI) and the generic 36-Item Short-Form Survey (SF-36). The side effects investigated in this study included mild skin erythema (redness), severe erythema, burning sensation, and blistering. Table 1 summarizes the details of the study.

Table 1: Characteristics of the Included Study

Author, Year	Study Design and Methods	Participants	Intervention	Comparator	Outcomes
Koek et al, 2009[28]	Pragmatic, multicentre, single-blinded randomized controlled noninferiority trial	196 people, aged ≥ 18 years, with psoriasis who were clinically eligible for NB-UVB phototherapy	Home NB-UVB using the TL01 home NB-UVB phototherapy unit (manufactured by Philips)	Outpatient-based standard NB-UVB phototherapy	Primary outcomes: SAPASI 50, PASI 50 Secondary outcomes: SAPASI 75, PASI 75, SAPASI 90, PASI 90 Quality of life: PDI, SF-36 Side effects: mild erythema, severe erythema, burning sensation, blistering

Abbreviations: NB-UVB, narrowband ultraviolet B; PASI, Psoriasis Area and Severity Index; PDI, Psoriasis Disability Index; SAPASI, Self-Administered Psoriasis Area and Severity Index; SF-36, 36-Item Short-Form Survey.

The percentage of participants using adjuvant drugs (i.e., using drugs in addition to NB-UVB phototherapy) prior to study follow-up was higher among participants treated at home versus in the outpatient clinic setting. However, this association was reversed during follow-up, when the use of these drugs was higher among those in the outpatient clinic group than in the home group. Table 2 provides a comparison of the characteristics of the two intervention groups.

Table 2: Intervention Group Comparison, PLUTO Study

Variable	Home NB-UVB Phototherapy	Outpatient NB-UVB Phototherapy	Difference (95% CI)
Irradiations			
Mean number of radiations	34.4 (n = 98)	28.6 (n = 98)	5.8 (2.7–9.0)
Mean Cumulative Dose, J/cm^2			
At 23 irradiations	21.2 (n = 85)	26.9 (n = 68)	−5.7 (−10.3 to −1.1)
At end of treatment	51.5 (n = 91)	46.1 (n = 93)	5.4 (−5.2 to 16.0)
Use of Adjuvant Drugs[a]			
During wait time[b]			
Topical steroids, %	25.5 (n = 24)	6.3 (n = 6)	19.2 (8.8 to 29.6)
Vitamin D derivatives, %	18.1 (n = 17)	6.3 (n = 6)	11.8 (2.5 to 21.1)
During treatment			
Topical steroids, %	31.5 (n = 29)	52.2 (n = 48)	−20.7 (−35.0 to −6.4)
Vitamin D derivatives, %	19.6 (n = 18)	40.2 (n = 37)	−20.6 (−33.8 to −7.4)
Wait Time[b] and Treatment Duration			
Mean wait time,[b] weeks	5.8	2.2	3.6 (2.9 to 4.4)
Mean treatment duration, weeks	11.4	14.1	−2.7 (−4.1 to −1.2)
Mean time from inclusion to end of treatment, weeks	17.2	16.2	1.0 (−0.6 to 2.5)

Abbreviations: CI, confidence interval; NB-UVB, narrowband ultraviolet B.
[a]Proportion of participants using adjuvant drugs during two consecutive phases of the trial.
[b]Time between inclusion in the trial and starting treatment.

Main Findings of the Included Study

Area and Severity of Disease

A total of 82% of participants treated at home compared with 79% of those treated in the outpatient setting demonstrated an improvement of 50% or more over their baseline SAPASI scores (mean difference 2.8%, 95% confidence interval [CI] −8.6% to 14.2%).[28] A total of 70% of participants treated at home demonstrated an improvement of 50% or more over their baseline PASI scores compared with 73% treated in the outpatient setting (mean difference −2.3%, 95% CI −15.7% to 11.1%). Findings consistent with noninferiority or borderline noninferiority hypothesis were observed for all other scales of the SAPASI and PASI (Table 3).

We downgraded the certainty of evidence for these outcomes to moderate owing to indirectness, because the study excluded people unwilling to undergo treatment according to randomization, as well as people unable to receive outpatient clinic treatment because they lived too far from the hospital providing treatment (Appendix 2, Table A1).

Quality of Life

The authors reported the point estimate for the PDI; however, they did not provide information that could be used to evaluate the precision of the PDI estimate. Therefore, we rated the certainty of the PDI evidence as very low, downgrading for reporting bias and indirectness (Appendix 2, Table A1).

The authors did not report estimates for SF-36 results, stating only that there was an improvement in both groups.[28] Therefore, we were unable to perform a GRADE assessment of the SF-36 evidence.

We have contacted the primary author to request additional information regarding the PDI and SF-36 findings.

Safety

In the study by Koek et al,[28] findings on the safety of home NB-UVB phototherapy were uncertain. The most commonly reported side effect was mild erythema, which constituted 29% of the types of side effect per irradiation. We downgraded the certainty of the evidence for safety outcomes to low owing to imprecision and indirectness (Appendix 2, Table A1).

Table 3: Main Findings of the Included Study

Variable	Home NB-UVB Phototherapy	Outpatient NB-UVB Phototherapy	Difference (95% CI)
Area and Severity of Disease			
SAPASI 50, 75, 90[a]	(n = 94)	(n = 91)	
SAPASI 50, %	81.9 (n = 77)	79.1 (n = 72)	2.8 (−8.6 to 14.2)
SAPASI 75, %	69.1 (n = 65)	59.3 (n = 54)	9.8 (−4.0 to 23.6)
SAPASI 90, %	43.6 (n = 41)	29.7 (n = 27)	13.9 (0.002 to 27.8)
PASI 50, 75, 90[b]	(n = 91)	(n = 84)	
PASI 50, %	70.3 (n = 64)	72.6 (n = 61)	−2.3 (−15.7 to 11.1)
PASI 75, %	40.7 (n = 37)	41.7 (n = 35)	−1.0 (−15.6 to 13.6)
PASI 90, %	19.8 (n = 18)	19.0 (n = 16)	0.8 (−10.9 to 12.5)
Quality of Life			
PDI, change from baseline	−11.9 (SE NR) End: 20.9 Baseline: 32.8	−12.3 (SE NR) End: 22.0 Baseline: 34.3	0.4[c]
SF-36[d]	NR	NR	NR
Safety			
Percentage of side effects per irradiation	(n = 93)	(n = 92)	
Mild erythema	28.8	28.6	0.3 (−7.4 to 8.0)
Burning sensation	7.1	10.0	−2.9 (−7.1 to 1.2)
Severe erythema	5.5	3.6	1.9 (−1.1 to 4.9)
Blistering	0.3	0.6	−0.3 (−0.9 to 0.3)

Abbreviations: CI, confidence interval; NB-UVB, narrowband ultraviolet B; NR, not reported; PASI, Psoriasis Area and Severity Index; PDI, Psoriasis Disability Index; SAPASI, Self-Administered Psoriasis Area and Severity Index; SE, standard error; SF-36, 36-Item Short-Form Survey

.
[a]The proportion of participants achieving an improvement of at least 50%, 75%, or 90% over their baseline SAPASI scores.
[b]The proportion of participants achieving an improvement of at least 50%, 75%, or 90% over their baseline PASI scores.
[c]Insufficient information was available to compute the confidence interval.
[d]The authors did not report any estimates; they stated only that both groups experienced an improvement.

Ongoing Studies

We are aware of one ongoing pragmatic randomized controlled trial of home versus outpatient clinic NB-UVB phototherapy for the treatment of psoriasis.[50] The study, expected to be completed in October, 2022, is registered on ClinicalTrials.gov (identifier: NCT03726489). Unlike the PLUTO study, which included only adults, the minimum age of inclusion in this trial is 12 years and older.

Discussion

Our review found that home NB-UVB phototherapy is at least as effective as outpatient clinic NB-UVB phototherapy for the treatment of mild to severe psoriasis as measured using the SAPASI and PASI scales. We did not identify any studies assessing home NB-UVB phototherapy for people with photoresponsive skin conditions other than psoriasis. Also, due to small number of events we could not determine if home NB-UVB phototherapy is more or less safe than clinic NB-UVB phototherapy.

While reviewing the study by Koek et al,[28] we noted that the use of adjuvant drugs was higher among participants in the home group than among those in the outpatient clinic group prior to the start of follow-up. Interestingly, during follow-up, there was a reversal in the use of adjuvant drugs: the rate of use was lower among those in the home group than among those in the outpatient group. However, this study had a pragmatic design, and the use of adjuvant drugs reflects real-world experience.

Strengths and Limitations

The main strength of our review is that the study that met our eligibility criteria applied a pragmatic design.[28] This design mimics treatment effectiveness outside the experimental environment, which is more useful to this health technology assessment than the efficacy reported in conventional randomized controlled trials. However, this design may still fail to fully address the issue of generalizability if the participants in the trial differ from the target population in ways that can affect treatment effectiveness. Of note, the authors of the included study observed that the mean baseline SAPASI and PASI scores were similar to those in trials in which participants were said to be representative of those receiving NB-UVB phototherapy, suggesting their findings may be generalizable. But they also noted that these same scores were somewhat higher than those in another trial that used the same principal inclusion criterion of clinical eligibility as in their study. It is unclear if this discrepancy can be explained by statistical fluctuations.

The major limitation of our review is the lack of more eligible studies. As of the time of writing, the study by Koek et al[28] is the only published study that has evaluated the effectiveness of home NB-UVB phototherapy. Since findings that may be a consequence of statistical fluctuations can be a concern for small to moderate-sized single studies, there is a need for additional studies to replicate the findings of the study by Koek et al.[28] Further research may help improve certainty of evidence. Moreover, the study by Koek et al[28] focused on only one photoresponsive skin condition (psoriasis); therefore, the findings of this review are applicable only to psoriasis. In addition, the study was restricted to people aged 18 years and older, so the findings of our review do not apply to children or adolescents.

Conclusions

Our review found that home NB-UVB phototherapy is at least as effective as outpatient clinic NB-UVB phototherapy for the treatment of psoriasis based on scores measuring the area and severity of disease (GRADE: Moderate). We are uncertain about the evidence for quality of life comparing home versus outpatient clinic NB-UVB phototherapy owing to missing data and reporting bias (GRADE: Very low). Similarly, we are uncertain if adverse effects happen more or less often with home NB-UVB phototherapy than with outpatient clinic NB-UVB phototherapy (GRADE: Low). Home NB-UVB phototherapy has the same possible side effects as outpatient clinic NB-UVB phototherapy, which can range from mild erythema to blistering of the skin. The findings of this review are not generalizable to photoresponsive skin conditions other than psoriasis, or to people under the age of 18 years.

ECONOMIC EVIDENCE

Research Question

What is the cost-effectiveness of home NB-UVB phototherapy compared with outpatient clinic NB-UVB phototherapy for the treatment of people with photoresponsive skin conditions?

Methods

Economic Literature Search

We performed an economic literature search on February 8, 2019, to retrieve studies published from database inception until the search date. To retrieve relevant studies, we developed a search using the clinical search strategy with an economic and costing filter applied.

We created database auto-alerts in MEDLINE, Embase, and CINAHL and monitored them for the duration of the assessment period. We also performed a targeted grey literature search of health technology assessment agency websites, clinical trial and systematic review registries, and the Tufts Cost-Effectiveness Analysis Registry. See the Clinical Literature Search section, above, for further details on methods used. See Appendix 1 for our literature search strategies, including all search terms.

Eligibility Criteria

Studies

Inclusion Criteria

- English-language full-text publications
- Studies in people with photoresponsive skin conditions
- Cost–utility analyses, cost-effectiveness analyses, cost-benefit analyses, cost-consequence analyses, or cost minimization analyses

Exclusion Criteria

- Abstracts, case reports, editorials, commentaries, reviews, letters, unpublished studies
- Costing analyses

Population

- People with photoresponsive skin conditions, defined as any skin condition that responds favourably to UV light exposure, including psoriasis, vitiligo, eczema, and T-cell lymphoma

Intervention

Home NB-UVB phototherapy

Outcome Measures

- Costs

- Health outcomes (e.g., quality-adjusted life-years [QALYs])
- Incremental costs and incremental effectiveness
- Incremental cost-effectiveness ratios

Literature Screening

A single reviewer conducted an initial screening of titles and abstracts using Covidence[45] and then obtained the full texts of studies that appeared eligible for review according to the inclusion criteria. The same reviewer then examined the full-text articles and selected studies eligible for inclusion. The reviewer also examined reference lists for any additional relevant studies not identified through the search.

Data Extraction

We extracted relevant data on study characteristics and outcomes to collect information about the following:

- Source (e.g., citation information, study type)
- Methods (e.g., study design, analytic technique, perspective, time horizon, population, intervention[s], comparator[s])
- Outcomes (e.g., health outcomes, costs, incremental cost-effectiveness ratios)

Study Applicability and Limitations

We determined the usefulness of each identified study for decision-making by applying a modified quality appraisal checklist for economic evaluations originally developed by the National Institute for Health and Care Excellence (NICE) in the United Kingdom to inform the development of NICE's clinical guidelines.[51] We modified the wording of the questions to remove references to guidelines and to make it specific to Ontario. Next, we separated the checklist into two sections. In the first section, we assessed the applicability of each study to the research question (directly, partially, or not applicable). In the second section, we assessed the limitations (minor, potentially serious, or very serious) of the studies that we found to be directly applicable.

Results

Economic Literature Search

The economic literature search yielded 89 citations published from database inception until February 8, 2019, after removing duplicates. We excluded a total of 70 articles based on information in the title and abstract. We then obtained the full texts of 19 potentially relevant articles for further assessment. We identified one study that met our inclusion criteria. See Appendix 3 for a list of studies excluded after full text review. Figure 2 presents the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram for the economic literature search.

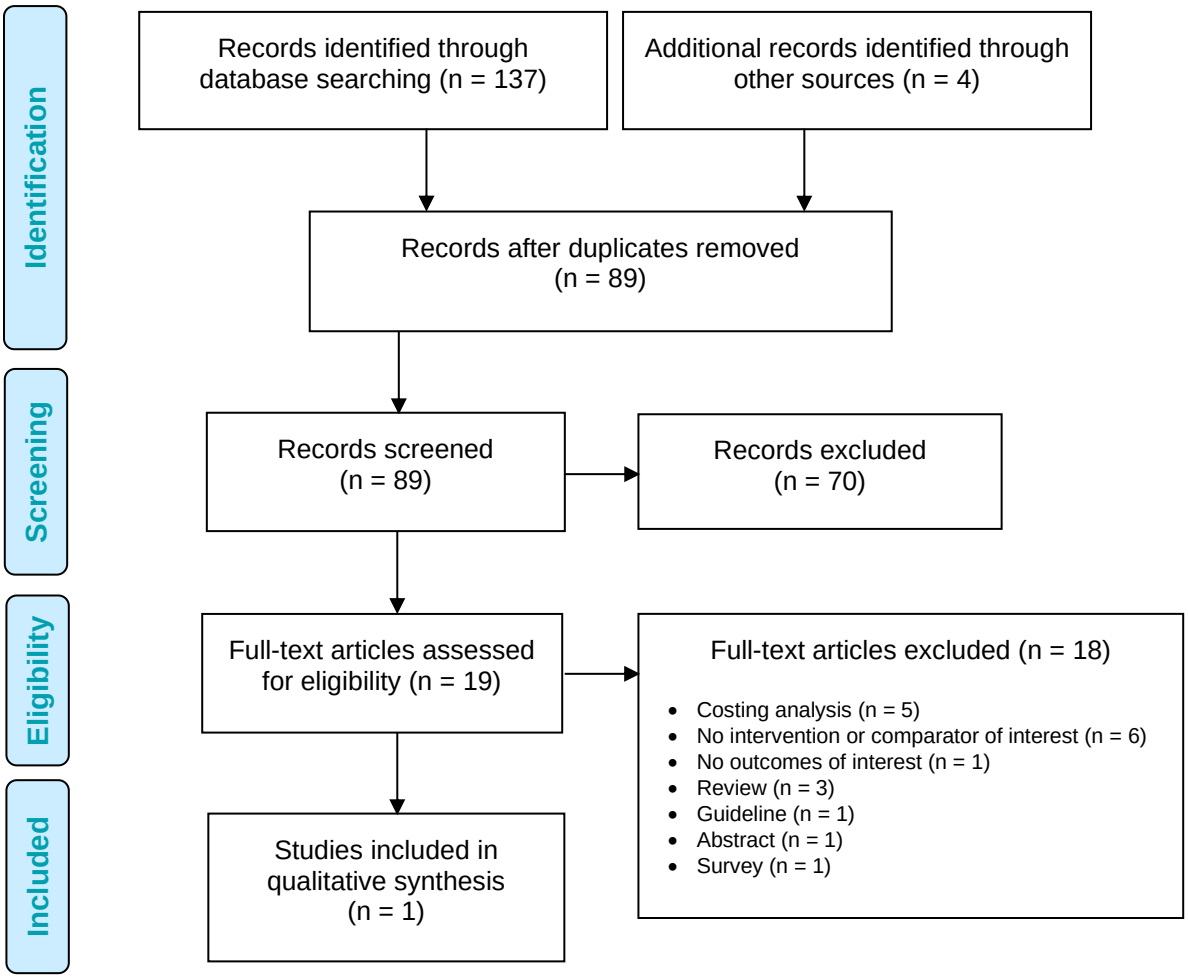

Figure 2: PRISMA Flow Diagram—Economic Search Strategy

Source: Adapted from Moher et al, 2009.[48]

Overview of Included Economic Studies

We identified one study that met the inclusion criteria. Koek et al[52] examined the cost effectiveness of home NB-UVB compared with outpatient clinic NB-UVB for adults with psoriasis based on a randomized controlled trial (the PLUTO study) in the Netherlands. The methods and results are summarized in Table 4. The authors conducted a cost–utility analysis examining the

incremental cost per QALY gained, as well as a cost-effectiveness analysis comparing the incremental cost per day with the relevant treatment effect (defined as ≥ 50% improvement in baseline severity of psoriasis). The costs and effects were measured at the end of phototherapy (mean duration: 17.6 weeks), as well as 1 year after the end of phototherapy (mean duration: 68.4 weeks). Utilities were measured using EQ-5D and SF-36 instruments at baseline, during phototherapy, and at the end of phototherapy. The analysis was conducted from the societal perspective and presented in 2003 euros. The analysis included costs related to phototherapy treatments, physician visits, travel costs, concomitant drug use, and reduced productivity while at work.

The authors found that home NB-UVB phototherapy achieves a slightly higher QALY than outpatient clinic NB-UVB phototherapy, but it is also slightly more expensive. At 1 year after the completion of phototherapy sessions, the total costs per patient were €1,272 for home and €1,148 for outpatient clinic NB-UVB phototherapy; the QALYs were 1.153 (home) versus 1.126 (outpatient clinic). The incremental cost-effectiveness ratio (ICER) was €4,646 per QALY gained, which was below the commonly accepted cost-effectiveness ratio in the Netherlands of €20,000 per QALY gained. For the cost-effectiveness analysis, the number of days with a relevant treatment effect were 216.5 for home NB-UVB phototherapy and 210.4 for outpatient clinic NB-UVB phototherapy, meaning that €20.50 is needed for outpatient clinic NB-UVB phototherapy to have 1 additional day with relevant treatment effect (defined as achieving ≥ 50% improvement from baseline).

With regards to the scenario analyses, using SF-36 instead of EQ-5D as utility inputs yielded a similar ICER below a willingness-to-pay of €20,000 per QALY gained. In another scenario, where the cost due to missed work days was calculated, the total costs for outpatient clinic NB-UVB phototherapy was higher than for home NB-UVB phototherapy (€2,209 vs. €1,857, respectively), making home NB-UVB phototherapy the dominating (less costly, more effective) strategy.

Table 4: Results of Economic Literature Review—Summary

Author, Year, Country of Publication	Analytic Technique, Study Design, Perspective, Time Horizon	Population	Intervention and Comparator	Results[a]		
				Health Outcomes	Costs	Cost-Effectiveness (Home vs. outpatient clinic)
Koek et al, 2010[52] The Netherlands	• Cost–utility analysis, cost-effectiveness analysis, cost minimization analysis • Within-RCT • Dutch societal • Time horizon: start of treatment to 1 yr after the end of phototherapy (68.4 wk total) • No discount	• Adults with psoriasis who were clinically eligible for NB-UVB • Total N = 105 • Average age: 41.2 (home), 45 (outpatient clinic) • Male (67%)	• Intervention: home NB-UVB • Comparator: outpatient clinic NB-UVB	**QALYs** • Home: 1.153 • Outpatient clinic: 1.126 • Incremental: 0.027 **No. days with a relevant treatment effect[b]** • Home: 216.5 • Outpatient clinic: 210.4 • Incremental: 6.1	• Home: €1,272 • Outpatient clinic: €1,148 • Incremental: €124	• €4,646 per QALY gained • €20.50 per additional day with relevant treatment effect

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy; No., number; QALY, quality-adjusted life year; RCT, randomized controlled trial.
[a]All costs reported in 2003 Euro.
[b]Defined in the study as achieving at least 50% reduction (improvement) from the baseline psoriasis area and severity index (PASI).

Applicability and Limitations of the Included Studies

Appendix 4 provides the results of the applicability and limitations checklists applied to Koek et al[52] (Tables A3 and A4). The study was deemed partially applicable to our research question because it considered one of our populations of interest (people with psoriasis) and the interventions of interest (home and outpatient clinic NB-NVB phototherapy). However, the analysis was conducted from the societal perspective of the Netherlands and not directly applicable to the Canadian setting. We considered the study to have minor limitations. The study benefited from being a part of a randomized controlled trial. Individual-level trial data was used as input when available, and authors appropriately considered the costs and outcomes from other sectors, such as costs related to travelling, parking and reduced productivity. However, the analysis has a relatively short time horizon (1 year after the end of phototherapy), which may be insufficient, considering the chronic nature of psoriasis.

Discussion

Based on published evidence, home UV phototherapy appears to be cost effective compared to conventional outpatient clinic UV phototherapy and biologic drugs. However, the available economic evidence has several limitations. The only cost–utility study identified addressed relatively short-term costs and outcomes.[52] The study was also not conducted from the Canadian perspective. We identified 11 other studies[53-63] addressing the costs of home NB-UVB phototherapy (findings summarized in Appendix 5). However, these studies did not meet our inclusion criteria due to being a costing study, survey, conference abstract, limited in quality or lacking direct comparison between home and outpatient clinic UV phototherapy. None of the available cost-effectiveness studies are conducted from the Ontario/Canadian perspective.

Other Studies Addressing Home UV Phototherapy

Costing of Home NB-UVB Phototherapy in Canada

We found three studies[58,61] that estimated the cost of home UV phototherapy in the Canadian setting, and the cost of home NB-UVB phototherapy appeared to be at least roughly similar, if not less than the cost of outpatient clinic NB-UVB phototherapy.

The Medical Advisory Secretariat conducted a health technology assessment in 2009 in which they estimated costs of NB-UVB phototherapy in different settings.[59] The annual cost per person was $365 (in 2009 dollars) for home NB-UVB phototherapy, which was less than the average costs of outpatient clinic NB-UVB phototherapy ($551). The study did not meet our inclusion criteria because a cost-effectiveness analysis was not performed. Another Ontario costing study by Mikhael et al[58] compared the costs of various psoriasis treatments in Ontario over a 10-year period. The total direct medical cost (i.e., drugs, physician visits, and laboratory tests) was slightly higher in the home NB-UVB phototherapy group ($400 per year in 2009 dollars) compared with outpatient clinic phototherapy ($315 per year). However, the authors did not include indirect out-of-pocket or lost productivity costs. The study also may not reflect real-world practice as it assumed that patients would remain on the same treatment for 10 years and did not consider switching. In a survey conducted by Haykal et al[64] in 2006, 16 respondents reported monthly savings of home UV phototherapy ranging from $20 to $600 in reduced travelling and work hours missed. The authors did not conduct an economic analysis.

Costing of Home NB-UVB Phototherapy Outside of Canada

We found four studies[53,57,62,63] that examined the costs of home versus outpatient clinic UV phototherapy outside of Canada. The evidence consistently showed greater costs for outpatient clinic phototherapy.

Two studies[62,63] conducted by Cameron and colleagues estimated the cost of home NB-UVB phototherapy in Scotland. In 2002, the authors found that the median estimated cost for home NB-UVB phototherapy was £128 GBP (in 2000 pound sterling), compared with an estimated £189 GBP had they attended outpatient clinic phototherapy.[63] In a second costing analysis, they found that the total cost to society was £410 GBP (in 2011 pound sterling) per course of home UV phototherapy, compared to an estimated £550 GBP for outpatient clinic UV therapy.[62] A similar result was reported in a costing study in the United States, where the total annual costs were $2,768 USD (in 2010 dollars) for home UV and $6,676 USD for outpatient clinic UV phototherapy.[57] Another costing analysis estimated the commuting cost of outpatient clinic phototherapy for 3 months, and reported that if a patient lives 20 or more miles (32 km) away from the phototherapy clinic, the expenses associated with commuting would be greater than the out-of-pocket cost of purchasing a home phototherapy unit ($2,600 USD).[53] Since treatment periods are generally longer than 3 months, additional commuting would only add to the economic burden of outpatient clinic phototherapy.

Home NB-UVB Phototherapy Versus Other Psoriasis Treatments

We found three studies[54,55,60] examining the costs of home NB-UVB phototherapy with other psoriasis treatments, including systemic agents and biologics. These studies did not have outpatient clinic phototherapy as a comparator, and thus were not eligible for inclusion. However, they provided some insight into the costs and outcomes of home NB-UVB phototherapy relative to other psoriasis treatments. Overall, home phototherapy incurred much lower costs compared to other systemic agents and biologics.

A retrospective cost-effectiveness analysis compared home NB-UVB phototherapy with biologics in 12 individuals with moderate-to-severe psoriasis.[55] The costs associated with effective treatment using biologic drugs in a single patient would provide effective home UV phototherapy for nine patients. In a costing study comparing the direct cost of home NB-UVB phototherapy with systemic and biologic therapies, home NB-UVB phototherapy cost $7,085 USD (in 2002 dollars) over the 30-year period, making it less expensive than any other treatment examined.[54] Similar results were seen from another costing study comparing home UV phototherapy with biologics.[60]

Home Versus Outpatient Clinic NB-UVB Phototherapy in Other Conditions

The cost of outpatient clinic NB-UVB phototherapy appeared to be higher than home NB-UVB phototherapy for other conditions as well. Thng et al[56] found that, among patients with vitiligo, the total cost was much higher in outpatient clinic phototherapy (around $13,000; the authors did not specify currency or year) compared to home phototherapy ($1,000). This study was published as a conference abstract and did not meet our inclusion criteria.

Conclusions

We found only one cost-effectiveness study comparing home NB-UVB phototherapy with outpatient clinic NB-UVB phototherapy for patients with psoriasis. The study found that home

NB-UVB phototherapy was cost-effective from the Dutch societal perspective.[52] We did not find any cost-effectiveness studies for other photoresponsive skin conditions.

PRIMARY ECONOMIC EVALUATION

We found a cost–utility analysis that compared home NB-UVB phototherapy to outpatient clinic NB-UVB phototherapy based on a randomized controlled trial conducted in people with psoriasis.[52] Although this study addressed our research question, the authors explored only relatively short-term (68.4 weeks) costs and outcomes, which may not accurately capture the costs associated with a chronic condition such as psoriasis.[52] The study also was not directly applicable to the Canadian setting, as it was conducted from the Dutch societal perspective. Although we also identified other studies that examined home NB-UVB phototherapy,[53-63] they did not meet the inclusion criteria and were limited in addressing our research question. Owing to these limitations in the available studies, we conducted a primary economic evaluation for psoriasis.

We did not conduct economic evaluations for other photoresponsive skin conditions as we did not find any clinical evidence comparing home to outpatient clinic NB-UVB phototherapy for these conditions.

Research Question

What is the cost-effectiveness of home NB-UVB phototherapy compared with outpatient clinic NB-UVB phototherapy for people with psoriasis, from the perspective of the Ontario Ministry of Health?

Methods

The information presented in this report follows the reporting standards set out by the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement.[65]

Type of Analysis

We conducted a cost–utility analysis to determine the costs and QALYs associated with home and outpatient clinic NB-UVB phototherapy. QALY is a commonly used summary outcome measure that combines the gains in both quantity and quality of life. We chose this type of analysis because utility inputs are available and a generic outcome measure such as the QALY allows decision-makers to make comparisons across different conditions and interventions. The outcomes reported are total costs and total QALYs for each treatment, and incremental cost per QALY gained.

Target Population

Based on the PLUTO trial, the target population are adults with psoriasis who were clinically eligible for phototherapy.[52] The mean age at baseline in this trial was 43 years, and 67% of participants were men. Baseline severity of psoriasis ranged from mild to severe, with individual Psoriasis Area and Severity Index (PASI) scores up to 48.6. The PASI combines the assessment of the severity of psoriatic lesions and the area of the body affected into a single score ranging from 0 (no disease) to 72 (maximal disease). Some patients on phototherapy may also use adjuvant treatments such as topical therapy.

Comparing trial participants to the Ontario population, the psoriasis distribution in Ontario is similar between males and females (49% were male), and the population tend to be older (highest prevalence of psoriasis is in the 65–74 age group).[6]

Perspective

We conducted the reference case analysis from the perspective of the Ontario Ministry of Health.

Since home NB-UVB phototherapy may reduce the patient burden of travelling to the outpatient clinic, we also conducted a scenario analysis from a societal perspective that included patient out-of-pocket expenses (e.g., travel and parking costs) and lost productivity costs.

Intervention and Comparator

The intervention is NB-UVB phototherapy conducted in the home. This intervention involves a phototherapy unit in the home for individuals to self-administer phototherapy. Home devices tend to be panel units consisting of 10 UVB narrowband bulbs. Smaller panel units or handheld devices may be used if the affected area is small.[59] Home phototherapy devices require an upfront cost (i.e., the purchase price) and regular maintenance. However, home phototherapy may be more convenient for those who have difficulty accessing outpatient phototherapy clinics on a regular basis.

The comparator is NB-UVB phototherapy conducted in an outpatient clinic (outpatient clinic NB-UVB phototherapy), which is publicly funded in Ontario. The individual must travel to a phototherapy clinic for supervised routine treatments. Hospital phototherapy clinics and private phototherapy offices tend to use booth units consisting of 48 UVB narrowband bulbs.[59] Outpatient clinic phototherapy allows people to receive regular supervised treatment without the upfront cost of acquiring a phototherapy unit. Each unit used for outpatient clinic phototherapy is acquired and maintained by the hospital or clinic and can be used on multiple people.

For this economic evaluation, we considered NB-UVB phototherapy as a standalone treatment (although may also include adjuvant topical treatment as reported in the PLUTO trial).[28] We did not evaluate the cost-effectiveness of home NB-UVB phototherapy as an adjunct treatment to systemic agents or biologics due to the lack of clinical trial data. Comparing home versus outpatient clinic NB-UVB as standalone therapies can better distill the effect of the home setting in phototherapy. We also did not directly compare home NB-UVB phototherapy to other psoriasis treatments (e.g., systemic non-biologics and biologics) since these treatments are often used after phototherapy (they are recommended for those who cannot access phototherapy or do not respond to phototherapy).[66]

Discounting and Time Horizon

Since psoriasis is a chronic condition, a 10-year time horizon was used for the reference case to capture the long-term costs and outcomes of NB-UVB phototherapy. The 10-year time horizon was consistent with previous economic studies for psoriasis, which estimated long-term costs of different treatments (e.g., 10 and 30 years).[54,58] We explored different time horizons in scenario analyses (e.g., 5 and 15 years). We used a cycle length of 1 month, taking into consideration the length of treatments and frequency of physician visits.

In accordance with the Canadian Agency for Drugs and Technologies in Health (CADTH) guidelines,[67] we applied an annual discount rate of 1.5% to both costs and QALYs incurred after the first year. We also explored discount rates of 0% and 3% in the sensitivity analysis.

Model Structure/Structure of the Analysis

We developed a Markov cohort model to determine the incremental cost per QALY gained of home versus outpatient clinic NB-UVB phototherapy.

As shown in Figure 3, the model has three health states: receiving UV phototherapy (± topical treatment), receiving topical treatment only, and dead. Patients enter the model when either home or outpatient clinic NB-UVB phototherapy is initiated. Phototherapy is indicated when topical treatment is insufficient, and a majority of the patients (80%) continue receiving topical treatment while on UV phototherapy (S. Glassman, email communication, May 15, 2019). At the end of each model cycle, patients can either remain on phototherapy or switch out (due to lack of response, inconvenience, or intolerance to adverse effects, etc.). According to clinical experts, a majority of the patients who switched out of UV phototherapy do not go on to receive the next line of treatment due to fear of adverse effects (S. Glassman, email communication, May 31, 2019). This group would receive topical treatments only (their condition returns to baseline). There are limited data on subsequent treatment switching in the literature. Therefore, for the reference case analysis, we assumed that patients who switched out of UV phototherapy would receive topical treatment only. In a scenario analysis, we considered subsequent treatment switching to systemic non-biologics and biologics (see more details in Appendix 6A). At any point during the model time horizon, patients may die from natural causes. Because psoriasis does not affect life expectancy, we used age-specific background mortality from the Ontario life table.[68]

We did not model based on severity because the course and progression of psoriasis can be unpredictable. Psoriasis usually waxes and wanes over time, and is influenced by a variety of environmental and external factors (e.g., physical trauma to the skin, streptococcal infection, exposure to various drugs, smoking, etc.).[69] As a result, the severity may fluctuate throughout the course of the condition.[70]

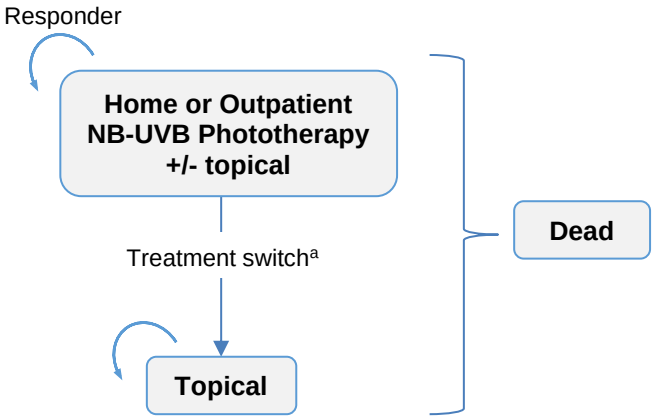

Figure 3: Model Structure (Reference Case)

[a]We did not consider reasons for treatment switch, but they may include treatment failure, inconvenience, or intolerance to adverse events.

Main Assumptions

The model's main assumptions were as follows:

- People who switch out of UV phototherapy would receive topical treatment only
- People who remain on UV phototherapy in the long term continued to have similar improvement as was observed during the trial period
- Side effects for NB-UVB phototherapy are mild (e.g., burning sensation and blistering) and short-term,[28] and the disutility and additional costs associated were negligible in both home and clinic settings
- In the reference case, the home NB-UVB phototherapy devices were purchased outright (i.e., paid for by the public payer). In the scenario analyses, patients could rent the devices on a monthly basis
- In the reference case, 100% of the home NB-UVB phototherapy units were full body panels. In the scenario analyses, a mix of different types of devices (50% full body panel, 20% small panel, 20% small handheld, and 10% hand-foot units)

Clinical Outcomes and Utility Parameters

We used several input parameters to populate the model:

- Treatment switching
- Mortality
- Health state utilities

Table 5 presents the clinical and utility parameters.

Table 5: Clinical and Utility Parameters Used in the Economic Model—Reference Case

	Mean	SE	Source
Clinical Parameters: Probabilities of Switching Out of NB-UVB			
First year			
Clinic	15%	5%	Kimball et al, 2015[71]
Home	10%	5%	Expert opinion[a]
Each subsequent year			
Clinic	10%	2.5%	Expert opinion[a]
Home	7.5%	2.5%	Expert opinion[a]
Utility Parameters (QALYs)			
Outpatient clinic NB-UVB	0.856[b]	–[c]	Koek et al, 2010[52]
Home NB-UVB	0.876[b]	0.0198	Koek et al, 2010[52]
Topical therapy	0.642	–[c]	Hendrix et al, 2018[72]

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year; SE, standard error.
[a]S. Glassman, email communication, May 14, 2019
[b]Calculated.
[c]Standard error was not provided in the source.

Treatment Switching

NB-UVB phototherapy compliance is essential for successful long-term management of psoriasis. In practice, patients may have difficulty accessing and/or adhering to NB-UVB

phototherapy over the long term. Currently there is limited data on the use of NB-UVB phototherapy beyond 1 year. The only randomized-controlled trial our search identified (the PLUTO trial) that compared home with outpatient clinic NB-UVB phototherapy followed participants up to 68 weeks (18 weeks of treatment plus up to 50 weeks posttreatment, about 16 months). All participants remained throughout the course of phototherapy.[28] As a result, we modelled treatment switching based on expert opinion and other literature sources and assumed that after the initial period of phototherapy, the majority would continue using phototherapy, while others will die or switch out of phototherapy due to non-compliance, difficulty in accessing treatment, and/or treatment failure. The vast majority of people switching out of phototherapy continue using topical therapy,[73] although other lines of treatment (e.g., systemic non-biologics and biologics) are also available.

Based on clinical expert opinion (S. Glassman, email communication, May 14, 2019) and published literature,[71] approximately 10% to 15% of people may switch out of outpatient clinic NB-UVB phototherapy during the 10-year scenario period. The rate of switching after the first year of phototherapy is not well studied in the literature. Clinical experts were consulted to provide the best estimates.

Adherence is not well studied in the home NB-UVB phototherapy group; we assumed greater adherence due to easier access.[74] However, it might also be easier for people to forget since they do not have established appointments such as those needed for clinic treatment. For these reasons, we tested a range of probabilities of switching out of the home NB-UVB phototherapy group in the scenario analyses.

Mortality

We obtained age- and sex-specific general mortality statistics from Statistics Canada Life Tables. The risk of death is based on age and sex alone, and all health states were assumed to have an equal risk of death. This is consistent with previous economic evaluations on psoriasis treatments.[72,75]

Health State Utilities

The utility parameters for people on home or outpatient clinic NB-UVB phototherapy were estimated from the PLUTO trial.[49] The PLUTO authors conducted a within-trial economic evaluation and calculated QALYs of NB-UVB phototherapy by plotting EQ-5D utilities against time, using the area under the curve approach. They found that by the end of phototherapy (mean 17.6 weeks), patients treated at home experienced a gain of 0.2960 QALYs, compared with 0.2908 QALYs for patients treated at an outpatient clinic (difference: 0.0052, −0.0244 to 0.0348). One year after the end of phototherapy (mean 68.4 weeks), the QALYs gained by people treated at home versus those receiving outpatient clinic NB-UVB phototherapy were 1.1528 versus 1.1261, respectively (difference: 0.0267, −0.024 to 0.078). Therefore, the reported utility of being on outpatient clinic phototherapy was 0.856, and the difference in utilities between outpatient clinic and home UV therapy was 0.015 (95% CI: −0.072 to 0.103). The baseline utility for patients whose psoriasis is uncontrolled by topical therapy alone was 0.642, based on the literature.[75]

Adverse Events

The most common acute side effects with NB-UVB phototherapy are erythema, burning sensations, and blistering.[28] Due to the acute and mild nature of these side effects,[28] we assumed that the disutility and additional costs associated are negligible. With regards to the

risk of skin cancer, based on a large analysis conducted in 3,867 people treated with NB-UVB phototherapy in clinic (with a follow-up of up to 22 years), there is no association established between NB-UVB phototherapy and skin cancers.[76] In this analysis, we assumed the risk of skin cancer due to NB-UVB phototherapy in both the home and clinic settings was low enough to not significantly impact the cost-effectiveness of either phototherapy arms in the model, although it is worth noting that the risk of skin cancer in reality may be influenced by other individual factors such as baseline risk, skin type, family history, comorbidities, etc.

Cost Parameters

We included the following types of costs.

Direct medical costs:

- NB-UVB device costs (e.g., acquisition costs, monthly bulb replacement/maintenance costs)
- Physician fees (e.g., dermatologist consultation, cost of clinic visits, etc.)
- Drug costs

Non-medical costs (from the scenario of societal perspective):

- Out of pocket costs (e.g., parking, travel costs)
- Lost productivity

All costs are reported in 2019 Canadian dollars. When 2019 costs were not available, the healthcare component of the Statistics Canadian Consumer Price Index (CPI) was used to adjust costs. Cost parameters used for the reference case are listed in Table 6. The cost parameters used in the societal perspective scenario are presented in Table 7. The detailed costing methods are described below.

UV Phototherapy Costs

The cost of home NB-UVB phototherapy varied depending on how it is implemented. For the reference case, we assumed the home phototherapy device is purchased outright by the person receiving treatment, who would then own the device. For the reference case, we assumed that only full body 10-bulb NB-UVB phototherapy panels are used at home, and in a scenario analysis, we assumed a mixture of panel units and smaller hand-held units (see Table 7). Additionally, we assumed a 5-year lifespan for bulbs, with replacement costs of $50 to $120 per bulb.[77] Device prices were obtained from the manufacturers. Since obtaining the costs of all commercially available NB-UVB phototherapy devices was beyond the scope of this analysis, we contacted two leading manufacturers to obtain their cost details.[78,79] We applied a 13% sales tax to all equipment expenditures and estimated an additional 10% for administrative costs. In the reference case, the final one-time cost of acquiring the device is $3,912, and the monthly average for the cost of bulb replacement is $24.90.

We also conducted a scenario analysis assuming a rental-purchase payment program for patients undergoing home phototherapy (see Table 8). Some manufacturers have offered a rental-purchase home phototherapy program in the past, but they are currently discontinued. Patients would pay a monthly rental fee for 18 months of usage. A portion of the rental fee would contribute to purchasing the unit. After 18 months, the device would be fully paid and owned by the patient. The one-time shipping cost and monthly rental cost were obtained from the manufacturer. We applied a 13% sales tax to all equipment expenditures and estimated an additional 10% for administrative costs.

The cost of outpatient clinic phototherapy was calculated based on the cost per irradiation session and the number of irradiations needed per year. The cost of outpatient phototherapy in private clinics is $7.85 per irradiation according to the Ontario Schedule of Benefits (G470),[35] and we used 30 irradiations per year based on the PLUTO trial.[52] The monthly cost is averaged to be $19.60. Note, we used this fee code billed by private clinics because the cost of phototherapy in hospital clinics is covered by each individual hospital's global budget, which will vary depending on numerous factors. We assumed there are enough machines currently in the clinics (and, therefore, no additional capital cost), and we assumed the cost of device maintenance can be covered by the revenue generated by the billing fee (no additional maintenance cost).

Other Medical Costs: Physician and Drug Costs

The frequency of physician visits (e.g., dermatologist consultations) associated with different psoriasis treatments were estimated from the Ontario costing study by Mikhael et al.[58] We calculated the monthly cost of NB-UVB phototherapy using three and two visits per year for home and outpatient clinic NB-UVB phototherapy, respectively, and three visits for people on topical therapy only. The unit costs for physician visits were obtained from the Schedule of Benefits.[35] We used the initial consultation fee for a dermatologist ($72.15) for the first visit, followed by the follow-up fee ($21.90) for subsequent visits.

Topical therapy is often used as an adjunct treatment.[80] Based on expert input, we assumed that approximately 80% of people using either type of NB-UVB phototherapy also use adjuvant topical therapy (S. Glassman, email communication, May 15, 2019). We used betamethasone valerate as the standard topical treatment. We obtained the costs of betamethasone valerate from the Ontario costing study.[58]

Cost Parameters Used in Scenario Analyses

In addition to the phototherapy and medical costs described in the reference case, the societal perspective scenario also included out-of-pocket and lost productivity costs for outpatient clinic NB-UVB phototherapy (see Table 7).

Out-of-Pocket (Travel and Parking) Costs

For those who undergo outpatient clinic NB-UVB phototherapy, we calculated the cost of travelling to and from phototherapy clinics. Based on the PLUTO trial, people on average travelled 20 km per treatment.[52] Assuming people had on average 30 treatments per year,[58] we estimated the total annual travel cost by multiplying the Canada Revenue Agency's suggested automobile allowance rate of $0.58 per kilometer × 20 km per treatment × 30 treatments per year.[81] In a separate scenario examining outpatient clinic treatments in remote areas, we assumed people would be willing to travel up to 60 km (round trip) to their phototherapy appointment.

We also included parking and other miscellaneous costs (e.g., meals) for people undergoing outpatient clinic NB-UVB phototherapy. Because the phototherapy clinic visits would be routine, we assumed that attending appointments will not require an overnight stay near the clinic or the use of ambulance services. We used the parking rate of a local hospital in Toronto[82] and assumed people would spend an hour of parking ($6) per visit. We assumed a maximum of $15 per visit to include other potential miscellaneous costs (e.g., meals).

Lost Productivity Costs

For those receiving outpatient clinic NB-UVB phototherapy, we calculated the lost productivity cost by estimating the time spent on travelling and attending treatment at phototherapy clinics and multiplying by the average hourly wage in Ontario. We assumed people would spend an average of 2 hours on travelling and treatment per visit. Based on data from Statistics Canada, the average hourly earnings in Ontario is $31.58. We also incorporated the Ontario labour participation rate (65%) to estimate the cost of lost productivity.[83,84]

Table 6: Monthly Per Person Cost Used in the Economic Model—Reference Case

	Mean ($)	SE[a]	Source
Phototherapy			
Home			
Initial cost: cost of device[b]	3,912.34	499.02	Manufacturer[79,c]
Monthly cost: cost of bulb replacement[b]	24.86	3.17	Manufacturer[79,c]
Outpatient clinic			
Monthly cost	19.63	2.50	Schedule of Benefits[35]
Physician[d]			
Home NB-UVB	9.66	1.23	Schedule of Benefits[35]
Outpatient clinic NB-UVB	7.84	1.00	Schedule of Benefits[35]
On topical therapy only	9.66	1.23	Schedule of Benefits[35]
Topical Treatment			
Betamethasone valerate, 0.05%	51.33	6.55	Mikhael et al, 2009[58]

Abbreviations: CI, confidence interval; NB-UVB, narrowband ultraviolet B phototherapy; SE, standard error.
[a]Assumed 95% CI as ± 25% of the mean, and SE was calculated accordingly.
[b]Cost included 13% sales tax and 10% administrative cost.
[c]Daavlin representative (S. Borton, phone communication, December 12, 2018).
[d]Calculated as the annual cost divided by 12.

Table 7: Monthly Per Person Non-Medical Cost Used in the Economic Model—Societal Perspective

	Mean ($)[a]	SE[b]	Source
Outpatient clinic NB-UVB, Non-Medical Costs			
Out-of-pocket expenses			
Travel	29.00	3.70	Canada Revenue Agency;[81] Koek et al, 2010;[52] Mikhael et al, 2009[58]
Parking and other miscellaneous	15.00	1.91	Local hospital parking rate;[82] Mikhael et al, 2009[58]
Lost productivity	102.64	13.09	Statistics Canada;[83,84] Mikhael et al, 2009[58]

Abbreviations: CI, confidence interval; NB-UVB, narrowband ultraviolet B phototherapy; SE, standard error.
[a]Monthly cost calculated as the annual cost divided by 12.
[b]Assumed 95% CI as ±25% of the mean, and SE was calculated accordingly.

Internal Validation

Formal internal validation was conducted by the secondary health economist. This included testing the mathematical logic of the model and checking for errors and accuracy of parameter inputs and equations.

Analysis

We conducted a reference case analysis and sensitivity analyses. Our reference case analysis adhered to the Canadian Agency for Drugs and Technologies in Health (CADTH) guidelines[67] when appropriate and represents the analysis with the most likely set of input parameters and model assumptions. Our sensitivity analyses explored how the results are affected by varying input parameters and model assumptions.

We calculated the reference case by running 10,000 simulations (probabilistic sensitivity analysis) that simultaneously captured the uncertainty in all parameters that were expected to vary. Distributions were assigned using the mean and standard error. We used gamma distributions to represent cost parameters and beta distributions to represent probabilities and utilities that are not close to zero. We calculated mean costs and mean QALYs for each intervention assessed. We also calculated the mean incremental costs, incremental QALYs, and ICERs for home versus outpatient clinic NB-UVB phototherapy.

The results of the probabilistic sensitivity analysis are presented on a cost-effectiveness plane with a cost-effectiveness acceptability curve. We present uncertainty quantitatively as the probability that an intervention is cost-effective at specific willingness-to-pay values. We also present uncertainty qualitatively, in one of five categories defined by the Ontario Decision Framework.[85] Under this framework, a procedure or technology may be:

- Highly likely to be cost-effective (80% to 100% probability of being cost-effective)
- Moderately likely to be cost-effective (60% to 79% probability of being cost-effective)
- Of uncertain likelihood (40% to 59% probability of being cost-effective)
- Moderately likely to not be cost-effective (20% to 39% probability of being cost-effective)
- Highly likely to not be cost-effective (0% to 19% probability of being cost-effective).[85]

We also conducted scenario analyses to address the structural uncertainty of the model. The scenarios are listed in Table 8. The decision analytic model was programmed using TreeAge Pro.[86]

Table 8: Scenario Analyses

Scenario	Parameter Used	
	Reference Case	**Scenario Analyses**
1. Cost perspective	Public payer perspective (Ontario Ministry of Health)	Societal perspective See Table 7 for more details
2. Cost perspective: remote outpatient clinic, societal perspective	Switching out of outpatient clinic NB-UVB: • First year: 15% • Each subsequent year: 10% Public payer perspective	Larger proportion switching out of outpatient clinic NB-UVB: • 20% per year Societal perspective; higher travel-related costs and lost productivity • Travel: $87/mo (based on 60 km/appointment or 3× higher than reference case) • Parking and other miscellaneous costs (ex., meals): $37.5/mo (based on $15/appointment) • Lost productivity: $205/mo (based on 4 hr/appointment or 2× higher than reference case)
3. Number of treatments for outpatients	30 (assuming outpatients have no maintenance phototherapy)	51 (assuming 50% have no maintenance phototherapy, 50% have 1 maintenance treatment per week after initial 30 treatments)
4. Cost of home NB-UVB: payment model	Purchased outright • Initial device cost: $3,912 • Bulb replacement: $25/mo	Rental-purchase • One-time shipping cost: $100 • Monthly fee: $256/mo
5. Cost of home NB-UVB: device type	100% full-body panel devices • Initial device cost: $3,912 • Bulb replacement: $25/mo	Mixed devices (50% full-body panel, 20% small panel, 20% handheld, and 10% hand–foot units) • One-time device cost: $2,771 • Bulb replacement: $17/mo
6. Cost of home NB-UVB device: cost-sharing	100% of cost of home NB-UVB device covered by the public payer (both purchase outright and rental purchase scenarios)	75% cost of home NB-UVB device covered by the public payer, applying to both purchase outright (scenario 6A) and rental purchase scenarios (scenario 6B) Rationale: we assumed that if home NB-UVB is publicly funded, the funding structure may be similar to the Assistive Device Program,[87] which offers 75% coverage to those 25–65 years of age who do not receive social assistance

Scenario	Parameter Used	
	Reference Case	**Scenario Analyses**
7. Transition probabilities for home NB-UVB	Home NB-UVB has slightly lower switching compared to outpatient clinic NB-UVB • First year: 10% (vs. outpatient clinic: 15%) • Each subsequent year: 7.5% (vs. outpatient clinic: 10%)	Scenario 7A: home NB-UVB has worse adherence (higher switching probabilities) compared to outpatient clinic NB-UVB • First year: 20% • Each subsequent year: 15% Scenario 7B: home NB-UVB has equal adherence (switching probabilities) as outpatient clinic NB-UVB • First year: 15% • Each subsequent year: 10% Scenario 7C: home NB-UVB has better adherence (lower switching probabilities) compared to outpatient clinic NB-UVB • First year: 7.5% • Each subsequent year: 5%
8. Cost of topical therapy	Betamethasone-17-valerate 0.05% • Monthly cost: $51.33	More expensive topical therapy (e.g., calcipotriol-betamethasone proprionate) • Monthly cost: $430
9. Treatment pathway	100% of those switching out of phototherapy would switch into topical therapy	Those switching out of phototherapy would switch to systemic non-biologic (16%), biologic (14%), and topical therapy (70%) For other clinical, utility and cost parameters, see Appendix 6A for more detail.
10. Utilities of home and outpatient clinic NB-UVB	Utilities directly reported in the PLUTO trial, measured using EQ-5D	Based on PASI scores reported in the PLUTO trial, utilities were derived using corresponding PASI utilities. See Appendix 6B for more detail.
11. Time horizon	10 years	5 years, 15 years
12. Discounting	1.5%	0%; 3%

Abbreviations: EQ-5D, EuroQol–five dimensions; NB-UVB, narrowband ultraviolet B phototherapy; PASI, Psoriasis Area and Severity Index.

Results

Reference Case Analysis

Table 9 presents the results of the probabilistic reference case analysis for the comparison of home versus outpatient clinic NB-UVB phototherapy. Over the 10-year horizon, home NB-UVB phototherapy has a total mean cost of $11,752 (95% CrI: $10,171–$13,470) and a total mean of 7.38 QALYs (95% CrI: 7.02–7.74). Outpatient clinic NB-UVB phototherapy has a total mean cost of $7,243 (95% CrI: $5,998–$8,623) and a total mean of 7.10 QALYs (95% CrI: 6.71–7.47). Compared with outpatient clinic NB-UVB phototherapy, home NB-UVB phototherapy has an incremental cost of $4,509 (95% CrI: $3,365–$5,714) and an incremental QALY of 0.29 (−0.24 to 0.81). The ICER of home compared with outpatient clinic NB-UVB phototherapy is $15,675 per QALY gained.

Table 9: Probabilistic Reference Case Analysis Results

Strategy	Average Total Costs (95% CrI)[a]	Incremental Cost[a] (95% CrI)	Average Total QALYs (95% CrI)	Incremental QALY[b] (95% CrI)	ICER ($/QALY)
Outpatient clinic NB-UVB	$7,243 ($5,998–$8,623)	—	7.10 (6.71–7.47)	—	—
Home NB-UVB	$11,752 ($10,171–$13,470)	$4,509 ($3,365–$5,714)	7.38 (7.02–7.74)	0.29 (−0.24–0.81)	15,675

Abbreviations: CrI, credible interval; ICER, incremental cost-effectiveness ratio; NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year.
[a]Incremental cost = average cost (strategy B) − average cost (strategy A).
[b]Incremental effect = average effect (strategy B) − average effect (strategy A).

The cost breakdown of the two strategies (Table 10) revealed that the incremental cost ($4,509) is largely driven by the difference in cost of phototherapy ($4,479), which mainly consisted of the upfront cost in acquiring a home NB-UVB device (at least $3,000). Since people having home NB-UVB phototherapy were assumed to have more physician visits for monitoring purposes, the cost of physician visits is slightly higher than with outpatient clinic NB-UVB phototherapy.

Table 10: Cost Breakdown of Reference Case Analysis Results

	Outpatient clinic NB-UVB ($)	Home NB-UVB ($)
Cost of phototherapy	1,304	5,783
Cost of physician visits	947	1,069
Cost of topical therapy	4,992	4,900
Total costs	7,243	11,752

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year.

Figure 4 presents the scatter plot of 1,000 simulated pairs of incremental costs and effects. A majority of the estimated ICERs are below a willingness-to-pay of $50,000 per QALY gained. Figure 5 presents the cost-effectiveness acceptability curve on the probability of home NB-UVB phototherapy being cost-effectiveness compared with outpatient clinic NB-UVB phototherapy across a range of willingness-to-pay thresholds. At a willingness-to-pay of $50,000 and $100,000 per QALY, home NB-UVB phototherapy is 77% and 81% likely to be cost-effective, respectively.

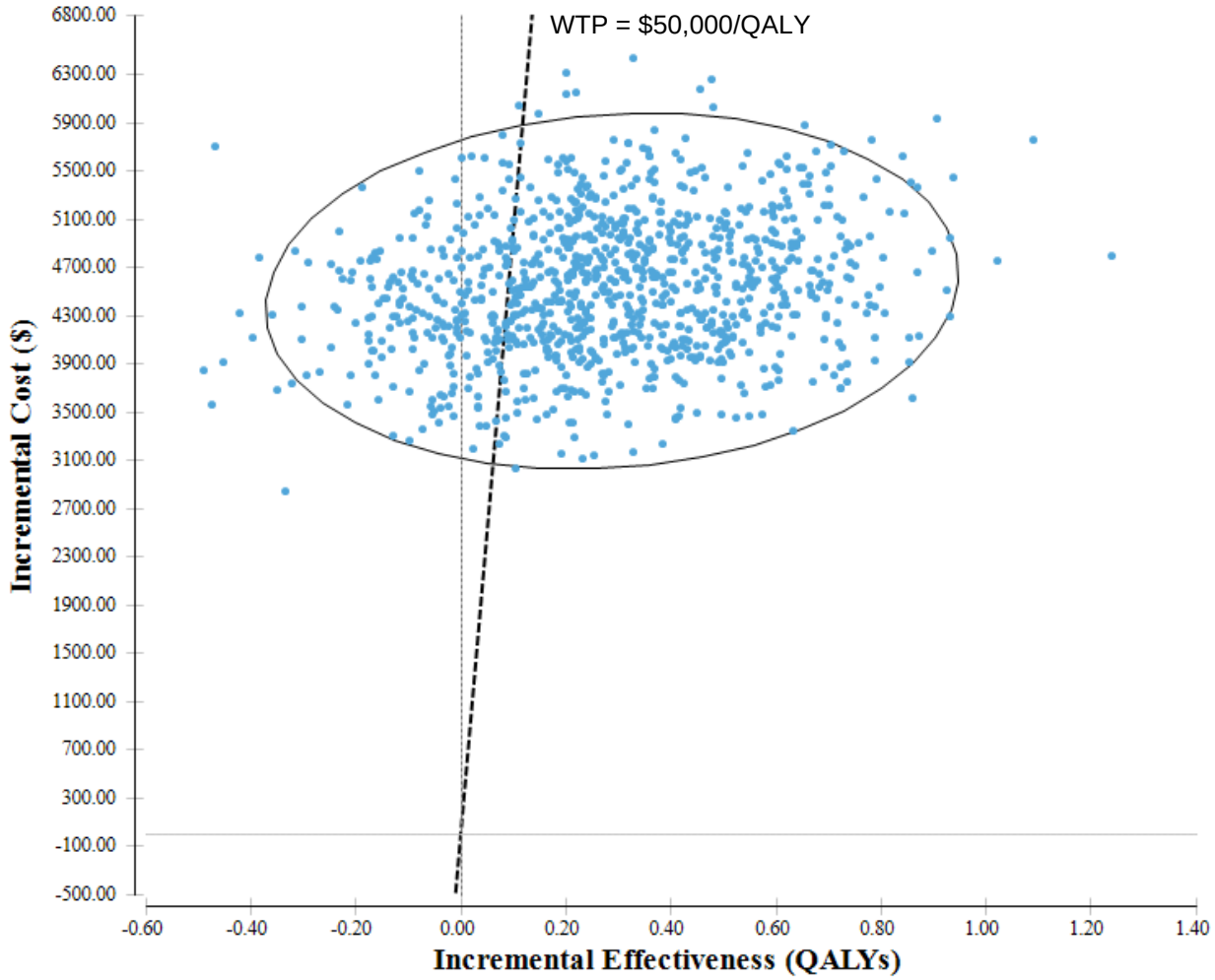

Figure 4: Scatter Plot of 1,000 Simulated Pairs of Incremental Costs and Effects in the Cost-Effectiveness Plane: Home Versus Outpatient Clinic NB-UVB Phototherapy, Reference Case

Abbreviations: QALY, quality-adjusted life year; WTP, willingness-to-pay.

Figure 5: Cost-Effectiveness Acceptability Curve—Home Versus Outpatient Clinic NB-UVB Phototherapy

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year.

Scenario Analysis

Table 11 presents the scenario analysis results. The ICER for home versus outpatient clinic NB-UVB phototherapy decreased in most of the scenarios, including:

- Increasing the number of outpatient clinic treatments per year (i.e., having long-term maintenance phototherapy in the clinic)
- Having a rental-purchase payment model for home phototherapy devices
- Using a variety of home phototherapy devices (including smaller units)
- Covering 75% of the home phototherapy device cost instead of 100%, in both purchased outright and rental-purchase scenarios
- Assuming lower switching for home compared to outpatient clinic phototherapy
- Using more expensive topical therapy
- Incorporating systemic non-biologics and biologics
- A longer time horizon
- No discounting

In these scenarios, the ICERs ranged from $6,814 (75% coverage of home devices using rental-purchase payment model) to $14,674 (reference case with no discounting) per QALY gained.

Home NB-UVB phototherapy became more costly and less effective (was dominated) in the scenario where we assumed higher switching from home compared to outpatient clinic NB-UVB phototherapy; this resulted in a lower total QALY for home NB-UVB phototherapy.

The ICER was increased in the scenario with a shorter time horizon ($28,889 per QALY), assuming equal switching for home phototherapy compared to outpatient clinic phototherapy ($38,424 per QALY), using utilities calculated from PASI scores ($36,691 per QALY), and a higher annual discounting factor ($16,711 per QALY).

Table 11: Scenario Analysis Results

	Home Versus Outpatient Clinic NB-UVB		
	Incremental Cost[a] (95% CrI)	**Incremental QALYs[b] (95% CrI)**	**ICER ($/QALY)**
Reference case	**$4,509 ($3,365–$5,714)**	**0.29 (−0.24 to 0.81)**	**15,675**
1. Cost perspective: societal	−$5,271 (−$9,356 to −$1,416)	0.29 (−0.24 to 0.81)	Outpatient clinic NB-UVB is dominated (more costly, less effective) by home NB-UVB
2. Cost perspective: societal and remote outpatients (higher switching out of outpatient clinic NB-UVB)	−$10,212 (−$13,069 to −$7,485)	0.67 (0.31–1.03)	Outpatient clinic NB-UVB is dominated (more costly, less effective) by home NB-UVB
3. Number of treatments for outpatients: 51	$3,587 ($2,351–$4,860)	0.29 (−0.24 to 0.81)	12,600
4. Cost of home NB-UVB device: rental-purchase	$3,038 ($1,936–$4,220)	0.29 (−0.24 to 0.81)	10,563
5. Cost of home NB-UVB device: mixed home phototherapy devices	$2,781 ($1,905–$3,697)	0.29 (−0.24 to 0.81)	9,669
6. Cost of home NB-UVB device with 75% of cost covered by the public payer			
A. Purchased outright	$3,063 ($2,158–$4,005)	0.29 (−0.24 to 0.81)	10,648
B. Rental-purchase	$1,960 ($1,075–$2,878)	0.29 (−0.24 to 0.81)	6,814
7. Transition probabilities for home NB-UVB			
A. Home NB-UVB has higher switching compared to outpatient clinic NB-UVB (worse adherence)	$4,170 ($3,095–$5,293)	−0.17 (−0.58–0.26)	Home NB-UVB is dominated (more costly, less effective) by outpatient clinic NB-UVB
B. Home NB-UVB has equal switching compared to outpatient clinic NB-UVB (equal adherence)	$4,379 ($3,292–$5,555)	0.11 (−0.12–0.33)	38,424
C. Home NB-UVB has much lower switching compared to outpatient clinic NB-UVB (better adherence)	$4,639 ($3,484–$5,868)	0.46 (0–0.93)	10,032

	Home Versus Outpatient Clinic NB-UVB		
	Incremental Cost[a] (95% CrI)	**Incremental QALYs[b] (95% CrI)**	**ICER ($/QALY)**
8. Cost of topical therapy: more expensive treatment	$3,835 ($1,791–$5,889)	0.29 (−0.24 to 0.81)	13,334
9. Treatment pathway include systemic non-biologics, biologic, and topical therapy	$2,398 (−$3,780–$8,212)	0.27 (−0.21 to 0.75)	8,877
10. Utilities of NB-UVB calculated using PASI scores	$4,509 ($3,365–$5,714)	0.12 (−1.23 to 1.44)	36,691
11. Time horizon			
5 years	$4,264 ($3,255−$5,338)	0.15 (−0.07 to 0.37)	28,889
15 years	$4,671 ($3,383−$6,038)	0.39 (−0.45 to 1.22)	11,917
12. Discounting			
0%	$4,550 ($3,384−$5,793)	0.31 (−0.26 to 0.88)	14,674
3%	$4,471 ($3,348−$5,649)	0.27 (−0.21 to 0.75)	16,711

Abbreviations: CrI, credible interval; ICER, incremental cost-effectiveness ratio; NB-UVB, narrowband ultraviolet B phototherapy; PASI, Psoriasis Area and Severity Index; QALY, quality-adjusted life year.

A few of the scenarios, specifically the societal perspective (scenario 1), the scenario exploring different probabilities of switching (scenario 7), and the scenario incorporating subsequent lines of psoriasis treatments (scenario 9), are discussed in more detail below.

Societal Perspective

When incorporating out-of-pocket and lost productivity costs, outpatient clinic NB-UVB phototherapy becomes more costly (an incremental cost of $5,271 per patient) and less effective (dominated) versus home NB-UVB phototherapy. Table 12 presents the results for this scenario.

Table 12: Scenario Analysis Result, Societal Perspective

Strategy	Average Total Costs (95% CrI)	Incremental Cost[a] (95% CrI)	Average Total QALYs (95% CrI)	Incremental QALY[b] (95% CrI)	ICER
Home NB-UVB	$11,752 (10,171–13,470)	—	7.38 (7.02–7.74)	—	—
Outpatient clinic NB-UVB	$17,023 (13,163–21,196)	$5,271 (1,415–9,354)	7.10 (6.71–7.47)	−0.29 (−0.81 to 0.24)	Dominated (more costly, less effective) by Home NB-UVB

Abbreviations: CrI, credible interval; ICER, incremental cost-effectiveness ratio; NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year.
[a]Incremental cost = average cost (strategy B) − average cost (strategy A).
[b]Incremental effect = average effect (strategy B) − average effect (strategy A).

Looking at the cost breakdown in Table 13, although the cost of phototherapy was $4,479 lower in outpatient clinic NB-UVB phototherapy, out-of-pocket expense and lost productivity cost of $9,780 contributed to a higher cost for outpatient clinic NB-UVB phototherapy overall.

Table 13: Cost Breakdown, Scenario Analysis Result, Societal Perspective

Cost	Outpatient Clinic NB-UVB	Home NB-UVB
Phototherapy	1,304	5,783
Physician visits	947	1,069
Topical therapy	4,992	4,900
Out-of-pocket: travelling	1,931	—
Out-of-pocket: parking and other miscellaneous	998	—
Lost productivity	6,851	—
Total	17,023	11,752

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year.

Outpatient clinic NB-UVB phototherapy was even more costly for people who live in remote areas (scenario 2) due to greater out-of-pocket and lost productivity costs. The total cost for outpatient clinic NB-UVB phototherapy increased from $17,023 (Table 13) to $21,964 when the out-of-pocket and lost productivity costs increased. The outpatient clinic NB-UVB phototherapy group also had a higher probability of switching out; thus the cost of downstream treatments also increased.

Scenarios Exploring Various Transition Probabilities of Switching Out of Home NB-UVB Phototherapy

We conducted several scenarios varying the probabilities of switching out of home NB-UVB phototherapy. In the reference case, we assumed that home NB-UVB phototherapy has slightly better adherence (i.e., lower probability of switching out) compared to outpatient clinic NB-UVB phototherapy, which resulted in an ICER of $15,675 per QALY for home NB-UVB phototherapy. In scenario 7A, we assumed that home NB-UVB phototherapy has worse adherence (i.e., higher probability of switching out) compared to outpatient clinic NB-UVB phototherapy. We found that home NB-UVB phototherapy resulted in lower QALY gain than outpatient clinic NB-UVB phototherapy (incremental QALY: −0.17). Since it was also more costly, home NB-UVB phototherapy was dominated by outpatient clinic NB-UVB phototherapy.

We then assumed that the probabilities of switching out of home and outpatient clinic NB-UVB phototherapy (scenario 7B) are equal (i.e., equal adherence). In this scenario, home NB-UVB phototherapy had an incremental cost of $4,379 with higher QALY gained (incremental QALY: 0.11), resulting in an ICER of $38,424 per QALY gained. In scenario 7C, we assumed that home NB-UVB phototherapy has a much better adherence than outpatient clinic NB-UVB phototherapy. As expected, the resulting ICER of $10,032 per QALY gained was smaller than the ICER in the reference case. The ICER scatter plots for these scenarios are presented in Appendix 6C.

We found that as soon as the adherence of home NB-UVB phototherapy became worse than that of outpatient clinic NB-UVB phototherapy, the ICER quickly increased (Table 14). When

assuming equal adherence for home and outpatient clinic NB-UVB phototherapy (scenario 7B), the ICER was $38,424. Increasing the probability of switching out of home NB-UVB phototherapy just 1% (from 10% to 11% per year) resulted in an ICER of $72,392. At 13% switching per year, home NB-UVB phototherapy had lower QALYs than outpatient clinic NB-UVB phototherapy (7.08 vs. 7.10, respectively), making home NB-UVB phototherapy dominated by outpatient clinic NB-UVB phototherapy.

The drastic change in ICERs was a result of the small QALY difference between the two groups. When adherence for home NB-UVB phototherapy decreased, the QALY difference between home and outpatient clinic NB-UVB phototherapy approached zero. In such scenarios, a large ICER would result since the incremental cost was divided by the small incremental QALY. When the annual probability of switching out of home NB-UVB phototherapy approached 13%, the incremental QALYs turned negative (i.e., home NB-UVB phototherapy had lower QALYs than outpatient clinic NB-UVB phototherapy), thus resulting in home NB-UVB phototherapy being dominated by outpatient clinic NB-UVB phototherapy.

Table 14: Scenario Analysis Result, Probabilities of Switching Out of Home NB-UVB Phototherapy

Adherence	Annual Probability of Switching out of Home NB-UVB[a]	ICER ($/QALY)
Equal adherence[b]	10%	38,424
Home NB-UVB worse adherence compared to outpatient clinic NB-UVB	11%	72,392
	12%	215,650
	13%	Home NB-UVB is dominated (more costly, less effective) by outpatient clinic NB-UVB

Abbreviations: ICER, incremental cost-effectiveness ratio; NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year.
[a]The probability of switching out of home NB-UVB phototherapy after the first year. In this scenario analysis, we assumed the probability of switching out in the first year was the same as outpatient clinic NB-UVB phototherapy, at 15%.
[b]Same annual probability as that of switching out of outpatient clinic NB-UVB phototherapy.

Scenario Incorporating Subsequent Lines of Treatments (Systemic Non-biologic and Biologic)

Compared to the reference case, the scenario incorporating systemic non-biologic and biologic in the model pathway resulted in a smaller incremental cost ($2,398 in the scenario vs. $4,509 in the reference case). The incremental QALYs gained remained similar; as a result, the ICER decreased from $15,675 per QALY gained in the reference case to $8,877 per QALY gained in this scenario (see Table 15). Looking at the cost breakdown in Table 16, home NB-UVB phototherapy had a lower medication and topical therapy cost compared to outpatient clinic NB-UVB phototherapy ($13,074 vs. $15,253, respectively), which somewhat offset the cost difference in phototherapy, thus lowering the overall incremental cost.

Table 15: Scenario Analysis Result, Treatment Incorporating Subsequent Lines of Psoriasis Treatments

Strategy	Average Total Costs (95% CrI)	Incremental Cost[a] (95% CrI)	Average Total QALYs (95% CrI)	Incremental QALY[b] (95% CrI)	ICER ($/QALY)
Outpatient clinic NB-UVB	$17,621 (12,276–24,344)	—	7.18 (6.83–7.51)	—	—
Home NB-UVB	$20,019 (16,216–24,839)	$2,398 (−3,780 to 8,212)	7.45 (7.11–7.79)	0.27 (−0.21 to 0.75)	8,877

Abbreviations: CrI, credible interval; ICER, incremental cost-effectiveness ratio; NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year.
[a]Incremental cost = average cost (strategy B) − average cost (strategy A).
[b]Incremental effect = average effect (strategy B) − average effect (strategy A).

Table 16: Cost Breakdown, Scenario Analysis Result, Treatment Incorporating Subsequent Lines of Psoriasis Treatments

Cost	Outpatient Clinic NB-UVB	Home NB-UVB
Phototherapy	1,304	5,783
Physician visits	963	1,081
Medication and topical therapy	15,253	13,074
Laboratory tests	101	81
Total	17,621	20,019

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy; QALY, quality-adjusted life year.

Discussion

Our reference case showed that in people with psoriasis, home NB-UVB phototherapy is moderately likely (77% likely) to be cost-effective compared with outpatient clinic NB-UVB phototherapy (ICER: $15,675) at a willingness-to-pay of $50,000 per QALY gained. The incremental cost in home NB-UVB phototherapy is largely driven by the cost of the home phototherapy device. The initial cost of purchasing a device for the home is at least $3,000, versus $236 per year for outpatient clinic phototherapy.

When costing the home devices, we took a different approach from previous Ontario costing studies. In the reference case, we assumed the device was paid upfront by the public payer, whereas previous Ontario costing analyses amortized the device cost over 10 years or longer.[58,59] Our approach is likely more conservative and, based on our approach, home NB-UVB phototherapy was still likely to be cost-effective. Furthermore, the amortized costing method is similar to our rental-purchase scenario, where patients pay a much smaller initial fee ($100) and a regular monthly fee ($256). In this scenario, the ICER of $10,563 per QALY gained is also lower than in our reference case, making home NB-UVB phototherapy a more favourable strategy.

In the reference case, the QALY difference between the two groups is small, as the 95% credible interval overlapped with 0. This suggests that the improvement in quality of life may not be drastically different between the two groups. Koek et al[52] (the PLUTO cost-effectiveness analysis, the original QALY study) commented that during the 1-year study follow-up, lost

productivity cost (participants' main concern) was mitigated through flexible work arrangement and compensation. This may have contributed to a small difference between the utility weights of home versus outpatient clinic NB-UVB phototherapy (0.876 and 0.856, respectively), and may have contributed to the small incremental QALY gains found in our model. Besides using these utility weights in the reference case, in scenario 10, we also derived alternative utilities for home and outpatient clinic NB-UVB phototherapy using the PASI scores reported in the PLUTO clinical trial.[28] Using the corresponding utilities at the various PASI levels, we calculated weighted average utilities for home and outpatient clinic NB-UVB phototherapy (0.831 and 0.833, respectively). Compared to the utilities in the reference case, the utilities derived using PASI scores were very similar between home and outpatient clinic NB-UVB phototherapy. The smaller utility difference between home and outpatient clinic NB-UVB phototherapy when calculated using PASI may be caused by PASI, a clinical outcome measuring the severity of psoriatic lesions and the area of body affected, not fully capturing convenience and other aspects related to quality-of-life. These factors may be more effectively captured by EQ-5D. In this scenario, due to the smaller utility difference between home and outpatient clinic NB-UVB phototherapy, the incremental QALYs were subsequently smaller, resulting in a larger ICER ($36,691 per QALY gained) compared to the reference case.

Our scenario analyses also showed that the ICER and the overall conclusion on the cost-effectiveness of home NB-UVB phototherapy were sensitive to the probability of switching out of home NB-UVB phototherapy, which could be influenced by a variety of factors, such as treatment failure, inconvenience, intolerance to adverse events, etc. The reference case, where the rate of switching was assumed to be slightly lower (i.e., adherence was better) in the home NB-UVB phototherapy group, was 77% likely to be cost-effective at a willingness-to-pay of $50,000 per QALY gained. When adherence was assumed to be equal, home NB-UVB phototherapy had an ICER of $38,424 per QALY gained.

As soon as the adherence of home NB-UVB phototherapy became worse than that of outpatient clinic NB-UVB phototherapy, the ICER quickly increased and surpassed $50,000 per QALY gained. From there, a few percentages of increase in the probability of switching out of home NB-UVB phototherapy would make it less effective (lower QALYs), with higher cost compared to outpatient clinic NB-UVB phototherapy, thus not cost-effective. This finding highlighted the role of treatment adherence on the cost-effectiveness of home NB-UVB phototherapy. It is important to note that, although we attempted to model realistic treatment patterns by incorporating treatment switching, adherence on home versus outpatient clinic phototherapy has not been extensively studied.[74] Due to the lack of long-term clinical data, this approach required assumptions about the rate of treatment switching, especially in the home NB-UVB phototherapy group. Our reference case assumption that home NB-UVB phototherapy may have a slightly lower probability of switching was based on expert advice that home NB-UVB phototherapy may have greater convenience in accessing treatment.[74] To test this model assumption, we also had a separate scenario testing a higher switching probability for home NB-UVB phototherapy, and the results changed our conclusion about the cost-effectiveness of home NB-UVB.

In the reference case, those who switch out of phototherapy would switch into topical therapy—this better reflects real-world patterns and involves fewer model assumptions on the transition probabilities between various psoriasis treatments. In a separate scenario, we incorporated next lines of psoriasis treatments into the model; i.e., we assumed that a portion of those switching out of phototherapy would switch into systemic non-biologics and biologic in addition to topical therapy. In this scenario, the ICER was lowered from $15,675 to $8,877 per QALY gained. More specifically, home NB-UVB phototherapy had a lower medication/topical treatment cost

compared to outpatient clinic NB-UVB phototherapy ($13,074 vs. $15,253, respectively), which offset some cost difference in phototherapy equipment, resulting in a lower incremental cost and a lower ICER.

Most of the other scenarios tested led to lower ICERs for home NB-UVB phototherapy, making it a more favourable and cost-effective strategy. A longer time horizon (i.e., scenario 11, 15-year time horizon), the lower the ICER for home NB-UVB phototherapy, making home NB-UVB phototherapy more cost-effective. Having a rental-purchase payment model for home phototherapy devices, using a variety of home phototherapy devices, and having 75% (instead of 100%) cost coverage of home phototherapy lowered the cost of home NB-UVB phototherapy and lowered the ICER. Furthermore, we found that incorporating out-of-pocket and lost productivity costs would make outpatient clinic NB-UVB phototherapy the dominated strategy (more costly and less effective than home NB-UVB phototherapy) and thus not cost-effective.

Other Considerations for Home and Outpatient Clinic NB-UVB Phototherapy

There are a number of potential drawbacks for home NB-UVB phototherapy. The human touch aspect of outpatient clinic phototherapy, which could contribute to peoples' acceptance of phototherapy, would be absent. Those receiving phototherapy at home may encounter unique challenges around compliance. For instance, the lack of appointment reminders/calls from the clinic may contribute to missed treatments due to forgetfulness. Individuals may also interrupt phototherapy at home (e.g., after symptoms subsided) even if they were advised to continue maintenance therapy. There are also safety precautions that patients should be aware of prior to starting home phototherapy (e.g., appropriate dosage, treatment plan, and protective equipment), and not all are able to maintain the device over time.

Uncertainty regarding the safety and efficacy of home phototherapy units may contribute to the reluctance of health care providers to recommend ongoing unsupervised phototherapy.[74,88] Thorough instructions and support from the suppliers on how to safely use the home phototherapy devices, careful patient selection, detailed treatment schedule, and equipment safety mechanisms to prevent inappropriate treatment would be essential in mitigating clinician concerns.[89]

Currently, the physician fee in the Ontario Schedule of Benefits (G470) for NB-UVB phototherapy used by private phototherapy offices is $7.85 per phototherapy service. This billing code is not used by phototherapy clinics in hospitals because they are funded through the global hospital budget (funding includes equipment and clinic personnel). Hospital equipment and staff costs are likely to vary across Ontario, making them difficult to estimate.

Psoriatic Arthritis

Psoriasis is often associated with psoriatic arthritis (PsA), an inflammatory arthritis occurring in approximately 30% of people with psoriasis.[90] Psoriatic arthritis influences treatment options as there is no evidence of phototherapy effectiveness on PsA.[91] Thus, non-phototherapy treatments (i.e., systemic agents or biologics) that can treat both psoriasis and PsA are favoured. While we acknowledge that PsA is a common comorbidity of psoriasis, people with existing PsA are not the focus of our target population since under current evidence, phototherapy is not the most appropriate intervention for PsA.

Strengths and Limitations

In terms of the strength and limitations of this analysis, we used the only randomized controlled trial found by our literature search that directly compared home and outpatient clinic NB-UVB phototherapy. The model did not address cost-effectiveness of home versus outpatient clinic NB-UVB phototherapy as an adjunct treatment with systemic agents or biologics, as there is limited clinical trials to support such model. We attempted to model a more realistic pathway by incorporating treatment switching by estimating the probabilities of switching out of home and outpatient clinic NB-UVB phototherapy. To test the assumptions on switching probability, we explored multiple scenarios (i.e., better and worse treatment adherence).

The analysis had a fairly long time horizon (10 years) to examine the cost-effectiveness of home NB-UVB phototherapy over the long term. The downside is that there was limited data on long-term treatment adherence; however, we based the parameters on expert opinion and tested multiple scenarios.

Conclusions

Home NB-UVB phototherapy is slightly more costly and has slightly higher QALYs than outpatient clinic NB-UVB phototherapy. The ICER of home compared with outpatient clinic NB-UVB phototherapy is $15,675 per QALY gained. The probability of home NB-UVB phototherapy being cost-effective versus outpatient clinic NB-UVB phototherapy is 77% (moderately likely to be cost-effective) at a willingness-to-pay of $50,000 per QALY gained.

Incorporating outpatients' out-of-pocket and lost productivity costs would make outpatient clinic NB-UVB phototherapy more costly with lower QALYs. Most of the other scenarios tested (e.g., having biologics in treatment pathway) would lower the ICER for home NB-UVB phototherapy, making it more cost-effective. However, if those in the home NB-UVB phototherapy group have a higher probability of switching out compared to the outpatient clinic NB-UVB phototherapy group, the home group would be more costly with lower QALYs.

BUDGET IMPACT ANALYSIS

Research Question

What is the potential 5-year budget impact for the Ontario Ministry of Health of publicly funding home NB-UVB phototherapy for people with photoresponsive skin conditions?

Methods

Analytic Framework

We estimated the budget impact of publicly funding home NB-UVB phototherapy using the cost difference between two scenarios: (1) current clinical practice without public funding for home NB-UVB phototherapy (the current scenario) and (2) anticipated clinical practice with public funding for home NB-UVB phototherapy (the new scenario). Figure 6 presents the budget impact model schematic.

We conducted a reference case analysis and sensitivity analyses. Our reference case analysis represents the analysis with the most likely set of input parameters and model assumptions. Our sensitivity analyses explored how the results are affected by varying input parameters and model assumptions.

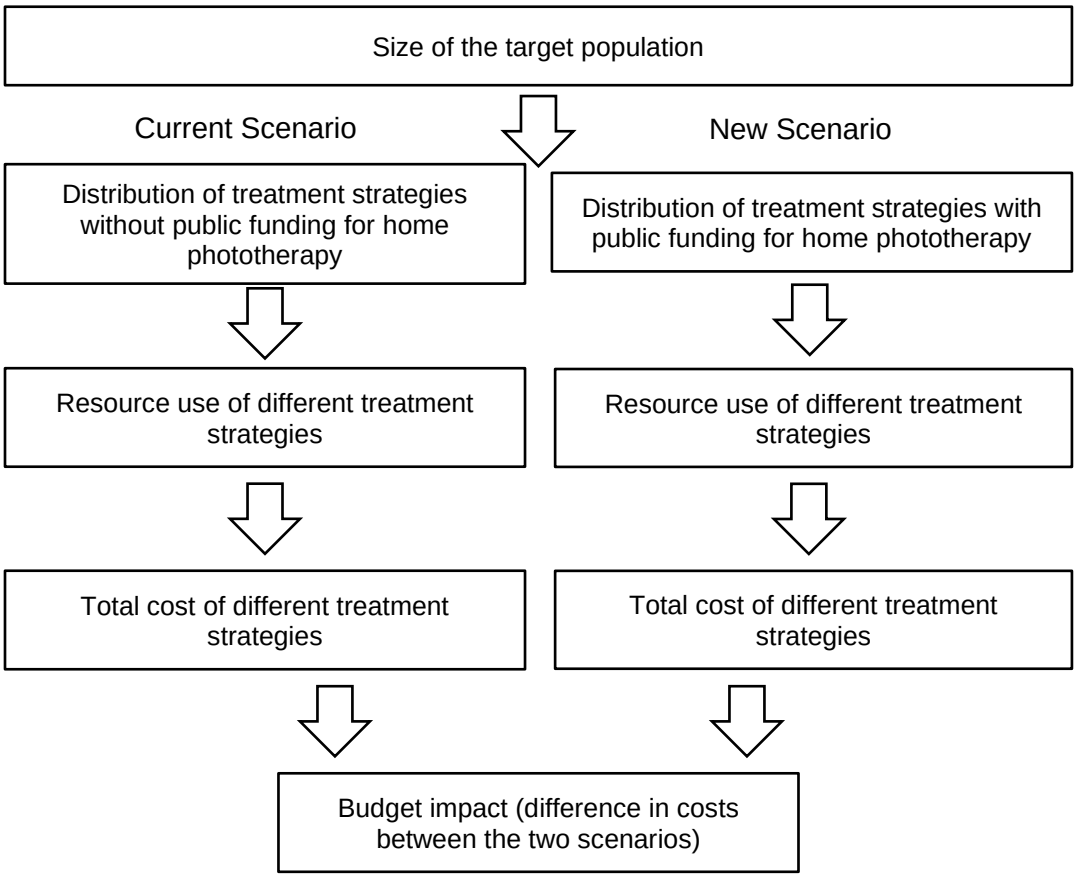

Figure 6: Schematic Model of Budget Impact

Key Assumptions

The assumptions of the primary economic evaluation (see Main Assumptions, above) are relevant to our budget impact analysis. Based on the most recent data provided by administrative databases (2011 to 2016), we also assumed that the target population remained stable for the 5-year period projected by this budget impact assessment.

Target Population

We estimated the number of people treated in private outpatient offices using IntelliHealth, a health administrative database.[92] We obtained the number of people accessing UV phototherapy in private offices using the Ontario Schedule of Benefits fee code G470. People could also be treated in hospital clinics; however, the number of people accessing treatment through this channel is not accurately captured in the database because physician costs in this setting are not billed directly to the Ontario Health Insurance Plan (OHIP). NB-UVB light therapy (G470) becomes payable at nil if rendered in a hospital in-patient or out-patient department or physiotherapy clinic.[35] Instead, phototherapy units and services provided in hospital are funded by the hospital's global budget.[59] We assumed that the number of people treated in hospital outpatient clinics is roughly equal to the number of people treated in private offices. To calculate the total target population, we doubled the estimate obtained from IntelliHealth to account for the volume from hospital clinics.

While the primary economic evaluation was focused on the psoriasis population, there is a wide range of photoresponsive skin conditions that may benefit from UV phototherapy. Using the administrative database, we developed scenarios to estimate all the relevant populations currently accessing UV phototherapy.

Psoriasis

Using recent IntelliHealth data from 2011 to 2016 and the diagnosis code 696_1, we found that over 3,000 people diagnosed with psoriasis each year use phototherapy in private offices. We doubled that number to include the volume from hospital-based clinics. We assumed around 50% of these people are better suited for home phototherapy for various reasons (e.g., inconvenience, lack of access, mobility issues). This is the estimated target population eligible for home phototherapy (see Table 17). Since the 2011–2016 data showed stable numbers of people using phototherapy, we assumed the target population is consistent from year to year.

We assumed that if home NB-UVB phototherapy is publicly funded, the funding structure would be similar to the Assistive Device Program,[87] which offers 100% coverage if individuals are under 25 or over 65 years of age. For those between 25 and 65 years of age, the coverage would be 100% for those receiving social assistance (around 30% of people in this age group),[93] and 75% for the rest. We estimated the corresponding number of people receiving 100% and 75% coverage based on the age distribution of phototherapy users obtained from the 2011–2016 IntelliHealth data.

The reference case examined the psoriasis population, which took into consideration other psoriasis-specific medical costs as captured in the primary economic evaluation. We also examined a scenario involving the total population (i.e., all conditions that may potentially use routine phototherapy).

All Photoresponsive Conditions

In the new scenario, we considered all the potential populations that may require routine UV phototherapy, including people with psoriasis and eczema. Since each photoresponsive skin condition can have varying phototherapy schedules and treatment lengths, it would be challenging to estimate precisely the average number of treatments and duration for each condition. Our approach was to identify from the administrative database the conditions that may require routine phototherapy (assumed to be five or more visits per year), the size of this population, and their average number of phototherapy visits.

We used the Ontario Schedule of Benefits fee code (G470) to obtain the number of people accessing UV phototherapy in private offices. We examined anonymized individual-level data on the number of phototherapy visits by diagnosis, and calculated the average number of visits for each diagnosis. We included the conditions whose standard treatment required, on average, five or more phototherapy sessions per year and the total number of people seeking treatment for each of these conditions. We then doubled this number to account for the people undergoing UV phototherapy in hospital clinics (who are not captured in IntelliHealth). Then assuming 50% of those currently in outpatient clinic phototherapy are better suited for home phototherapy, the target population was estimated to be 6,919.

Table 17 presents our estimate of target populations. We also explored different population assumptions in the scenario analyses and examined the eczema population. The detailed calculations for these scenarios are described in Appendix 7, A and B.

Table 17: Estimate of the Target Population Using IntelliHealth Data

	Psoriasis (N, annual)	All Photoresponsive Conditions (N, annual)
Total number of adults[a] receiving outpatient clinic UV-UVB[b]	6,880	13,838
Proportion of people who may have access or mobility issues[c]	50%	50%
Total suitable for home NB-UVB (***target population***):	**3,440**	**6,919**
100% coverage[d]	1,702	3,477
75% coverage[e]	1,738	3,441

Abbreviation: NB-UVB, narrowband ultraviolet B phototherapy.
[a]Twenty years and older. We assumed that the number of NB-UVB phototherapy users who are ages 18 and 19 is negligible.
[b]We assumed that roughly equal numbers of people were using private offices as were using hospital-based clinics.
[c]This percentage was assumed.
[d]This group includes those under 25 or over 65 years of age and those receiving social assistance between 25 to 65 years of age.
[e]This group includes those between 25 and 65 years of age who are not receiving social assistance.
Source: Data provided by Ontario IntelliHealth.

Current Intervention Mix

In the current scenario, we assumed the Ministry of Health funds NB-UVB phototherapy only in the clinic setting (100% outpatient clinic and 0% home NB-UVB phototherapy).

Uptake of the New Intervention and New Intervention Mix

In the new scenario, we assumed that only a small proportion of health care providers would prescribe home NB-UVB phototherapy, as some may not feel comfortable recommending or monitoring home units. We assumed that 5% of the target population each year would take up home NB-UVB phototherapy in the next 5 years. The remaining population would continue with outpatient clinic NB-UVB phototherapy. See Tables 18 and 19 for the uptakes of home NB-UVB phototherapy in psoriasis and in all photoresponsive conditions, respectively.

Table 18: Uptake of Home NB-UVB Phototherapy—Reference Case, Psoriasis

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Target population (n)	3,440	3,440	3,440	3,440	3,440	—
Current Scenario						
Proportion funded (home)	0%	0%	0%	0%	0%	—
Number of people (home)	0	0	0	0	0	0
Number of people (outpatient clinic)	3,440	3,440	3,440	3,440	3,440	—
New Scenario						
Proportion funded (home)	5%	5%	5%	5%	5%	—
Number of people (home)	172	172	172	172	172	860
100% coverage	85	85	85	85	85	425
75% coverage	87	87	87	87	87	435
Number of people (outpatient clinic)	3,268	3,096	2,924	2,752	2,580	—

Abbreviation: NB-UVB, narrowband ultraviolet B phototherapy.

Table 19: Uptake of Home NB-UVB Phototherapy—Scenario Analysis, All Photoresponsive Conditions

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Target population (n)	6,919	6,919	6,919	6,919	6,919	
Current Scenario						
Proportion funded (home)	0%	0%	0%	0%	0%	—
Number of people (home)	0	0	0	0	0	0
Number of people (outpatient clinic)	6,919	6,919	6,919	6,919	6,919	—
New Scenario						
Proportion funded (home)	5%	5%	5%	5%	5%	—
Number of people (home)	346	346	346	346	346	1,730
100% coverage	174	174	174	174	174	870
75% coverage	172	172	172	172	172	860
Number of people (remaining in outpatient clinic)	6,573	6,227	5,881	5,535	5,189	—

Abbreviation: NB-UVB, narrowband ultraviolet B phototherapy.

Resources and Costs

Psoriasis

The undiscounted, annual per person costs for treatment for psoriasis were derived from the primary economic model (see Table 20). Costs were broken into two categories: 1) cost of phototherapy and 2) other medical costs, including physicians and drug costs. For home phototherapy, the cost of phototherapy included the cost of device, bulb replacement, tax, and an additional 10% for administrative costs. For outpatient clinic phototherapy, we applied the Ontario Schedule of Benefits reimbursement amount ($7.85 per visit) multiplied by 30 treatments per year (average yearly number of treatments per patient according to the PLUTO trial).[28] Only 50% of the outpatient clinic phototherapy cost was accounted for in the budget impact analysis since only private clinics (assumed to be 50% of the total outpatient clinic phototherapy volume) are reimbursed through this fee code. The other 50% (hospital clinics) is paid through the hospital's global budget.

Table 20: Annual Per-Patient Cost—Reference Case, Psoriasis

	Year 1	Year 2	Year 3	Year 4	Year 5
Home NB-UVB					
Phototherapy[a]	3,668	224	207	191	176
100% cost coverage	4,198	256	236	218	201
75% cost coverage	3,149	192	177	164	151
Other medical costs	614	625	632	638	643
Total	4,281	848	838	829	819
Outpatient Clinic NB-UVB					
Phototherapy	110	93	84	75	68
Other medical costs	596	615	626	635	643
Total	706	709	710	710	711

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy.
[a]Weighted average.

All Photoresponsive Conditions

For the scenario examining all photoresponsive conditions, we included only the cost of phototherapy in our budget impact estimates. The heterogeneity of the conditions prevented us from accurately estimating condition-specific medical costs (e.g., number of physician visits, medications, potential laboratory tests, etc.).

For outpatient clinic phototherapy, we applied the Ontario Schedule of Benefits reimbursement amount ($7.85 per visit), multiplied by 15, which was the average number of visits as reported by the 2011–2016 data from IntelliHealth. Similar to the reference case, only 50% of the phototherapy cost was accounted for in the budget impact analysis as 50% of phototherapy treatments took place in hospital clinics and was covered by the hospitals' global budgets. See Table 21 for the annual per-patient costs for the all photoresponsive conditions scenario.

Table 21: Annual Per-Patient Cost—Scenario Analysis, All Photoresponsive Conditions

	Year 1	Year 2	Year 3	Year 4	Year 5
Home NB-UVB					
Phototherapy[a]	3,556	131	131	131	131
100% cost coverage	4,062	149	149	149	149
75% cost coverage	3,046	112	112	112	112
Outpatient Clinic NB-UVB					
Phototherapy	59	59	59	59	59

Abbreviation: NB-UVB, narrowband ultraviolet B phototherapy.
[a]Weighted average.

For per-person costs used in other scenarios, please see Appendix 7, A (eczema) and B (scenarios for psoriasis).

Internal Validation

The secondary health economist conducted a formal internal validation. This process included checking for errors and ensuring the accuracy of parameter inputs and equations in the budget impact analysis.

Analysis

For the reference case analysis, we calculated the required budget to publicly fund home NB-UVB phototherapy for adults with psoriasis in Ontario. We also conducted several scenario analyses as described in Table 22. We calculated the net budget impact as the cost difference between the new scenario (publicly funding home NB-UVB phototherapy) and the current scenario (no public funding for home NB-UVB phototherapy). Total costs were presented along with cost breakdowns (i.e., phototherapy cost, other medical costs, and non-medical costs).

Table 22: Budget Impact Sensitivity Analysis Population Parameters

New Scenario	Parameter Used in Reference Case	Parameter Used in Scenario Analyses
Perspective	Ontario Ministry of Health	Societal (includes non-medical costs for outpatient clinic NB-UVB phototherapy) (See Appendix 7B for details)
Treatment pathway	100% of those switching out of phototherapy would switch into topical therapy	Those switching out of phototherapy would switch to systemic non-biologic (16%), biologic (14%), or topical (70%) therapy (see Appendix 7B for details)
Percent population uptake	5% uptake each year	Starting with 5% uptake in year 1, increase uptake 5% each year (i.e., 5% in year 1, 10% in year 2, etc.)
Proportion suitable for home NB-UVB	50%	25%; 75%
IntelliHealth assumption: those with unknown diagnosis	Include only those with known psoriasis diagnosis Annual number of people: 3,440	Also include a portion of people with unknown diagnosis (as reported in IntelliHealth) who may have a psoriasis diagnosis Annual number of people: 4,404[a]
Population	People with psoriasis	People with eczema (Appendix 7A); all photoresponsive conditions

Abbreviation: NB-UVB, narrowband ultraviolet B phototherapy.
[a]Based on data from 2011 to 2016. Phototherapy users diagnosed with psoriasis accounted for 50% of all users with known diagnosis. We applied this proportion to the number of phototherapy users with unspecified diagnosis (N = 1,935 per year) and assumed 50% of those people to be suitable for home phototherapy to calculate the additional number of people for the target population.

Results

Reference Case

Table 23 presents the results of the reference case analysis, which consisted of the psoriasis population only. In the current scenario, in which home NB-UVB phototherapy is not publicly funded, the total cost per year is around $2.4 million, which mainly consisted of other medical costs, such as physicians and adjuvant medical treatments (about $2.0 to $2.2 million per year). In the new scenario, in which home NB-UVB phototherapy is publicly funded, other medical costs decreased slightly (a savings of $13,032), while the costs of phototherapy increased to just under $1 million. The 5-year total net budget impact is $3.3 million, ranging from $614,995 in year 1 to $698,748 in year 5. The budget impact mostly consisted of the increased cost in phototherapy.

Table 23: Budget Impact Analysis Results—Reference Case, Psoriasis

	Budget Impact[a]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total[b]**
Current Scenario, Budget Impact						
Phototherapy	378,859	321,633	289,001	259,640	233,222	1,482,355
Other medical costs	2,049,162	2,115,962	2,152,103	2,183,832	2,211,518	10,712,577
Total	**2,428,021**	**2,437,595**	**2,441,104**	**2,443,472**	**2,444,740**	**12,194,931**
New Scenario, Budget Impact						
Phototherapy	990,790	958,806	950,508	945,366	942,850	4,788,320
Other medical costs	2,052,226	2,117,351	2,150,921	2,178,409	2,200,638	10,699,545
Total	**3,043,016**	**3,076,157**	**3,101,428**	**3,123,775**	**3,143,488**	**15,487,865**
Net Budget Impact						
Phototherapy	611,931	637,173	661,506	685,726	709,628	3,305,965
Other medical costs	3,064	1,389	−1,182	−5,423	−10,880	−13,032
Total	**614,995**	**638,562**	**660,324**	**680,303**	**698,748**	**3,292,932**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Sensitivity Analysis

Examining all photoresponsive skin conditions, with only the cost of phototherapy included, the total cost per year in the current scenario is around $407,000. In the new scenario, the total cost per year increased to about $1.6 to $1.7 million, resulting in a net budget impact of $1.2 to $1.3 million per year. The 5-year total net budget impact is $6.3 million. Table 24 presents the results of this scenario analysis.

Table 24: Budget Impact Sensitivity Analysis Results—Scenario Analysis, All Photoresponsive Conditions

	Budget Impact[a]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total[b]**
Current Scenario	407,346	407,346	407,346	407,346	407,346	2,036,732
New Scenario	1,617,317	1,642,146	1,666,974	1,691,803	1,716,632	8,334,872
Net Budget Impact	**1,209,970**	**1,234,799**	**1,259,628**	**1,284,457**	**1,309,286**	**6,298,141**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Table 25 presents the results of all scenario analyses. When patients' out-of-pocket and lost productivity costs were accounted for in the analysis (scenario 1), these costs almost offset the increased cost of phototherapy, resulting in a reduced net budget impact of $0.2 million over 5 years. When subsequent lines of treatment are incorporated (scenario 2), we saw cost savings in other medical costs, lowering the 5-year net budget impact to $2.0 million. Population assumptions that lead to a reduced population size (scenario 4) lowered the 5-year net budget impact to $1.6 million.

In contrast, increasing the annual uptake of home NB-UVB phototherapy (scenario 3) and adjusting assumptions to increase the target population (scenarios 5 and 6) increased the net budget impact estimates, ranging from $4.2 to $9.7 million over 5 years.

The 5-year total net budget impact for the eczema population (scenario 7) is under $1 million. Including all photoresponsive skin conditions (scenario 8) raised the 5-year net budget impact to $6.3 million.

Tables A12 and A15–A20 (Appendix 7) present a detailed breakdown of the results of the scenario analyses.

Table 25: Scenario Analysis Results—Net Budget Impact

	Budget Impact[a]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total[b]**
Scenario 1: Societal Perspective						
Phototherapy	611,931	637,173	661,506	685,726	709,628	3,305,965
Other medical costs	3,064	1,389	−1,182	−5,423	−10,880	−13,032
Non-medical costs	−283,077	−480,639	−647,812	−775,996	−871,299	−3,058,823
Total	**331,918**	**157,923**	**12,512**	**−95,692**	**−172,552**	**234,110**
Scenario 2: Incorporating Subsequent Lines of Treatments						
Phototherapy	611,931	637,173	661,506	685,726	709,628	3,305,965
Other medical costs	−7,170	−106,729	−225,103	−377,752	−557,052	−1,273,806
Total	**604,762**	**530,444**	**436,403**	**307,974**	**152,576**	**2,032,159**
Scenario 3: 5% Annual Increase in Uptake						
Phototherapy	611,931	1,251,966	1,918,367	2,612,902	3,335,739	9,730,904
Other medical costs	3,064	1,113	−5,490	−20,431	−45,155	−66,899
Total	**614,995**	**1,253,079**	**1,912,877**	**2,592,470**	**3,290,584**	**9,664,005**
Scenario 4: 25% Suitable for Home NB-UVB						
Phototherapy	305,966	318,587	330,753	342,863	354,814	1,652,983
Other medical costs	1,532	695	−591	−2,711	−5,440	−6,516
Total	**307,498**	**319,281**	**330,162**	**340,152**	**349,374**	**1,646,467**
Scenario 5: 75% Suitable for Home NB-UVB						
Phototherapy	917,897	955,760	992,260	1,028,590	1,064,442	4,958,948
Other medical costs	4,596	2,084	−1,773	−8,134	−16,320	−19,548
Total	**922,493**	**957,843**	**990,487**	**1,020,456**	**1,048,122**	**4,939,400**
Scenario 6: Include Portion of People With Unknown Diagnosis on IntelliHealth						
Phototherapy	783,377	815,691	846,842	877,847	908,445	4,232,202
Other medical costs	3,923	1,778	−1,513	−6,942	−13,929	−16,683
Total	**787,299**	**817,469**	**845,328**	**870,905**	**894,517**	**4,215,519**
Scenario 7: Eczema						
Total (cost of phototherapy only)	**189,477**	**194,619**	**199,761**	**204,902**	**210,044**	**998,803**
Scenario 8: All Photoresponsive Conditions						
Total (cost of phototherapy only)	**1,209,970**	**1,234,799**	**1,259,628**	**1,284,457**	**1,309,286**	**6,298,141**

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy.
[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Discussion

The budget impact analysis showed that publicly funding home NB-UVB phototherapy in the psoriasis population would lead to a 5-year net budget impact of $3.3 million, or about $0.7 million each year. If we include the cost of phototherapy only, funding home NB-UVB phototherapy for all photoresponsive skin conditions (that may use routine phototherapy) would lead to a 5-year net budget impact of $6.3 million, or about $1.3 million each year.

Our budget impact analysis assumed that the volume of people undergoing outpatient clinic UV phototherapy would decrease if home UV phototherapy is publicly funded. However, it is possible that the uptake of outpatient clinic UV phototherapy will not decrease if the people who switch to home UV phototherapy are replaced by others who are currently waiting to commence outpatient clinic phototherapy treatment. In this case, the anticipated cost savings may not be realized because the total number of people with access to phototherapy would increase.

Our analysis also assumed that every individual undergoing home UV phototherapy would receive a device funded by the Ministry of Health. This "initial purchase model" is a conservative approach anticipating the maximum projected budget impact. Finally, more competitive pricing for the device, such as was experienced in the home oxygen program,[94] could also lower the budget impact.

Strengths and Limitations

We considered multiple scenarios for various populations that may routinely use phototherapy. Within the psoriasis population, we also examined a scenario estimating the potential cost savings on subsequent treatments. We were able to use the volume of people using phototherapy from Ontario administrative databases.

However, we were unable to estimate treatment-specific medical costs associated with all possible photoresponsive skin conditions. Several factors also prevented us from developing confident estimates of outpatient NB-UVB hospital clinic costs. Hospital NB-UVB clinics do not bill to OHIP. Costs to hospital clinics may vary across region, hospital, size of clinic, etc. However, our current approach yielded a more conservative budget impact estimate: if hospital clinic costs were added into the analysis, the cost of outpatient clinic NB-UVB phototherapy would increase, decreasing the cost difference between home and outpatient clinic NB-UVB phototherapy, reducing the net budget impact.

Conclusions

Publicly funding home NB-UVB phototherapy in the psoriasis population would lead to a total 5-year net budget impact of $3.3 million, about $0.7 million each year. If accounting for the cost of phototherapy only, funding home NB-UVB phototherapy to people with photoresponsive skin conditions would lead to a 5-year net budget impact of $6.3 million, about $1.3 million each year.

PREFERENCES AND VALUES EVIDENCE

Objective

The objective of this analysis was to explore the underlying preferences, values, needs, and priorities of those who have lived experience with photoresponsive skin conditions, as well as the preferences and values of both patients and providers of home-based versus outpatient clinic narrow band ultraviolet B (NB-UVB) phototherapy treatment.

Background

Exploring patient preferences and values provides a unique source of information about people's experiences of a health condition and the health technologies or interventions used to manage or treat the health condition. It includes the impact of the condition and its treatment on the person with the health condition, their family and other caregivers, and the person's personal environment. Engagement also provides insights into how a health condition is managed by the province's health system.

Information shared from lived experience can also identify gaps or limitations in published research (e.g., outcomes important to those with lived experience that are not reflected in the literature).[95-97] Additionally, lived experience can provide information and perspectives on the ethical and social values implications of health technologies or interventions.

Because the needs, preferences, priorities, and values of those with lived experience in Ontario are not often adequately explored in published literature, we speak directly with people who live with a given health condition, including those with experience with the intervention we are exploring.

For this analysis, we examined in two ways the preferences and values of people with photoresponsive skin conditions of home-based NB-UVB phototherapy treatment:

- A review of the quantitative evidence of patient and provider preferences and values
- Direct engagement of people with these conditions through interviews

Quantitative Evidence

Research Question

What are the preferences of patients and providers on the use of home NB-UVB phototherapy compared with outpatient clinic NB-UVB phototherapy?

Methods

Literature Search

We performed a targeted literature search on April 1, 2019 for published studies on patient or provider preferences and values from database inception to the search date. We used the Ovid interface to search in MEDLINE only. The search was based on the clinical search strategy with a methodological filter applied to limit retrieval to quantitative evidence of preferences and values.[98] We further modified the search filter to include additional key terms relevant to psychological and emotional outcomes, specific types of health care providers, and patient or provider satisfaction. The final search strategy was peer reviewed using the PRESS Checklist.[44] See Appendix 1 for literature search strategies, including all search terms.

Eligibility Criteria

Studies

We included any published study that applied quantitative methods to evaluate patients' or providers' preferences and values on the use of home NB-UVB phototherapy. We excluded editorials, commentaries, conference abstracts, letters to the editors, and newspapers.

Participants

People with photoresponsive skin conditions or their health care providers who have used NB-UVB phototherapy in the home setting.

Intervention

Home NB-UVB phototherapy.

Comparator

Any or none.

Data Extraction

One reviewer extracted relevant data using a data extraction form that included study population and description of the intervention.

Statistical Analysis

Results are summarized narratively. No additional statistical analyses were conducted beyond those reported in the primary studies.

Critical Appraisal of Evidence

We did not undertake a formal critical appraisal of the included studies. The purpose of our literature survey is to gain a broad overview of the quantitative preferences of patients and health care providers.

Results

Literature Search

The literature search of the quantitative evidence of preferences and values yielded 41 citations published from inception until April 1, 2019. We identified three studies that met our inclusion criteria. Figure 7 presents the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram for the quantitative preferences literature search.

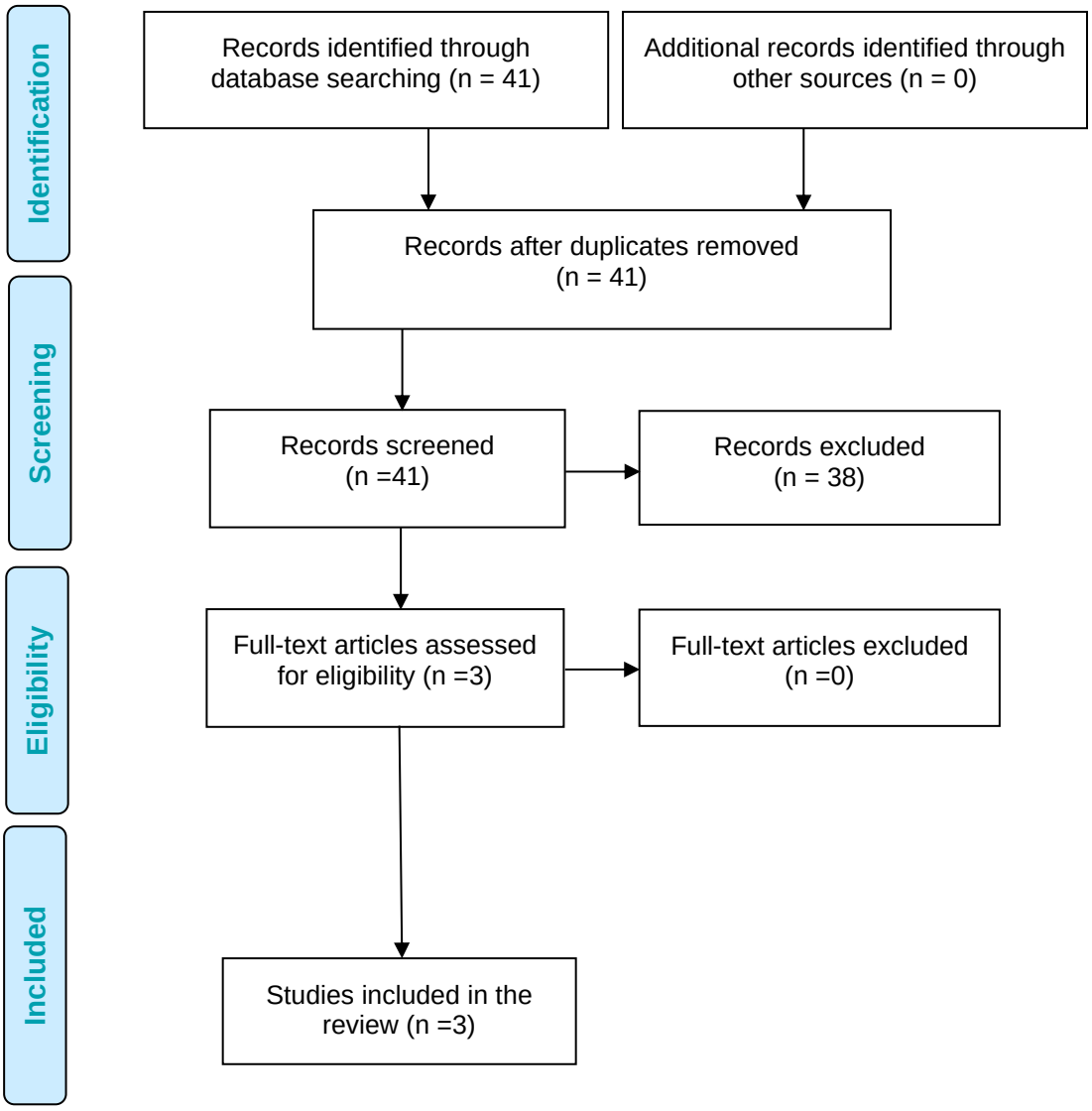

Figure 7: Modified PRISMA Flow Diagram—Quantitative Evidence of Preferences and Values Search Strategy

Source: Adapted from Moher et al.[48]

Characteristics of Included Studies

We identified three studies eligible for this review.[63,64,99] Table 26 shows characteristics of these studies.

Table 26: Characteristics of Included Studies

Study, Year	Design	Population Characteristics	Study Size
Koek et al., 2009[28] (PLUTO study)	RCT in which people with psoriasis from 14 hospitals in the Netherlands were randomized to receive home or outpatient NB-UVB	Adults aged ≥ 18 years	196 participants, 98 in each intervention arm
Haykal and DesGroseillers, 2006[64]	Convenience sampling in which people with a photoresponsive skin condition attended one of two photodermatology clinics in Ottawa	The distribution of photoresponsive skin conditions was as follows: 20 psoriasis, 2 vitiligo, 2 mycosis fungoides, and 1 atopic dermatitis	25 participants
Cameron et al., 2002[63]	Convenience sampling in which people with psoriasis received routine outpatient phototherapy from one of two rural hospitals in the UK	Not reported	52 patients

Abbreviation: NB-UVB: narrowband ultraviolet B phototherapy.

Results

Koek et al[28] found that 92% (83/90) of people with psoriasis who were treated at home preferred to continue treatment at home and 60% (53/88) of people who were treated in an outpatient setting preferred to switch to home NB-UVB phototherapy treatment in the future. Haykal and DesGroseilliers[64] surveyed 25 people with photoresponsive diseases who were receiving treatment at a photodermatology clinic in Ottawa. Of these, 96% felt that home UV phototherapy can be effective. Cameron et al.[63] interviewed 52 people with psoriasis from dermatology outpatient clinics in the United Kingdom. The authors noted that 42% of respondents found outpatient clinic phototherapy inconvenient and 75% reported feeling that home phototherapy would be helpful. We did not find any studies on healthcare providers' preference.

Conclusions

Findings from this review suggest that home NB-UVB phototherapy is viewed favorably by most patients.

Direct Patient Engagement

Methods

Engagement Plan

The engagement plan for this health technology assessment focused on consultation to examine the experiences of people with photoresponsive skin conditions and those of their families and other caregivers. We engaged people via face-to-face and phone interviews.

We used a qualitative interview, as this method of engagement allowed us to explore the meaning of central themes in the experiences of people with photoresponsive skin conditions, as well as those of their families and caregivers.[100] The sensitive nature of exploring people's experiences of a health condition and their quality of life are other factors that support our choice of an interview methodology.

Participant Outreach

We used an approach called purposive sampling,[101-104] which involves actively reaching out to people with direct experience of the health condition and health technology or intervention being reviewed. We approached a variety of partner organizations, including dermatology clinics in Ontario, support groups, and social media, to spread the word about this engagement activity and to contact people with photoresponsive skin conditions, family members, and caregivers, including those with experience of home NB-UVB phototherapy.

Inclusion Criteria

We sought to speak with people who had been actively managing photoresponsive skin conditions with NB-UVB phototherapy or any other type of treatment.

Exclusion Criteria

People less than 18 years old.

Participants

For this project, we spoke with 12 people with various photoresponsive conditions living across Ontario—including rural, remote, and urban areas. Interviews revealed that participants had different socioeconomic backgrounds, genders, and cultures. They had experience with a variety of treatments, including outpatient clinic and home NB-UVB phototherapy.

Approach

At the beginning of the interview, we explained the role of Health Quality Ontario, the purpose of this health technology assessment, the risks of participation, and how participants' personal health information would be protected. We gave this information to participants both verbally and in a letter of information (Appendix 8). We then obtained participants' verbal consent before starting the interview. With participants' consent, we audio-recorded and then transcribed the interviews.

Interviews lasted approximately 20 to 30 minutes. The interview was loosely structured and consisted of a series of open-ended questions. Questions were based on a list developed by the Health Technology Assessment International Interest Group on Patient and Citizen Involvement

in Health Technology Assessment.[105] Questions focused on the impact of photoresponsive skin conditions on the quality of life of people, their experiences with treatments to manage their condition, their experiences with outpatient clinic NB-UVB phototherapy, and their perceptions of the benefits or limitations of home NB-UVB phototherapy. See Appendix 9 for our interview guide.

Data Extraction and Analysis

We used a modified version of a grounded-theory methodology to analyze interview transcripts. The grounded-theory approach allowed us to organize and compare information on experiences across participants. This method consists of a repetitive process of obtaining, documenting, and analyzing responses while simultaneously collecting, analyzing, and comparing information.[106,107] We used the qualitative data analysis software program NVivo[108] to identify and interpret patterns in the data. The patterns we identified allowed us to highlight the impact of NB-UVB phototherapy and other treatments on the people with photoresponsive skin conditions who we interviewed.

Results

The people with photoresponsive skin conditions with whom we spoke emphasized that their condition was "life-long*"* and noted the constant struggle of managing the condition. They reported using a variety of topical, systemic, and combined systemic and phototherapeutic treatments to manage their condition. Although the topical and systemic medications helped manage symptoms, they also had side effects that could be severe at times. People with photoresponsive skin conditions reported being interested in exploring treatment options that were safe and provided a better quality of life in the long-term.

People with experience of home NB-UVB phototherapy were able to comment on the similarities and differences of this treatment compared with outpatient clinic NB-UVB phototherapy. They commented that home NB-UVB phototherapy was appealing as it minimized the treatment burden but noted that it is not for everyone. They outlined some important considerations that should be made before providing home NB-UVB phototherapy for individuals, such as personal circumstances and the importance of appropriate use, follow-up, and logistics.

Day to Day Impact of the Condition

Participants with a photoresponsive skin condition described it as "non-life threatening" but still a "life-long" struggle that involved time and energy to manage daily. Some regarded it as "embarrassing", "uncomfortable" and even "ugly".

> *My psoriasis never cleared no matter what treatment.*
>
> *You're shedding all of the time, so you're having to … clean up after yourself. You have to spend time in taking care … . Normal people don't have to really concern themselves with the health of their skin.*
>
> *I just don't want anybody looking at me, and maybe it's an upset-their-stomach kind of a thing.*

They noted the impact their condition had on their quality of life and psychology. Depending on the nature of the condition, it could reduce their quality of life by reducing their mobility, their activities, and their relationships.

> *I'm a tennis player and I had a lesion on the arch of my right foot that developed into pustules that made it impossible to walk.*

> *I don't want to have any kind of sexual relationship, because it's just bloody ugly and it's very uncomfortable.*

Some participants mentioned the impact on their self-esteem, confidence, and pride. They expressed feeling stigmatized and anxious in public places and this had an impact on their ability to seek and hold jobs.

> *I would not be, in the summertime, wearing short-sleeved shirts because of … pride, injured pride.*

> *It's hard to go to a job interview when you have a breakout … I was constantly breaking out, especially with the face, neck, arms.*

> *I worked for [an employer] … and they chased me for years, they threatened, they held back money, they did all kinds of things to me for taking sick leave…I had a real problem with them.*

Some participants also noted co-existing conditions such as anxiety and irritable bowl syndrome. Many participants with co-existing conditions perceived that stress often resulted in a flare-up of their co-existing condition and their skin condition; thereby underscoring the importance of managing their stress:

> *[W]ith psoriasis I'm sure there's a mental aspect to it, I think stress you could even say is a trigger for … flaring or getting worse. … Stress—mental and financial—just made me worse.*

Experience With Currently Available Treatments

Most participants reported having tried various treatment options, including topical creams, oral medications, outpatient clinic NB-UVB phototherapy, as well as other alternative treatments. They noted that the treatments helped with management of their skin condition but did not cure it.

> *I'm not clear, I never will be clear. I don't have the expectation that I ever will be … . No treatment for me with the level of psoriasis I have is ever going to clear me, but it's okay … it's tolerable.*

Medications

Participants mentioned that topical creams were the most accessible treatments, but the effectiveness often waned with time. Topical creams were also noted to have undesirable effects such as odor and staining of clothes, as well as side effects such as skin peeling, thinning, and discoloration.

> *I tried the creams and [they] seemed to help for a while … and then all of a sudden it [skin condition] would start up again and the cream couldn't seem to handle it, so they'd try a different cream. And usually it worked for a while too and eventually it would stop working as well.*
>
> *When you use them around the groin area … the skin thins and becomes … not transparent but more reddish-coloured than normal skin colour for a white person…. It leads to mild discolouration of your skin.*

Oral medications were helpful in managing the severity of most conditions, but came with side-effects such as nausea, light sensitivity, and damage to the retina, kidney, and liver. Participants who had tried oral medications reported undergoing a trial and error period where they were weighing the benefits with the side-effects of their medications.

> *[T]hey upset your stomach … you have to figure out how to, what time of day…to take them so that you aren't nauseous…. You have to protect your eyes.*
>
> *Methotrexate kicks the hell out of … [my] liver and kidneys.… [M]y liver went from a grade 1 to a grade 2, so they stopped the treatment.*
>
> *I had to wear UV glasses all the time—at work, outside … inside at home—because it made [my] body very sensitive to the ultraviolet light.*

Barriers to Accessing Medication

The ongoing cost of medications was reported as a barrier for people without drug coverage or who are living on a fixed income:

> *My dermatologist cleared me for a new drug … a biologic, but it was very expensive, it was about $20,000 … for a month.*
>
> *I can't afford it. I'm on disability. And I don't know if Indian Affairs would pay for something like that.*

Alternatives to Medication

Many participants reported seeking out alternatives to oral medication if they could not receive a medication, for instance due to co-existing health condition, or in addition to medication if they were unsatisfied with their current level of condition management. Some participants reported trying self-help methods such as coal tar or bleach baths to better manage their skin condition.

> *She did some blood work and … when she got the results of my cholesterol … she said, "Okay, we're not going to go with the pill because you need to have a lower cholesterol in order to do this.*
>
> *I have a bleach bath three times a week … [usually] for about 20 minutes.*

Outpatient Clinic NB-UVB Phototherapy

We were interested in comparing participants' experiences with outpatient clinic versus home NB-UVB phototherapy. Participants reported finding outpatient clinic NB-UVB phototherapy

helpful in improving their skin conditions with several months of treatment. However, some people noted concerns related to treatment burden, depending on factors such as employment status, travel distance to their clinic, and costs associated with attending appointments.

Treatment Process

Participants noted that outpatient clinic NB-UVB phototherapy improved their skin condition but required several months of commitment to treatment sessions. They noted the treatment helped them manage their skin condition better than they were able to with the topical creams and oral medications.

> *I never actually saw a miracle happen, like the day after I took the first treatment or anything like that … I just took it and eventually it seemed to be under control …*
>
> *It's probably taken a year before we really noticed that my condition might be improving … It takes that long to see a change.*
>
> *I've been starting to get increased colour in my skin.*

Participants also *noted that the treatment started with several appointments each week, but with short exposure time. As the treatment progressed, there were fewer treatments, but each had a longer exposure time. Each course of treatment involved multiple sessions and took several months to complete. The participants returned to treatment when they had a "flare-up" or "outbreak"—which could immediately follow the completion of treatment, or it could take several months.*

> *[Y]ou go for a couple of months three times a week, you go for a couple of months twice a week, and then you go [for] a couple of months once a week, and then the doctor assesses and says, "well that's enough of that." And in a month and a half or so the lesions reappear and then progress and progress.*

Treatment Side Effects

Some participants noted burning and skin redness when they re-started the treatment, or had the sessions too close together. Some participants who had long-term phototherapy noted aging of skin as possible long-term side effect.

> *Sometimes, the light is too hot … If I go two days in a row, that's not good.*
>
> *I get sunburnt sometimes. And then they adjust the level. But most of the time, there're no side effects.*

Treatment Barriers

Participants noted that the outpatient clinic NB-UVB phototherapy kept their skin condition in check; however, the travel time, travel costs, and impact on work schedules made the treatment process challenging and at times stressful.

Cost. Participants noted their condition was never cured. Their treatment could only control the condition. People on fixed income noted the financial barriers to accessing care—they would have to allocate expenses from areas of self care towards their phototherapy treatments.

> *It's like a teeter-totter. You're balancing the benefit with the cost. And the benefit to me was adequately controlled psoriasis, because it was never eliminated, but adequately controlled versus the [ability to pay] at the moment.*

> *They [clinics] tend to be in downtown facilities, which means you … have to have a vehicle … . And you have to have money for parking.*

For people with active employment status, the costs associated with missed work presented an additional barrier.

> *If you have to miss work or … drive all that distance … there's also quite a bit of cost to that.*

Access. Some participants found that the nature of their conditions made it difficult to access outpatient clinic phototherapy:

Place of Residence. Some participants who lived far from hospitals or in remote areas experienced challenges associated with the travel distance and transportation costs (gas, parking, wear and tear on their car).

> *I drove 40 minutes one way to be in that box for 8 seconds.*

> *It's sometimes a logistical challenge … . I live in Port Credit and getting to downtown Toronto … it's not a pleasant trip … . It's at least a 2-hour commitment, three times a week. The treatment … does constrain you, because you have to … alter your working day [] to accommodate the availability of clinics.*

Nature of the Condition. Some people who had blisters on their feet found the commute to the clinic painful. Participants who were disabled reported finding it difficult to get to the clinic for treatment.

> *I'd rather stay home. I'd rather do something else than run all the way down there and come all the way back. I find it a nuisance... I usually get my family to help me, because my mother … lives … right across the hall. So [I have] the support right there.*

Treatment Limitations

Some people noted the stress related to scheduling treatments and maintaining their work and life schedule. However, despite the treatment burden related to physical and financial factors, many participants expressed their dependency on phototherapy to keep their condition in check.

> *I think maybe the light treatment has contained it … but I'm afraid if I stop the treatment then maybe it will get worse. And it's bad enough now, never mind getting worse.*

> F*or me*, *[phototherapy] works very* [well]*. However, that being said, if I stop the light treatment, I get about two weeks [respite] and then it starts to come back big time.*

Home NB-UVB Phototherapy

Participants who had undergone home NB-UVB phototherapy also had experience with outpatient clinic NB-UVB phototherapy, and were able to compare their experiences related to the treatment process, benefits, and limitations of the two treatment methods.

Treatment Process

Participants who purchased home NB-UVB units reported that they had to get a prescription from their dermatologist for the unit. Their clinic trained them in the operation of the unit and treatment methods.

> *The doctor had to write a prescription … so I could get it and then … they had a pamphlet and they told me to start at a real low dosage and slowly increase until [I] find … how much light [I] need and that's what I did.*

They reported that home NB-UVB phototherapy provided similar benefits as outpatient clinic NB-UVB phototherapy. The home units were helpful in keeping their condition in check until they had the next flare up:

> *For me that [home unit] works very [well]. However, if I stop the light treatment … [after] about two weeks, it starts to come back big time....*

In addition, home NB-UVB phototherapy had benefits over outpatient clinic NB-UVB phototherapy, such as a reduced treatment burden and additional control over the pace and frequency of treatment.

> *I treat myself to about four or five treatments every second day, and then I don't take any treatments for 2 weeks, and then I go back and do the same for four or five treatments, and then just go off of it for 2 weeks. I find that by doing it that way, my total time on the lamp stays lower … . If I try to treat it constantly, I have to keep going up in time. So I have less exposure doing it my way.*

> *I just play it by ear and then just [treat] depending upon how the lesions reappear or not.*

Participants reported appreciating the reduced time commitment involved in home therapy. They shared a sense of comfort and relief as they were able to forgo the waiting necessary for scheduled appointments, the stress of travelling to the clinic, and the challenges of co-ordinating their work and appointment schedules.

> *Once I got the home unit, I was better able to look after myself because I could treat myself on weekends if I needed it, I didn't have to wait till [the clinic] opened on Monday … . I was able to improve my treatment because of it.*

> *Not everybody can drive like 2 or 3 hours to get a treatment … . This disease isn't going to go away, there's no cure for it … it's an awful thing to … spend your life going to [appointments to] get treated for a few seconds.*

> *I wish I found this 30 years ago because I wouldn't have had the trouble I did at work.*

Treatment Barriers

Participants who had home units and those who were considering home NB-UVB phototherapy noted cost and access as barriers to the treatment.

*Cost***.** Participants who were considering purchasing a home unit noted that they would need coverage to overcome the cost barrier. Participants who already owned a home unit also felt that cost would be a barrier for those without private health insurance coverage or who were on fixed income.

> *That's quite a bit of cash to dole out … if people haven't saved up enough, if they're on a very limited income.*

> *The cost … [of buying] a light unit and … the extended cost of replacing the light bulbs and stuff, it becomes pretty expensive. I'm self-employed, I don't have any extended health care to cover anything.*

Access. Many participants who were receiving outpatient clinic NB-UVB phototherapy were unaware of home NB-UVB phototherapy, noting that "*it was never given to me as an option."* Some expressed interest, reporting that, "*it gives … [me] better control of … [my] life*."

Treatment Considerations

Although participants agreed that home NB-UVB phototherapy treatment provided additional benefits, some participants noted that it may not be the best course of treatment for everybody.

Patient's Circumstances. Some participants noted that different people have different needs. It is important to consider every individual's circumstances before making home therapy available. Things they felt should be considered include the patient's health condition, their ability to comprehend and follow training instructions, and their ability to problem solve.

> *It would depend on the patient. If you've got a … patient who is [able to follow device protocols], is well-instructed on how to use the unit properly, and commits to adequate follow-up, then yes … it would work.*

> *You don't want to put in 10 minutes instead of one. You need to be competent in its operation.*

> *I cannot see myself doing it [light therapy] without having somebody else here with me.*

A visually impaired patient noted that home therapy would be helpful in reducing the stressful commute to the hospital, but it would be challenging for them to monitor their skin condition.

> *Home therapy … it would be a little different for me because I'm visually impaired. The only barrier I have is looking at it. If I was able to see my skin, then I could tell if it's clearing up, that it is working.*

Appropriate Use. Participants noted the importance of compliance and monitoring of the use and operation of the unit, including the potential for misuse by other people in the patient's household.

> *I would caution [people] to make sure they're not using them as tanning booths … and that they actually do use them [according to instructions]. I'd be nervous about … abuse and the use in the home by others.*

Follow-up. It was also noted that frequent follow-ups with a dermatology clinic are important to ensure there were no side-effects occurring from inappropriate use of the home unit.

> *[I had to have a doctor] look at them either quarterly or half-yearly to see whether or not they're getting … lesions or actual squamous cell or, God forbid, melanoma, as a result of [the treatments].*

Logistics. Patients and their health care professionals need to consider logistical factors such as whether the patient has space in their home, how stable their living situation is (are they planning to relocate soon?), whether their family would support them, etc.

> *I'd have to have somebody … install it. And I'm planning on selling my house within the next 5 years, so then I'm going to have to pay somebody to take it down and move it to wherever I'm going. [After I move,] I'll be renting, so I don't know how that would work … . Eventually I'll go into a retirement community.*

> *I've got a place. I could put it out in my shop, I guess, but I don't think it fits into the … decorating ideas that my wife has for the house.*

Discussion

People with photosensitive skin conditions shared their experiences about the struggles of managing their condition in their daily lives. They discussed the impact on their quality of life and their psychology, relationships, and work.

Participants described their experiences with several treatment options, such as topical creams, oral medications, and outpatient clinic NB-UVB phototherapy. Most reported that the benefits of topical creams are temporary and noted that they lose their effectiveness with time. Some participants experience undesirable side effects from oral medications. Cost was also considered a barrier for ongoing access.

People with experience of outpatient clinic NB-UVB phototherapy indicated that it had therapeutic benefits, but that there are barriers. Several people reported that treatment burdens related to outpatient clinic NB-UVB phototherapy, including the time commitment required for treatment duration and travel to and from appointments, the transportation cost, and the nature of the condition sometimes made it difficult or impossible to attend therapy appointments.

Participants who had experience with home NV-UVB phototherapy also had experience with outpatient clinic NB-UVB phototherapy and were able to compare the two. They reported that home NV-UVB phototherapy was helpful in keeping them comfortable and their skin condition in check. They reported that they had appropriate training for operating the home unit. Additional benefits for home NB-UVB phototherapy include increased flexibility and control over the time and administration of phototherapy. Reported barriers to accessing home NB-UVB phototherapy included the cost of the unit and access to the unit.

A majority of the people who we spoke to reported that home NB-UVB phototherapy was not offered as an option to them. They felt that important considerations for access to home NV-

UVB phototherapy include a patient's overall health condition, appropriateness of use, their ability to comprehend training, their ability to problem solve, and to maintain appropriate follow-up with a dermatologist, as well as other logistical factors.

Conclusions

People with photoresponsive skin conditions with whom we spoke viewed both outpatient clinic and home NB-UVB phototherapy to be effective treatment options. Home NB-UVB phototherapy may be especially beneficial for those with health conditions that make it difficult to travel, for those with busy schedules, and for those who may not have the means to pay for travel to clinics. However, home NB-UVB phototherapy is associated with barriers and considerations such as cost, the ability to comprehend training, the ability to operate the home unit, the ability to follow-up with a dermatologist, and logistics such as having an appropriate space in the home.

CONCLUSIONS OF THE HEALTH TECHNOLOGY ASSESSMENT

Home NB-UVB phototherapy is at least as effective as outpatient clinic NB-UVB phototherapy for the treatment of psoriasis based on scores measuring the area and severity of disease (GRADE: Moderate). We are uncertain if side effects happen more or less often with home NB-UVB phototherapy than outpatient clinic NB-UVB phototherapy due to small number of events (GRADE: Low). The same side effects were reported in both treatment groups, and ranged from mild erythema to blistering of the skin. The findings of this review may not be generalizable to photoresponsive skin conditions other than psoriasis or to people under the age of 18 with psoriasis or other photoresponsive skin conditions.

Our best estimates suggest that home NB-UVB phototherapy is more costly (incremental cost $4,509) and has slightly higher QALYs (incremental QALY 0.29) than outpatient clinic NB-UVB phototherapy. Our best estimate of the ICER of home compared with outpatient clinic NB-UVB phototherapy is $15,675 per QALY gained. Incorporating out-of-pocket and lost productivity costs would make outpatient clinic NB-UVB phototherapy more costly with lower QALYs. If those in the home NB-UVB phototherapy group have a higher probability of switching out compared to the outpatient clinic NB-UVB phototherapy group, the home group would be more costly with lower QALYs.

Publicly funding home NB-UVB phototherapy in the psoriasis population would lead to a total 5-year net budget impact of $3.3 million; about $0.7 million each year. Funding home NB-UVB phototherapy for people with photoresponsive skin conditions would lead to a 5-year net budget impact of $6.3 million; about $1.3 million each year.

People with photoresponsive skin conditions with whom we spoke viewed both outpatient clinic and home NB-UVB phototherapy to be effective treatment options. Home NB-UVB phototherapy may be especially beneficial for those with health conditions that make it difficult to travel, for those with busy schedules, and for those who may not have the means to pay for travel to clinics. However, home NB-UVB phototherapy is associated with barriers and considerations for patients such as cost, the ability to comprehend training, the ability to operate the home unit, the ability to follow-up with their dermatologist, and logistics such as an appropriate space in the home.

ABBREVIATIONS

CI	Confidence interval
EQ-5D	EuroQol–five dimensions
GRADE	Grading of Recommendations Assessment, Development, and Evaluation
ICER	Incremental cost-effectiveness ratio
NB-UVB	Narrowband ultraviolet B
OHIP	Ontario Health Insurance Plan
PsA	Psoriatic arthritis
PASI	Psoriasis Area and Severity Index
QALY	Quality-adjusted life-year
SAPASI	Self-Administered Psoriasis Area and Severity Index
WTP	Willingness-to-pay

GLOSSARY

Adverse event	An adverse event is an unexpected medical problem that happens during treatment for a health condition. Adverse events may be caused by something other than the treatment.
Budget impact analysis	A budget impact analysis estimates the financial impact of adopting a new health care intervention on the current budget (i.e., the affordability of the new intervention). It is based on predictions of how changes in the intervention mix will impact the level of health care spending for a specific population. Budget impact analyses are typically conducted for a short-term period (e.g., 5 years). The budget impact, sometimes referred to as the net budget impact, is the estimated cost difference between the current scenario (i.e., the anticipated amount of spending for a specific population without using the new intervention) and the new scenario (i.e., the anticipated amount of spending for a specific population following the introduction of the new intervention).
Cohort model	In economic evaluations, a cohort model is used to simulate what happens to a homogeneous cohort (group) of patients after receiving a specific health care intervention. The proportion of the cohort who experiences certain health outcomes or events is estimated, along with the relevant costs and benefits. In contrast, a microsimulation model follows the course of individual patients.
Cost–benefit analysis	A cost–benefit analysis is a type of economic evaluation that expresses the effects of a health care intervention in terms of a monetary value so that these effects can be compared with costs. Results can be reported either as a ratio of costs to benefits or as a simple sum that represents the net benefit (or net loss) of one intervention over another. The monetary valuation of the different intervention effects is based on either prices that are revealed by markets or an individual or societal willingness-to-pay value.
Cost-effective	A health care intervention is considered cost-effective when it provides additional benefits, compared with relevant alternatives, at an additional cost that is acceptable to a decision-maker based on the maximum willingness-to-pay value.
Cost-effectiveness acceptability curve	In economic evaluations, a cost-effectiveness acceptability curve is a graphical representation of the results of a probabilistic sensitivity analysis. It illustrates the probability of health care interventions being cost-effective over a range of willingness-to-pay values. Willingness-to-pay values are plotted on the horizontal axis of the graph, and the probability of the intervention of interest and its comparator(s) being cost-effective at corresponding willingness-to-pay values is plotted on the vertical axis.

Cost-effectiveness analysis	Used broadly, "cost-effectiveness analysis" may refer to an economic evaluation used to compare the benefits of two or more health care interventions with their costs. It may encompass several types of analysis (e.g., cost-effectiveness analysis, cost–utility analysis). Used more specifically, "cost-effectiveness analysis" may refer to a type of economic evaluation in which the main outcome measure is the incremental cost per natural unit of health (e.g., life-year, symptom-free day) gained.
Cost–utility analysis	A cost–utility analysis is a type of economic evaluation used to compare the benefits of two or more health care interventions with their costs. The benefits are measured using quality-adjusted life-years, which capture both the quality and quantity of life. In a cost–utility analysis, the main outcome measure is the incremental cost per quality-adjusted life-year gained.
Decision tree	A decision tree is a type of economic model used to assess the costs and benefits of two or more alternative health care interventions. Each intervention may be associated with different outcomes, which are represented by distinct branches in the tree. Each outcome may have a different probability of occurring and may lead to different costs and benefits.
Discounting	Discounting is a method used in economic evaluations to adjust for the differential timing of the costs incurred and the benefits generated by a health care intervention over time. Discounting reflects the concept of positive time preference, whereby future costs and benefits are reduced to reflect their present value. The health technology assessments conducted by Health Quality Ontario use an annual discount rate of 1.5% for both future costs and future benefits.
Disutility	A disutility is a decrease in utility (i.e., a decrease in preference for a particular health outcome) typically resulting from a particular health condition (e.g., experiencing a symptom or complication).
Dominant	A health care intervention is considered dominant when it is more effective and less costly than its comparator(s).
EuroQol–Five Dimensions (EQ-5D)	The EQ-5D is a generic health-related quality-of-life classification system widely used in clinical studies. In economic evaluations, it is used as an indirect method of obtaining health state preferences (i.e., utility values). The EQ-5D questionnaire consists of five questions relating to different domains of quality of life: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. For each domain, there are three response options: no problems, some problems, or severe problems. A newer instrument, the EQ-5D-5L, includes five response options for each domain. A scoring table is used to convert EQ-5D scores to utility values.
Health-related quality of life	Health-related quality of life is a measure of the impact of a health care intervention on a person's health. It includes the dimensions of physiology, function, social life, cognition, emotions, sleep and rest, energy and vitality, health perception, and general life satisfaction.

Health state	A health state is a particular status of health (e.g., sick, well, dead). A health state is associated with some amount of benefit and may be associated with specific costs. Benefit is captured through individual or societal preferences for the time spent in each health state and is expressed in quality-adjusted weights called utility values. In a Markov model, a finite number of mutually exclusive health states are used to represent discrete states of health.
Incremental cost	The incremental cost is the additional cost, typically per person, of a health care intervention versus a comparator.
Incremental cost-effectiveness ratio (ICER)	The incremental cost-effectiveness ratio (ICER) is a summary measure that indicates, for a given health care intervention, how much more a health care consumer must pay to get an additional unit of benefit relative to an alternative intervention. It is obtained by dividing the incremental cost by the incremental effectiveness. Incremental cost-effectiveness ratios are typically presented as the cost per life-year gained or the cost per quality-adjusted life-year gained.
Markov model	A Markov model is a type of decision-analytic model used in economic evaluations to estimate the costs and health outcomes (e.g., quality-adjusted life-years gained) associated with using a particular health care intervention. Markov models are useful for clinical problems that involve events of interest that may recur over time (e.g., stroke). A Markov model consists of mutually exclusive, exhaustive health states. Patients remain in a given health state for a certain period of time before moving to another health state based on transition probabilities. The health states and events modelled may be associated with specific costs and health outcomes.
Ministry of Health perspective	The perspective adopted in economic evaluations determines the types of costs and health benefits to include. Health Quality Ontario develops health technology assessment reports from the perspective of the Ontario Ministry of Health and Long-Term Care. This perspective includes all costs and health benefits attributable to the Ministry of Health and Long-Term Care, such as treatment costs (e.g., drugs, administration, monitoring, hospital stays) and costs associated with managing adverse events caused by treatments. This perspective does not include out-of-pocket costs incurred by patients related to obtaining care (e.g., transportation) or loss of productivity (e.g., absenteeism).
Probabilistic sensitivity analysis (PSA)	A probabilistic sensitivity analysis (PSA) is used in economic models to explore uncertainty in several parameters simultaneously and is done using Monte Carlo simulation. Model inputs are defined as a distribution of possible values. In each iteration, model inputs are obtained by randomly sampling from each distribution, and a single estimate of cost and effectiveness is generated. This process is repeated many times (e.g., 10,000 times) to estimate the number of times (i.e., the probability) that the health care intervention of interest is cost-effective.

Quality-adjusted life-year (QALY)	The quality-adjusted life-year (QALY) is a generic health outcome measure commonly used in cost–utility analyses to reflect the quantity and quality of life-years lived. The life-years lived are adjusted for quality of life using individual or societal preferences (i.e., utility values) for being in a particular health state. One year of perfect health is represented by one quality-adjusted life-year.
Reference case	The reference case is a preferred set of methods and principles that provide the guidelines for economic evaluations. Its purpose is to standardize the approach of conducting and reporting economic evaluations, so that results can be compared across studies.
Scenario analysis	A scenario analysis is used to explore uncertainty in the results of an economic evaluation. It is done by observing the potential impact of different scenarios on the cost-effectiveness of a health care intervention. Scenario analyses include varying structural assumptions from the reference case.
Sensitivity analysis	Every economic evaluation contains some degree of uncertainty, and results can vary depending on the values taken by key parameters and the assumptions made. Sensitivity analysis allows these factors to be varied and shows the impact of these variations on the results of the evaluation. There are various types of sensitivity analysis, including deterministic, probabilistic, and scenario.
Societal perspective	The perspective adopted in an economic evaluation determines the types of costs and health benefits to include. The societal perspective reflects the broader economy and is the aggregation of all perspectives (e.g., health care payer and patient perspectives). It considers the full effect of a health condition on society, including all costs (regardless of who pays) and all benefits (regardless of who benefits).
Time horizon	In economic evaluations, the time horizon is the time frame over which costs and benefits are examined and calculated. The relevant time horizon is chosen based on the nature of the disease and health care intervention being assessed, as well as the purpose of the analysis. For instance, a lifetime horizon would be chosen to capture the long-term health and cost consequences over a patient's lifetime.
Utility	A utility is a value that represents a person's preference for various health states. Typically, utility values are anchored at 0 (death) and 1 (perfect health). In some scoring systems, a negative utility value indicates a state of health valued as being worse than death. Utility values can be aggregated over time to derive quality-adjusted life-years, a common outcome measure in economic evaluations.

Willingness-to-pay value	A willingness-to-pay value is the monetary value a health care consumer is willing to pay for added health benefits. When conducting a cost–utility analysis, the willingness-to-pay value represents the cost a consumer is willing to pay for an additional quality-adjusted life-year. If the incremental cost-effectiveness ratio is less than the willingness-to-pay value, the health care intervention of interest is considered cost-effective. If the incremental cost-effectiveness ratio is more than the willingness-to-pay value, the intervention is considered not to be cost-effective.

APPENDICES

Appendix 1: Literature Search Strategies

Clinical Evidence Search

Search date: February 8, 2019

Databases searched: All Ovid MEDLINE, Embase, Cochrane Database of Systematic Reviews, CRD Health Technology Assessment Database, Cochrane Central Register of Controlled Trials, NHS Economic Evaluation Database, CINAHL

Database: EBM Reviews - Cochrane Central Register of Controlled Trials <December 2018>, EBM Reviews - Cochrane Database of Systematic Reviews <2005 to February 6, 2019>, EBM Reviews - Health Technology Assessment <4th Quarter 2016>, EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016>, Embase <1980 to 2019 Week 05>, Ovid MEDLINE(R) ALL <1946 to February 07, 2019>

Search strategy:

---

1 Phototherapy/ (29466)
2 Ultraviolet Therapy/ (5385)
3 PUVA Therapy/ (12866)
4 Ultraviolet Rays/tu, th (152)
5 ((ultraviolet or ultra violet or UV or UVB or UVA) adj5 (therap* or treatment* or unit*1 or device*)).ti,ab,kf. (21797)
6 (NBUVB or NB UVB or PUVA or Goeckerman or photochemotherap* or photo chemotherap* or photoradiat* or photo radiat* or phototherap* or photo therap* or actinic therap* or actinotherap* or actino therap*).ti,ab,kf. (31160)
7 (Handylux or Panasol or Houva or Handisol or Foldalite or Dermalight or SolarC or DermaPal or SorRx or UVBioTek or Luma or Lumera or Dermfix or Daavlin or clarify med or Waldmann or "TL 01" or TL01 or Levia).ti,ab,kf. (1206)
8 or/1-7 (74234)
9 Home Care Services/ (78280)
10 home.ti,ab,kf. (496527)
11 9 or 10 (520843)
12 8 and 11 (968)
13 Case Reports/ or Comment.pt. or Editorial.pt. or (Letter not (Letter and Randomized Controlled Trial)).pt. or Congresses.pt. (5021239)
14 12 not 13 (910)
15 exp Animals/ not Humans/ (15669563)
16 14 not 15 (679)
17 limit 16 to english language [Limit not valid in CDSR; records were retained] (609)
18 17 use medall,coch,cctr,clhta,cleed (357)
19 phototherapy/ (29466)
20 exp ultraviolet phototherapy/ (10037)
21 phototherapy device/ (317)
22 exp ultraviolet radiation/ and (therap* or treatment*).tw,kw,dv. (36729)
23 ((ultraviolet or ultra violet or UV or UVB or UVA) adj5 (therap* or treatment* or unit*1 or device*)).tw,kw,dv. (21862)

24 (NBUVB or NB UVB or PUVA or Goeckerman or photochemotherap* or photo chemotherap* or photoradiat* or photo radiat* or phototherap* or photo therap* or actinic therap* or actinotherap* or actino therap*).tw,kw,dv. (32544)
25 (Handylux or Panasol or Houva or Handisol or Foldalite or Dermalight or SolarC or DermaPal or SorRx or UVBioTek or Luma or Lumera or Dermfix or Daavlin or clarify med or Waldmann or "TL 01" or TL01 or Levia).tw,kw,dv. (1462)
26 or/19-25 (94259)
27 home care/ (87376)
28 home.tw,kw,dv. (501366)
29 27 or 28 (528033)
30 26 and 29 (1104)
31 Case Report/ or Comment/ or Editorial/ or (letter.pt. not (letter.pt. and randomized controlled trial/)) or conference abstract.pt. (10221968)
32 30 not 31 (859)
33 (exp animal/ or nonhuman/) not exp human/ (10166484)
34 32 not 33 (851)
35 limit 34 to english language [Limit not valid in CDSR; records were retained] (774)
36 35 use emez (362)
37 18 or 36 (719)
38 37 use medall (271)
39 37 use coch (1)
40 37 use cctr (78)
41 37 use clhta (5)
42 37 use cleed (2)
43 37 use emez (362)
44 remove duplicates from 37 (440)

CINAHL

#	Query	Results
S1	(MH "Phototherapy")	2,844
S2	(MH "Ultraviolet Therapy")	399
S3	(MH "PUVA Therapy")	191
S4	(MH "Ultraviolet Rays/TU")	84
S5	((ultraviolet or ultra violet or UV or UVB or UVA) N5 (therap* or treatment* or unit*1 or device*))	900
S6	(NBUVB or NB UVB or PUVA or Goeckerman or photochemotherap* or photo chemotherap* or photoradiat* or photo radiat* or phototherap* or photo therap* or actinic therap* or actinotherap* or actino therap*)	4,974
S7	(Handylux or Panasol or Houva or Handisol or Foldalite or Dermalight or SolarC or DermaPal or SorRx or UVBioTek or Luma or Lumera or Dermfix or Daavlin or clarify med or Waldmann or "TL 01" or TL01 or Levia)	42
S8	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7	5,637

S9	(MH "Home Health Care")	20,858
S10	(MH "Home Care Equipment and Supplies")	440
S11	home	165,436
S12	S9 OR S10 OR S11	165,436
S13	S8 AND S12	164
S14	PT (Case Study or Commentary or Editorial or Letter or Proceedings)	956,434
S15	S13 NOT S14	147
S16	(MH "Animals+") not (MH "Animals+" and MH "Human")	72,648
S17	S15 NOT S16	147
S18	S15 NOT S16 Limiters - English Language	146

Economic Evidence Search

Search date: February 8, 2019

Databases searched: All Ovid MEDLINE, Embase, PsycINFO, Cochrane Database of Systematic Reviews, CRD Health Technology Assessment Database, Cochrane Central Register of Controlled Trials, NHS Economic Evaluation Database, CINAHL

Database: EBM Reviews - Cochrane Central Register of Controlled Trials <December 2018>, EBM Reviews - Cochrane Database of Systematic Reviews <2005 to February 6, 2019>, EBM Reviews - Health Technology Assessment <4th Quarter 2016>, EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016>, Embase <1980 to 2019 Week 05>, Ovid MEDLINE(R) ALL <1946 to February 07, 2019>
Search Strategy:
---
1 Phototherapy/ (29466)
2 Ultraviolet Therapy/ (5385)
3 PUVA Therapy/ (12866)
4 Ultraviolet Rays/tu, th (152)
5 ((ultraviolet or ultra violet or UV or UVB or UVA) adj5 (therap* or treatment* or unit*1 or device*)).ti,ab,kf. (21797)
6 (NBUVB or NB UVB or PUVA or Goeckerman or photochemotherap* or photo chemotherap* or photoradiat* or photo radiat* or phototherap* or photo therap* or actinic therap* or actinotherap* or actino therap*).ti,ab,kf. (31160)
7 (Handylux or Panasol or Houva or Handisol or Foldalite or Dermalight or SolarC or DermaPal or SorRx or UVBioTek or Luma or Lumera or Dermfix or Daavlin or clarify med or Waldmann or "TL 01" or TL01 or Levia).ti,ab,kf. (1206)
8 or/1-7 (74234)
9 Home Care Services/ (78280)
10 home.ti,ab,kf. (496527)
11 9 or 10 (520843)

12 8 and 11 (968)
13 economics/ (250954)
14 economics, medical/ or economics, pharmaceutical/ or exp economics, hospital/ or economics, nursing/ or economics, dental/ (808876)
15 economics.fs. (415033)
16 (econom* or price or prices or pricing or priced or discount* or expenditure* or budget* or pharmacoeconomic* or pharmaco-economic*).ti,ab,kf. (846000)
17 exp "costs and cost analysis"/ (566757)
18 (cost or costs or costing or costly).ti. (253695)
19 cost effective*.ti,ab,kf. (308355)
20 (cost* adj2 (util* or efficacy* or benefit* or minimi* or analy* or saving* or estimate* or allocation or control or sharing or instrument* or technolog*)).ab,kf. (202527)
21 models, economic/ (12230)
22 markov chains/ or monte carlo method/ (77556)
23 (decision adj1 (tree* or analy* or model*)).ti,ab,kf. (40011)
24 (markov or markow or monte carlo).ti,ab,kf. (123509)
25 quality-adjusted life years/ (38123)
26 (QOLY or QOLYs or HRQOL or HRQOLs or QALY or QALYs or QALE or QALEs).ti,ab,kf. (68257)
27 ((adjusted adj1 (quality or life)) or (willing* adj2 pay) or sensitivity analys*s).ti,ab,kf. (111165)
28 or/13-27 (2451847)
29 12 and 28 (155)
30 Case Reports/ or Comment.pt. or Editorial.pt. or (Letter not (Letter and Randomized Controlled Trial)).pt. or Congresses.pt. (5021239)
31 29 not 30 (148)
32 exp Animals/ not Humans/ (15669563)
33 31 not 32 (106)
34 limit 33 to english language [Limit not valid in CDSR; records were retained] (98)
35 34 use medall,coch,cctr,clhta (55)
36 limit 12 to english language [Limit not valid in CDSR; records were retained] (884)
37 36 use cleed (2)
38 35 or 37 (57)
39 phototherapy/ (29466)
40 exp ultraviolet phototherapy/ (10037)
41 phototherapy device/ (317)
42 exp ultraviolet radiation/ and (therap* or treatment*).tw,kw,dv. (36729)
43 ((ultraviolet or ultra violet or UV or UVB or UVA) adj5 (therap* or treatment* or unit*1 or device*)).tw,kw,dv. (21862)
44 (NBUVB or NB UVB or PUVA or Goeckerman or photochemotherap* or photo chemotherap* or photoradiat* or photo radiat* or phototherap* or photo therap* or actinic therap* or actinotherap* or actino therap*).tw,kw,dv. (32544)
45 (Handylux or Panasol or Houva or Handisol or Foldalite or Dermalight or SolarC or DermaPal or SorRx or UVBioTek or Luma or Lumera or Dermfix or Daavlin or clarify med or Waldmann or "TL 01" or TL01 or Levia).tw,kw,dv. (1462)
46 or/39-45 (94259)
47 home care/ (87376)
48 home.tw,kw,dv. (501366)
49 47 or 48 (528033)
50 46 and 49 (1104)
51 Economics/ (250954)

52 Health Economics/ or Pharmacoeconomics/ or Drug Cost/ or Drug Formulary/ (125975)
53 Economic Aspect/ or exp Economic Evaluation/ (443767)
54 (econom* or price or prices or pricing or priced or discount* or expenditure* or budget* or pharmacoeconomic* or pharmaco-economic*).tw,kw. (870694)
55 exp "Cost"/ (566757)
56 (cost or costs or costing or costly).ti. (253695)
57 cost effective*.tw,kw. (319648)
58 (cost* adj2 (util* or efficac* or benefit* or minimi* or analy* or saving* or estimate* or allocation or control or sharing or instrument* or technolog*)).ab,kw. (210771)
59 Monte Carlo Method/ (61972)
60 (decision adj1 (tree* or analy* or model*)).tw,kw. (43727)
61 (markov or markow or monte carlo).tw,kw. (128517)
62 Quality-Adjusted Life Years/ (38123)
63 (QOLY or QOLYs or HRQOL or HRQOLs or QALY or QALYs or QALE or QALEs).tw,kw. (72074)
64 ((adjusted adj1 (quality or life)) or (willing* adj2 pay) or sensitivity analys*s).tw,kw. (130876)
65 or/51-64 (2095366)
66 50 and 65 (196)
67 Case Report/ or Comment/ or Editorial/ or (letter.pt. not (letter.pt. and randomized controlled trial/)) or conference abstract.pt. (10221968)
68 66 not 67 (178)
69 (exp animal/ or nonhuman/) not exp human/ (10166484)
70 68 not 69 (177)
71 limit 70 to english language [Limit not valid in CDSR; records were retained] (169)
72 71 use emez (67)
73 38 or 72 (124)
74 73 use medall (46)
75 73 use coch (0)
76 73 use cctr (9)
77 73 use clhta (0)
78 73 use cleed (2)
79 73 use emez (67)
80 remove duplicates from 73 (87)

CINAHL

#	Query	Results
S1	(MH "Phototherapy")	2,846
S2	(MH "Ultraviolet Therapy")	399
S3	(MH "PUVA Therapy")	191
S4	(MH "Ultraviolet Rays/TU")	84
S5	((ultraviolet or ultra violet or UV or UVB or UVA) N5 (therap* or treatment* or unit*1 or device*))	901

S6	(NBUVB or NB UVB or PUVA or Goeckerman or photochemotherap* or photo chemotherap* or photoradiat* or photo radiat* or phototherap* or photo therap* or actinic therap* or actinotherap* or actino therap*)	4,977
S7	(Handylux or Panasol or Houva or Handisol or Foldalite or Dermalight or SolarC or DermaPal or SorRx or UVBioTek or Luma or Lumera or Dermfix or Daavlin or clarify med or Waldmann or "TL 01" or TL01 or Levia)	42
S8	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7	5,641
S9	(MH "Home Health Care")	20,868
S10	(MH "Home Care Equipment and Supplies")	440
S11	home	165,487
S12	S9 OR S10 OR S11	165,487
S13	S8 AND S12	164
S14	(MH "Economics")	12,600
S15	(MH "Economic Aspects of Illness")	8,080
S16	(MH "Economic Value of Life")	573
S17	MH "Economics, Dental"	121
S18	MH "Economics, Pharmaceutical"	1,960
S19	MW "ec"	160,635
S20	(econom* or price or prices or pricing or priced or discount* or expenditure* or budget* or pharmacoeconomic* or pharmaco-economic*)	253,910
S21	(MH "Costs and Cost Analysis+")	100,388
S22	TI cost*	46,701
S23	(cost effective*)	34,669
S24	AB (cost* N2 (util* or efficacy* or benefit* or minimi* or analy* or saving* or estimate* or allocation or control or sharing or instrument* or technolog*))	26,211
S25	(decision N1 (tree* or analy* or model*))	6,784
S26	(markov or markow or monte carlo)	4,773
S27	(MH "Quality-Adjusted Life Years")	3,745
S28	(QOLY or QOLYs or HRQOL or HRQOLs or QALY or QALYs or QALE or QALEs)	9,198
S29	((adjusted N1 (quality or life)) or (willing* N2 pay) or sensitivity analys?s)	14,695
S30	S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29	341,954

S31	S13 AND S30	14
S32	PT (Case Study or Commentary or Editorial or Letter or Proceedings)	956,543
S33	S31 NOT S32	13
S34	(MH "Animals+") not (MH "Animals+" and MH "Human")	72,689
S35	S33 NOT S34	13
S36	S33 NOT S34 Limiters - English Language	13

Preference and Values Evidence Search

Search Date: April 01, 2019

Database: Ovid MEDLINE(R) ALL <1946 to March 29, 2019>
Search Strategy:
---
1 Phototherapy/ (7906)
2 Ultraviolet Therapy/ (4455)
3 PUVA Therapy/ (3427)
4 Ultraviolet Rays/tu, th (152)
5 ((ultraviolet or ultra violet or UV or UVB or UVA) adj5 (therap* or treatment* or unit*1 or device*)).ti,ab,kf. (9897)
6 (NBUVB or NB UVB or PUVA or Goeckerman or photochemotherap* or photo chemotherap* or photoradiat* or photo radiat* or phototherap* or photo therap* or actinic therap* or actinotherap* or actino therap*).ti,ab,kf. (12968)
7 (Handylux or Panasol or Houva or Handisol or Foldalite or Dermalight or SolarC or DermaPal or SorRx or UVBioTek or Luma or Lumera or Dermfix or Daavlin or clarify med or Waldmann or "TL 01" or TL01 or Levia).ti,ab,kf. (423)
8 or/1-7 (28999)
9 Home Care Services/ (32030)
10 home.ti,ab,kf. (202435)
11 9 or 10 (212191)
12 8 and 11 (331)
13 Attitude to Health/ (81351)
14 Health Knowledge, Attitudes, Practice/ (101836)
15 Patient Participation/ (23609)
16 Patient Preference/ (7028)
17 Attitude of Health Personnel/ (114816)
18 *Professional-Patient Relations/ (11025)
19 *Physician-Patient Relations/ (33939)
20 Choice Behavior/ (30579)
21 (choice or choices or value* or valuation*).ti. (188076)
22 (preference* or expectation* or attitude* or acceptab* or knowledge or point of view).ti,ab. (1095137)
23 ((patient*1 or user*1 or men or women or personal or provider* or practitioner* or professional*1 or (health* adj2 worker*) or clinician* or physician* or doctor* or dermatologist*) adj2 (participation or perspective* or perception* or misperception* or perceiv* or view* or understand* or misunderstand* or value*1)).ti,ab. (110430)

24 health perception*.ti,ab. (2512)
25 *Decision Making/ (38607)
26 (patient*1 or user*1 or men or women or personal or provider* or practitioner* or professional*1 or (health* adj2 worker*) or clinician* or physician* or doctor* or dermatologist*).ti. (2269884)
27 25 and 26 (7033)
28 (decision* and mak*).ti. (26019)
29 (decision mak* or decisions mak*).ti,ab. (123852)
30 28 or 29 (125306)
31 (patient*1 or user*1 or men or women or personal or provider* or practitioner* or professional*1 or (health* adj2 worker*) or clinician* or physician* or doctor* or dermatologist*).ti,ab. (7493175)
32 30 and 31 (77771)
33 (discrete choice* or decision board* or decision analy* or decision-support or decision tool* or decision aid* or latent class* or decision* conflict* or decision* regret*).ti,ab. (29816)
34 Decision Support Techniques/ (18562)
35 (health and utilit*).ti. (1327)
36 (gamble* or prospect theory or health utilit* or utility value* or utility score* or utility estimate* or health state or feeling thermometer* or best-worst scaling or time trade-off or TTO or probability trade-off).ti,ab. (11943)
37 (preference based or preference score* or preference elicitation or multiattribute or multi attribute).ti,ab. (2499)
38 or/13-24,27,32-37 (1651987)
39 12 and 38 (44)
40 limit 39 to english language (41)

Grey Literature Search

Performed: February 7–21, 2019

Websites searched:
HTA Database Canadian Repository, Alberta Health Technologies Decision Process reviews, BC Health Technology Assessments, Canadian Agency for Drugs and Technologies in Health (CADTH), Institut national d'excellence en santé et en services sociaux (INESSS), Institute of Health Economics (IHE), Laval University, McGill University Health Centre Health Technology Assessment Unit, National Institute for Health and Care Excellence (NICE), Agency for Healthcare Research and Quality (AHRQ) Evidence-based Practice Centers, Australian Government Medical Services Advisory Committee, Queensland Health Technology Evaluation, Centers for Medicare & Medicaid Services Technology Assessments, Institute for Clinical and Economic Review, Healthcare Improvement Scotland, Ireland Health Information and Quality Authority Health Technology Assessments, Washington State Health Care Authority Health Technology Reviews, ClinicalTrials.gov, PROSPERO, EUnetHTA, Epistemonikos, Tuft's Cost-Effectiveness Analysis Registry

Keywords used: UV, phototherapy, photo therapy, UVB, NBUVB, PUVA, ultraviolet, ultra violet, light therapy, home

Clinical Results (included in PRISMA): 1

Ongoing clinical trials: 3 (ClinicalTrials.gov)

Ongoing HTAs: 1 (PROSPERO)

Economic Results (included in PRISMA): 2

Ongoing clinical trials: 1 (ClinicalTrials.gov)

Ongoing HTAs: 1 (PROSPERO)

Grey Literature Search Update, July 19–23, 2019: no additional records were found.

Appendix 2: Critical Appraisal of Clinical Evidence

Table A1: Risk of Bias in the Included Study—Cochrane Risk-of-Bias Tool, Version 2.0[46]

Outcome	Risk of Bias					
	Randomization Process[a,b]	Deviation from the Intended Interventions[c]	Missing Outcome Data[d]	Outcome Measurement[e]	Selection of Reported Results[f]	Overall Risk of Bias
SAPASI 50	Low	Low	Low	Low	Low	Low
SAPASI 75	Low	Low	Low	Low	Low	Low
SAPASI 90	Low	Low	Low	Low	Low	Low
PASI 50	Low	Low	Low	Low	Low	Low
PASI 75	Low	Low	Low	Low	Low	Low
PASI 90	Low	Low	Low	Low	Low	Low
PDI	Low	Low	Low	Low	High[g]	High[g]
Mild erythema	Low	Low	Low	Low	Low	Low
Severe erythema	Low	Low	Low	Low	Low	Low
Blistering	Low	Low	Low	Low	Low	Low
Burning sensation	Low	Low	Low	Low	Low	Low

Abbreviations: PASI, Psoriasis Area and Severity Index; PDI, Psoriasis Disability Index; SAPASI, Self-Administered Psoriasis Area and Severity Index.
[a]Both participants and dermatologist were informed of the assigned treatment after randomization.
[b]Based on three signalling questions: (1) Was the allocation sequence random? (2) Was the allocation sequence concealed until participants were enrolled and assigned to interventions? (3) Did baseline differences between the intervention groups suggest a problem with the randomization process?
[c]Based on seven signalling questions: (1) Were participants aware of their assigned intervention during the trial? (2) Were carers and people delivering the interventions aware of participants' assigned intervention during the trial? (3) If yes/probably or yes/not important, were there deviations from the intended intervention that arose because of the experimental context? (4) If yes/probably yes, were these deviations from the intended intervention balanced between groups? (5) If no/probably no/not important, were these deviations likely to have affected the outcome? (6) Was an appropriate analysis used to estimate the effect of assignment to intervention? (7) If no/probably no/not important, was there potential for a substantial impact (on the result) of the failure to analyze participants in the group to which they were randomized?
[d]Based on five signalling questions: (1) Were data for this outcome available for all, or nearly all, participants randomized? (2) Is there evidence that the result was not biased by missing outcome data? (3) Could missingness in the outcome depend on its true value? (4) Do the proportions of missing outcome data differ between intervention groups? (5) Is it likely that missingness in the outcome depended on its true value?
[e]Based on five signalling questions: (1) Was the method of measuring the outcome inappropriate? (2) Could measurement or ascertainment of the outcome have differed between intervention groups? (3) Were outcome assessors aware of the intervention received by study participants? (4) Could assessment of the outcome have been influenced by knowledge of the intervention received? (5) Is it likely that assessment of the outcome was influenced by knowledge of the intervention received?
[f]Based on three signalling questions: (1) Was the trial analyzed in accordance with a prespecified plan that was finalized before unblinded outcome data were available for analysis? (2) Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple outcome measurements? (3) Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple analyses of the data?
[g]The authors did not provide estimates for random errors or provide information that would allow readers to compute these estimates by themselves.

Table A2: GRADE Evidence Profile for the Comparison of Home NB-UVB Phototherapy With Outpatient Clinic NB-UVB Phototherapy

Number of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
SAPASI 50							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
SAPASI 75							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
SAPASI 90							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
PASI 50							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
PASI 75							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
PASI 90							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
PDI							
1 (RCT)	Serious limitations (-2)[c]	Undetermined	Serious limitations (–1)[a]	Undetermined	Undetected	None	⊕ Very low
Mild erythema							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	Serious limitations (–1)[b]	Undetected	None	⊕⊕ Low
Severe erythema							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	Serious limitations (–1)[b]	Undetected	None	⊕⊕ Low
Burning sensation							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	Serious limitations (–1)[b]	Undetected	None	⊕⊕ Low

Number of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
Blistering							
1 (RCT)	No serious limitations	Undetermined	Serious limitations (–1)[a]	Serious limitations (–1)[b]	Undetected	None	⊕⊕ Low

Abbreviations: GRADE, Grading of Recommendations Assessment, Development, and Evaluation; NB-UVB, narrowband ultraviolet B; PASI, Psoriasis Area and Severity Index; PDI, Psoriasis Disability Index; RCT, randomized controlled trial; SAPASI, Self-Administered Psoriasis Area and Severity Index.

[a]The study excluded those unwilling to undergo treatment according to randomization and those unable to receive one of the two treatments offered because they lived too far from the hospital providing outpatient clinic treatment.

[b]The confidence interval includes values consistent with null and non-null effects.

[c]The authors did not provide estimates for random errors or provide information that would allow readers to compute these estimates by themselves.

Appendix 3: Selected Excluded Studies—Economic Evidence

For transparency, we provide a list of studies that readers might have expected to see but that did not meet the inclusion criteria, along with the primary reason for exclusion.

Citation	Primary Reason for Exclusion
Cameron H, Yule S, Dawe RS, Ibbotson SH, Moseley H, Ferguson J. Review of an established UK home phototherapy service 1998-2011: improving access to a cost-effective treatment for chronic skin disease. Public health. 2014;128(4):317-24.	Costing analysis; minimal information on cost-effectiveness methods
Cameron H, Yule S, Moseley H, Dawe RS, Ferguson J. Taking treatment to the patient: development of a home TL-01 ultraviolet B phototherapy service. Br J Dermatol. 2002;147(5):957-65.	Costing analysis
Franken SM, Vierstra CL, Rustemeyer T. Improving access to home phototherapy for patients with psoriasis: current challenges and future prospects. Psoriasis (Aukl). 2016;6:55-64.	Review; screened primary studies mentioned
Haykal KA, DesGroseilliers JP. Are narrow-band ultraviolet B home units a viable option for continuous or maintenance therapy of photoresponsive diseases? J Cutan Med Surg. 2006;10(5):234-40.	Survey
HealthPACT Secretariat. Home ultraviolet B (UVB) phototherapy for the treatment of severe psoriasis [Internet]. Adelaide (Australia): Commonwealth of Australia; 2010 [cited 2019 Apr 2]. Available from: https://www.nice.org.uk/guidance/cg153/evidence/full-guideline-pdf-188351533	Review; screened primary studies mentioned
Hyde K, Cardwell LA, Stotts R, Feldman SR. Psoriasis treatment cost comparison: biologics versus home phototherapy. Am J Pharm Benefits. 2018;10(1):18-21.	No comparator of interest (outpatient clinic NB-UVB)
Medical Advisory Secretariat. Ultraviolet phototherapy management of moderate-to-severe plaque psoriasis: an evidence-based analysis. Ont Health Technol Assess Ser. 2009;9(27):1-66.	Costing analysis
Mustonen A, Mattila K, Leino M, Koulu L, Tuominen R. Psoriasis causes significant economic burden to patients. Dermatol Ther (Heidelb). 2014;4(1):115-24.	No intervention of interest (home NB-UVB)
National Clinical Guideline Centre. Psoriasis: assessment and management of psoriasis [Internet]. London (UK): National Clinical Guideline Centre; 2012 [cited 2019 Apr 2]. Available from: https://www.nice.org.uk/guidance/cg153/evidence/full-guideline-pdf-188351533	Guideline; studies used to inform guideline already captured in search
Nolan BV, Yentzer BA, Feldman SR. A review of home phototherapy for psoriasis. Dermatol Online J. 2010;16(2):1.	Review; screened primary studies mentioned
Staidle JP, Dabade TS, Feldman SR. A pharmacoeconomic analysis of severe psoriasis therapy: a review of treatment choices and cost efficiency. Expert opinion on pharmacotherapy. 2011;12(13):2041-54.	No outcomes of interest; not appropriate to calculate ICER between treatments because effectiveness data was gathered from different clinical trials and variations between trials were not adjusted
Thng TG, Theng C, Chang A. Bringing therapy to the patient. A study on the efficacy, compliance and cost-effectiveness of home-based phototherapy as opposed to institution-based phototherapy for the treatment of patients with focal Vitiligo. Ann Acad Med Singapore.44(10 SUPPL. 1):S29.	Abstract
Thomas KS, Batchelor JM, Bath-Hextall F, Chalmers JR, Clarke T, Crowe S, et al. A programme of research to set priorities and reduce uncertainties for the prevention and treatment of skin disease. NIHR J Libr. 2016;12:12.	No intervention of interest (home NB-UVB); did not compare home vs. outpatient clinic NB-UVB
Van Coevorden AM, Kamphof WG, Van Sonderen E, Bruynzeel DP, Coenraads PJ. Comparison of oral psoralen-UV-A with a portable tanning unit at home vs hospital-administered bath psoralen-UV-A in patients with chronic hand eczema: an open-label randomized controlled trial of efficacy. Arch Dermatol. 2004;140(12):1463-6.	No intervention of interest (home NB-UVB)
Vano-Galvan S, Garate MT, Fleta-Asin B, Hidalgo A, Fernandez-Guarino M, Bermejo T, et al. Analysis of the cost effectiveness of home-based phototherapy with narrow-band UV-B radiation compared with biological drugs for the treatment of moderate to severe psoriasis. Actas dermo-sifiliograficas. 2012;103(2):127-37.	No comparator of interest (outpatient clinic NB-UVB)

Yelverton CB, Kulkarni AS, Balkrishnan R, Feldman SR. Home ultraviolet B phototherapy: a cost-effective option for severe psoriasis. Manag Care Interface. 2006;19(1):33-6, 39.	No comparator of interest (outpatient clinic NB-UVB)
Yentzer BA, Gustafson CJ, Feldman SR. Explicit and implicit copayments for phototherapy: examining the cost of commuting. Dermatol Online J. 2013;19(6):18563.	Costing analysis
Yentzer BA, Yelverton CB, Simpson GL, Simpson JF, Hwang W, Balkrishnan R, et al. Paradoxical effects of cost reduction measures in managed care systems for treatment of severe psoriasis. Dermatol Online J. 2009;15(4):1.	Costing analysis

Appendix 4: Results of Applicability and Limitation Checklists for Studies Included in the Economic Literature Review

Table A3: Assessment of the Applicability of Studies Evaluating the Cost-Effectiveness of Home NB-UVB for Photoresponsive Skin Conditions

Author, Year, Country of Publication	Is the study population similar to the question?	Are the interventions similar to the question?	Is the health care system studied sufficiently similar to Ontario?	Were the perspectives clearly stated? If yes, what were they?	Are all direct effects included? Are all other effects included where they are material?	Are all future costs and outcomes discounted? If yes, at what rate?	Is the value of health effects expressed in terms of quality-adjusted life-years?	Are costs and outcomes from other sectors fully and appropriately measured and valued?	Overall Judgment[a]
Koek et al 2010,[52] The Netherlands	Yes (people with psoriasis who were clinically eligible for NB-UVB)	Yes (home and outpatient clinic NB-UVB)	No (Dutch societal)	Yes (Dutch societal)	Yes (appropriate health effects included)	No discount (time horizon at 1 year post phototherapy)	Yes	Yes (considered costs of travelling, parking, and reduced productivity)	Partially applicable

Abbreviation: NB-UVB, narrowband ultraviolet B phototherapy.
Note: Response options for all items were "yes," "partially," "no," "unclear," and "NA" (not applicable).
[a]Overall judgment may be "directly applicable," "partially applicable," or "not applicable."

Table A4: Assessment of the Limitations of Studies Evaluating the Cost-Effectiveness of Home NB-UVB for Photoresponsive Conditions

Author, Year, Country of Publication	Does the model structure adequately reflect the nature of the health condition under evaluation?	Is the time horizon sufficiently long to reflect all important differences in costs and outcomes?	Are all important and relevant health outcomes included?	Are the clinical inputs[a] obtained from the best available sources?	Do the clinical inputs[a] match the estimates contained in the clinical sources?	Are all important and relevant (direct) costs included in the analysis?	Are the estimates of resource use obtained from the best available sources?	Are the unit costs of resources obtained from the best available sources?	Is an appropriate incremental analysis presented, or can it be calculated from the reported data?	Are all important and uncertain parameters subjected to appropriate sensitivity analysis?	Is there a potential conflict of interest?	Overall Judgment[b]
Koek et al 2010,[52] The Netherlands	Yes (conducted alongside trial)	No (time horizon at 1 year post phototherapy, may not be long enough to capture chronic nature of psoriasis)	Yes (QALYs, treatment effect, safety)	Yes (obtained directly from trial)	Yes (obtained directly from trial)	Yes (included relevant costs from societal perspective)	Yes (obtained directly from trial's individual-level data)	Yes (used country-specific estimates from best available sources)	Yes	Yes (varied sources of utility input and cost assumptions)	No	Minor limitations

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy; QALY: quality-adjusted life year.
Note: Response options for all items were "yes," "partially," "no," "unclear," and "NA" (not applicable).
[a]Clinical inputs include relative treatment effects, natural history, and utilities.
[b]Overall judgment may be "minor limitations," "potentially serious limitations," or "very serious limitations."

Appendix 5: Economic Evidence—Summary of Other Informative (Though Not Eligible) Studies

Table A5: Other Informative (Though Not Eligible) Studies—Summary

Author, Year, Country of Publication	Analytic Technique, Study Design, Perspective, Time Horizon	Population	Intervention(s) and Comparator(s)	Results		
				Health Outcomes	Costs	Cost-Effectiveness
Cameron et al, 2002,[63] United Kingdom	• Costing analysis • UK patient and hospital perspectives • Time horizon: 2 years	• Adults with psoriasis • N = 21 • 50% male	• Intervention: home NB-UVB • Comparator: hospital clinic NB-UVB	• Not applicable	• 2000 GBP Patient perspective: • Home: £128 per course • Outpatient: £189 per course[a] Hospital perspective: • Home: £112 per course • Outpatient: £89 per course • No discount	• Not applicable
Cameron et al, 2014,[62] United Kingdom	• Costing analysis[a] • UK patient, hospital, and combined perspectives • Time horizon: 13 years	• Adults with photoresponsive conditions (psoriasis 72%) • N = 212 • 56% male	• Intervention: home NB-UVB • Comparator: hospital clinic phototherapy	• Not applicable	• 2011 GBP Patient perspective • Home: £137 per course • Outpatient: £438 per course[b] Hospital perspective • Home: £270 per course • Outpatient: £114 per course Combined perspectives • Home: £410 per course • Outpatient: £550 per course • No discount	• Not applicable

Author, Year, Country of Publication	Analytic Technique, Study Design, Perspective, Time Horizon	Population	Intervention(s) and Comparator(s)	Results		
				Health Outcomes	Costs	Cost-Effectiveness
Haykal et al, 2006,[64] Ontario, Canada	• Survey, no economic analysis • Ontario patient perspective • Time horizon: not applicable	• Patients who were prescribed home phototherapy, conditions not specified • N = 25 • 52% male	• Intervention: home NB-UVB • Comparator: none	• Not applicable	• 2006 CAD • Self-reported monthly savings from $20 to $600 depending on distance travelled, work hours missed, and associated expenses	• Not applicable
Hyde et al, 2018,[60] United States	• Costing analysis[a] • US health care payer perspective • Time horizon: 3 years	• Hypothetical cohort of patients with moderate-to-severe psoriasis	• Intervention: home NB-UVB • Comparator: biologic	• Not applicable	• USD, year not specified • Home NB-UVB: $5,000 (over 3 years) • Biologic: $138,342 (infliximab, biologic with the lowest cost over 3 years) • No discount	• Not applicable
Medical Advisory Secretariat, 2009,[59] Ontario, Canada	• Costing analysis • Ontario MOH perspective • Time horizon: 1 year	• Adults (18 years or older) in Ontario with moderate-to-severe plaque-type psoriasis who may be using NB-UVB • N = 7,700 (estimated)	• Intervention: home NB-UVB • Comparators: hospital clinics, private clinics, NB-UVB	• Not applicable	• 2009 CAD • Home: $365 per person per year • Hospital clinics: $292 per person per year • Private clinics: $810 per person per year • No discount	• Not applicable

Author, Year, Country of Publication	Analytic Technique, Study Design, Perspective, Time Horizon	Population	Intervention(s) and Comparator(s)	Results		
				Health Outcomes	Costs	Cost-Effectiveness
Mikhael et al, 2009,[58] Ontario, Canada	• Costing analysis • Ontario, perspective not specified (included direct medical costs only) • Time horizon: 10 years	• Hypothetical cohort of people with plaque-type psoriasis of moderate severity	• Intervention: home NB-UVB • Comparators: outpatient UV (NB-UVB and broadband UVB), systemic non-biologics, and biologics	• Not applicable	• 2009 CAD • Home: $400 per person per year • Outpatient: $315 per person per year • Systemic non-biologic: $712 per person per year • Biologic: $18,728 per person per year • No discount	• Not applicable
Staidle et al, 2011,[57] United States	• Cost-effectiveness analysis • US health care payer perspective • Time horizon: 1 year	• Hypothetical cohort of patients with moderate-to-severe psoriasis	• Intervention: home NB-UVB • Comparator: outpatient NB-UVB	Percentage of people achieving PASI-75: • Home: 41% • Outpatient: 42% to 80%	• 2010 USD • Home: $2,768 per year • Outpatient: $6,676 per year • No discount	• Not calculated as data was obtained from different trials and variations between trials were not adjusted
Thng et al, 2015,[56] Singapore	• Costing analysis • RCT (conference abstract only) • Singapore, perspective not specified • Time horizon: 6 months	• Patients with focal vitiligo vulgaris • N = 44	• Intervention: home phototherapy (type of UV not specified) • Comparator: outpatient phototherapy	• Not applicable	• Currency and cost year unclear • Home: $1,000 per person • Outpatient: $13,000 per person • No discount	• Not applicable
Vano-Galvan et al, 2012,[55] Spain	• Cost-effectiveness analysis • Decision tree • Spain health care payer perspective • Time horizon: 4 months	• Patients with moderate-to-severe psoriasis • N = 12 • 75% male (9 of 12)	• Intervention: home NB-UVB • Comparator: biologic	Percentage of people achieving PASI-75: • Home NB-UVB: 66% (4/6) • Biologic: 83% (5/6) • Incremental: 1	• 2010 EUR • Home NB-UVB: €3,612 • Biologic: €41,280 • Incremental: €37,668 • No discount	• Biologic vs. home NB-UVB: €37,668 per additional patient with a PASI-75 response

Author, Year, Country of Publication	Analytic Technique, Study Design, Perspective, Time Horizon	Population	Intervention(s) and Comparator(s)	Results		
				Health Outcomes	Costs	Cost-Effectiveness
Yelverton et al, 2006,[54] United States	• Costing analysis • US third-party payer perspective • Time horizon: 30 years	• Hypothetical cohort of patients with severe psoriasis	• Intervention: home NB-UVB • Comparator: systemic non-biologic, biologic	• Not applicable	• USD 2002 • Home NB-UVB: $7,085 (over 30 years) • Systemic non-biologic: $19,102 (over 30 years) • Biologic: $171,915 (over 30 years) • Discount rate: 5%	• Not applicable
Yentzer et al, 2013,[53] US	• Costing analysis • US patient perspective • Time horizon: 3 months	• Hypothetical cohort of patients with psoriasis undergoing phototherapy	• Intervention: home NB-UVB • Comparator: outpatient phototherapy	• Not applicable	• 2010 USD • Home (standard 6-bulb NB-UVB home unit): $2,600 per person • Outpatient: total travel costs would exceed cost of home unit if patient lives 20 or more miles from the clinic • No discount	• Not applicable

Abbreviations: RCT, randomized controlled trial; UV, ultraviolet; MOH, Ministry of Health; NB-UVB, narrowband ultraviolet B phototherapy; PASI; psoriasis area severity index.
[a]Although the study discussed the cost-effectiveness of home NB-UVB, minimal information was provided on the methods.
[b]Estimated cost by the same group if they were to attend outpatient NB-UVB.

Appendix 6: Primary Economic Evaluation

Appendix 6A: Incorporating Subsequent Lines of Psoriasis Treatments

Model Structure

In this scenario, we assumed that a portion of those switching out of phototherapy would switch into systemic non-biologics and biologics, in addition to topical therapy. Since there is limited clinical data on treatment switching between systemic non-biologics and biologics, additional assumptions on model transition probabilities were required for this scenario analysis. Furthermore, since there were various possible treatment sequences due to the availability of different psoriasis treatments, we modelled the most likely treatment sequence involving subsequent lines of treatments: based on the treatment guideline, we assumed patients usually receive NB-UVB phototherapy first, followed by systemic non-biologics, and then biologics.[66]

Similar to the reference case, all patients entered the model undergoing either home or outpatient clinic NB-UVB phototherapy, and a proportion of people may switch out of NB-UVB phototherapy for a variety of reasons, such as treatment failure or difficulty in accessing treatment over the long term. When people switched out of phototherapy, some may switch to the next line of treatment—a systemic non-biologic agent. While on the systemic agent, if people respond to the therapy (i.e., if they achieve a 75% or greater improvement in PASI compared to baseline), they would remain on the treatment. If they did not respond, they may move on to a different systemic non-biologic agent as the next line, and then a biologic drug. People who were contraindicated to both lines of non-biologics would receive biologics directly after phototherapy. At each point of switching treatment (i.e., switching out of phototherapy and systemic non-biologics), some people may choose to not proceed to the next line of treatment and remain on topical therapy for the rest of the time horizon. The model did not extend beyond the first biologic (i.e., switching between biologics was not examined) because phototherapy was the focus of the model and biologic-switching was unlikely to be different between the home and outpatient clinic NB-UVB phototherapy groups. Figure A1 presents the model structure.

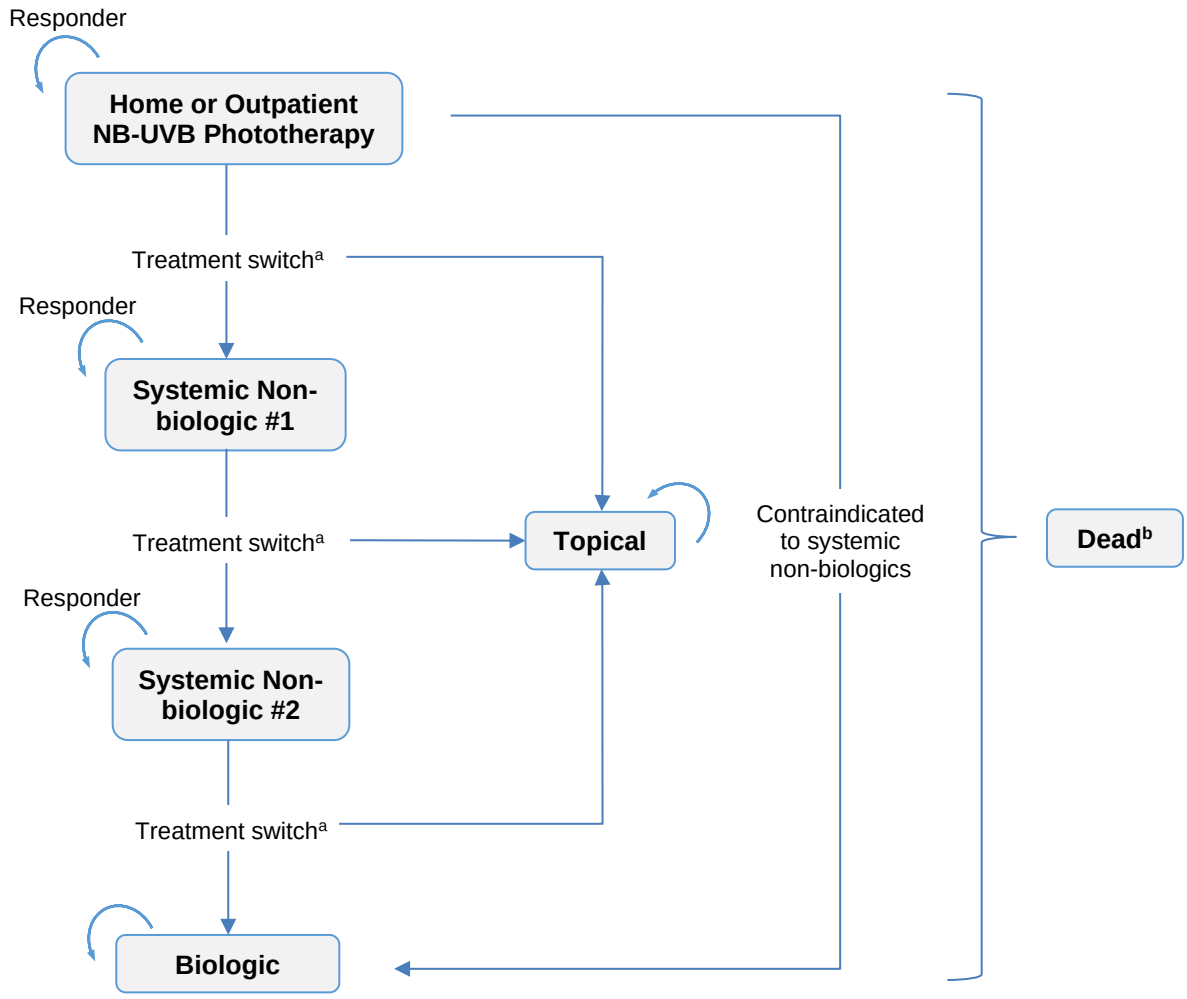

Figure A1: Model Structure—Scenario Analysis, Incorporating Subsequent Lines of Psoriasis Treatments

[a]Due to various reasons, such as treatment failure, inconvenience, adverse events, etc.
[b]People may enter the dead category (i.e., leave the treatment model) at any time.

Regardless of the drug choice and treatment sequence, the focus of the model was to assess the initial setting of phototherapy (home vs. outpatient clinic) rather than the subsequent lines of treatment. Upon consulting the literature and clinical experts, we used methotrexate and acitretin as the two commonly used systemic non-biologics, adalimumab as a commonly used biologic, and betamethasone valerate as an example of the topical therapy.[109]

Clinical Outcomes and Utility Parameters

PASI Categories

The treatment benefits people experience from phototherapy are measured by the Psoriasis Area and Severity Index (PASI). This index combines the assessment of the severity of psoriatic lesions and the area of the body affected into a single score ranging from 0 (no disease) to 72

(maximal disease). Although PASI score ranges from 0 to 72, individual responses to psoriasis treatment are commonly described by the percent change in PASI score relative to baseline, rather than by the PASI number. For example, achieving PASI-75 means the individual has achieved at least 75% improvement in their PASI compared to baseline. The PASI-75 rating is the most commonly used measure of treatment efficacy. PASI response levels are divided into four broad categories: PASI 90–100 (greatest improvement), PASI 75–89, PASI 50–74, and PASI <50 (least improvement). The PASI-75 score reported in most literature refers to the percentage of people in a trial who achieve at least 75% improvement in their PASI score compared to baseline. The treatment benefit for systemic agents and biologics were taken from the literature and previous economic analyses.[72,110,111]

Treatment Switching

The probabilities of treatment switching are obtained from expert opinion and treatment patterns reported in the literature.[71] In contrast to the reference case, where 100% of those switching out of phototherapy receive topical therapy, this scenario has 70% receiving topical therapy, 16% receiving the first systemic non-biologic, and 14% receiving biologic directly due to contraindications to systemic non-biologics. People who did not respond to the first systemic non-biologic would switch to a second systemic non-biologic agent, then biologic. For systemic non-biologic and biologics, we assumed the rate of switching during the initial trial period would be determined by the treatment effectiveness; i.e., people who did not achieve PASI-75 would switch to the next line. Those who achieved the desired treatment effect during the initial trial period would stay on the treatment past the usual course of treatment until they discontinue and switch treatment. This switch could be due to treatment failure or other adverse events. The probabilities of switching for systemic non-biologics were obtained from the literature and expert opinion.[71,110,111]

Adverse Events

We also considered serious adverse events associated with systemic non-biologics and biologics, specifically those that are frequent (annual incidence rates ≥ 5%), severe, expensive to treat, or have a large impact on health effects or resources from the analysis. Frequent serious adverse events were not identified because the incidence rates of serious adverse events for all psoriasis treatments are rare and comparable.[112,113] This was consistent with the approach taken by previous economic evaluations.[72]

Utilities by PASI Category

The utilities while on treatments other than phototherapy were reflected using the PASI categories. The utility values for various PASI categories and the baseline utility (untreated) were obtained from published economic evaluations.[72,75]

Disutilities Due to Adverse Events

Since we did not identify frequent serious adverse events associated with non-biologics and biologics in the literature, adverse event–associated disutilities were not included.

Table A6: Clinical and Utility Parameters Used in Economic Model—Scenario Analysis, Incorporating Subsequent Lines of Psoriasis Treatments

Parameters	Mean	Lower 95% CI	Upper 95% CI	Source
PASI Categories by Treatment				
Systemic non-biologic #1 (methotrexate)				
PASI 90–100	13.6%	7.2%	20.0%	Saurat et al, 2008[110]
PASI 75–89	21.8%	14.1%	29.5%	Saurat et al, 2008[110]
PASI 50–74	26.4%	18.1%	34.6%	Saurat et al, 2008[110]
PASI < 50	38.2%	29.1%	47.3%	Saurat et al, 2008[110]
Systemic non-biologic #2 (acitretin)				
PASI 90–100	0.0%	—	—	Caproni et al, 2009[111]
PASI 75–89	26.7%	10.8%	42.5%	Caproni et al, 2009[111]
PASI 50–74	40.0%	22.5%	57.5%	Caproni et al, 2009[111]
PASI < 50	33.3%	16.5%	50.2%	Caproni et al, 2009[111]
Biologic (adalimumab)				
PASI 90–100	37.2%	32.0%	42.2%	Hendrix et al, 2018[72]
PASI 75–89	27.7%	23.2%	32.0%	Hendrix et al, 2018[72]
PASI 50–74	16.9%	13.4%	20.2%	Hendrix et al, 2018[72]
PASI < 50	18.2%	14.5%	21.7%	Hendrix et al, 2018[72]
Treatment Switching				
Switching out of NB-UVB				
Proportions of those switching out of NB-UVB who switch into:				
Topical	70%	—	—	Expert opinion
Systemic non-biologic #1	15.7%	12.4%	19.0%	Kimball et al, 2015[71]
Biologic	14.3%	11.1%	17.5%	Kimball et al, 2015[71]
Switching out of systemic non-biologic #1				
Probabilities of switching out of systemic non-biologic #1				
Initial trial period	% of patients did not achieve PASI-75			Saurat et al, 2008[110]
Subsequent years	18.8%	17.0%	20.5%	Kimball et al, 2015[71]
Proportions of those switching out of systemic non-biologic #1 who switch into:				
Topical	70%	—	—	Expert opinion
Systemic non-biologic #2	30%	—	—	
Switching out of systemic non-biologic #2				
Probabilities of switching out of systemic non-biologic #2				
Initial trial period	% of patients did not achieve PASI-75			Caproni et al, 2009[111]
Subsequent years	19.8%	18.4%	21.1%	Kimball et al, 2015[71]
Proportion of those switching out of systemic non-biologic #2 who switch into:				

Parameters	Mean	Lower 95% CI	Upper 95% CI	Source
Topical	70%	—	—	Expert opinion
Biologic	30%	—	—	
Utility Parameters				
PASI categories				
90–100	0.906	0.856	0.956	Hendrix et al, 2018[72]
75–89	0.868	0.818	0.918	Hendrix et al, 2018[72]
50–74	0.835	0.79325	0.87675	Hendrix et al, 2018[72]
< 50	0.751	0.71345	0.78855	Hendrix et al, 2018[72]

Abbreviations: CI, confidence interval; NB-UVB, narrowband ultraviolet B phototherapy; PASI, Psoriasis Area and Severity Index.

Cost Parameters

Based on the estimated number of physician visits per year provided by the Ontario costing study by Mikhael et al,[58] we assumed four visits per year for those receiving systemic non-biologics and biologics. The unit costs of physician visits were obtained from the Ontario Schedule of Benefits.[35] We used the fee for a dermatological initial consultation ($72.15) for the first visit, followed by the fee for a follow-up visit ($21.90) for the subsequent visits.

We obtained the costs of non-biologics (methotrexate and acitretin) and biologics (adalimumab) from the Ontario Drug Benefit Formulary.[114] Similar to the reference case, we assumed that approximately 80% of people receiving systemic non-biologics and biologics undergo adjuvant topical therapy, and we used the cost of betamethasone valerate as an example of topical treatment.

For individuals taking non-biologic and biologic treatments, routine laboratory testing may be required for monitoring liver toxicity. The annual costs of diagnostic procedures and laboratory charges for systemic non-biologics and biologics were taken from the Ontario costing study[58] and adjusted to 2019 CAD. The detailed cost per treatment is listed in Table A7.

Table A7: Monthly Per Person Cost Used in Economic Model—Scenario Analysis, Incorporating Subsequent Lines of Psoriasis Treatments

	Mean	Lower 95% CI[a]	Upper 95% CI[a]	Source
Physician				
Systemic non-biologic #1	11.5	8.6	14.4	Schedule of Benefits[35]
Systemic non-biologic #2	11.5	8.6	14.4	Schedule of Benefits[35]
Biologic	11.5	8.6	14.4	Schedule of Benefits[35]
Drugs[b]				
Systemic non-biologic #1 (Methotrexate 15 mg per week)	37.5	28.1	46.9	Ontario Drug Benefit Formulary[114]
Systemic non-biologic #2 (Acitretin 25 mg per day)	136.6	102.5	170.8	Ontario Drug Benefit Formulary[114]
Biologic (Adalimumab 40 mg every 2 weeks)	1539.9	1155.0	1924.9	Ontario Drug Benefit Formulary[114]
Laboratory				
Systemic non-biologic #1	22.0	16.5	27.6	Mikhael et al, 2009[58]
Systemic non-biologic #2	18.9	14.2	23.6	Mikhael et al, 2009[58]
Biologic	9.0	6.8	11.3	Mikhael et al, 2009[58]

Abbreviation: CI, confidence interval.
[a]Assumed ± 25%.
[b]Listed cost not including adjuvant topical therapy, but it was incorporated into each treatment in the analysis.

Appendix 6B: Exploring Utilities for Home and Outpatient Clinic NB-UVB Phototherapy

In the reference case, we used the utility parameters reported in the PLUTO economic evaluation.[52] Specifically, the PLUTO authors calculated the QALYs for home and outpatient clinic NB-UVB phototherapy by plotting EQ-5D utilities against time, using the area under the curve approach. The utilities were then calculated from the QALYs reported, which were 0.876 for home and 0.856 for outpatient clinic NB-UVB phototherapy.

In this scenario analysis, we calculated utilities using an alternative parameter provided in the PLUTO clinical trial,[28] which was the proportion of people at various PASI levels (PASI 90–100, PASI 75–89, PASI 50–74, and PASI < 50). We used the corresponding utility of these PASI levels to calculate a weighted average utility for the home and outpatient clinic NB-UVB phototherapy groups. The calculated utilities were 0.831 for home and 0.833 for outpatient clinic NB-UVB phototherapy. The proportions of people at each PASI category and the corresponding utilities are presented in Table A8.

Table A8: PASI Parameters Used in Calculating Utilities of Home and Outpatient Clinic NB-UVB-Scenario Analysis, Utilities of NB-UVB using PASI categories

	Mean	Lower 95% CI	Upper 95% CI	Source
PASI Categories				
Home NB-UVB				
PASI 90–100	19.78%	11.6%	28.0%	Koek et al, 2009[28]
PASI 75–89	20.88%	12.5%	29.2%	Koek et al, 2009[28]
PASI 50–74	29.67%	20.3%	39.1%	Koek et al, 2009[28]
PASI < 50	29.67%	20.3%	39.1%	Koek et al, 2009[28]
Outpatient clinic NB-UVB				
PASI 90–100	19.05%	10.7%	27.4%	Koek et al, 2009[28]
PASI 75–89	22.62%	13.7%	31.6%	Koek et al, 2009[28]
PASI 50–74	30.95%	21.1%	40.8%	Koek et al, 2009[28]
PASI < 50	27.38%	17.8%	36.9%	Koek et al, 2009[28]
Utilities of PASI Categories				
PASI 90–100	0.906	0.856	0.956	Hendrix et al, 2018[72]
PASI 75–89	0.868	0.818	0.918	Hendrix et al, 2018[72]
PASI 50–74	0.835	0.79325	0.87675	Hendrix et al, 2018[72]
PASI < 50	0.751	0.71345	0.78855	Hendrix et al, 2018[72]

Abbreviations: CI, confidence interval; NB-UVB, narrowband ultraviolet B phototherapy; PASI, Psoriasis Area and Severity Index.

Appendix 6C: Exploring Probabilities of Switching Out of Home NB-UVB Phototherapy

Home NB-UVB Phototherapy With Higher Switching Compared to Outpatient Clinic NB-UVB Phototherapy

When home NB-UVB phototherapy has higher switching (i.e., worse adherence) compared to outpatient clinic NB-UVB phototherapy, the vast majority of the estimated ICERs are above the willingness-to-pay of $50,000 per QALY gained (see Figure A2), suggesting that home NB-UVB phototherapy is less likely to be cost-effective at this willingness-to-pay.

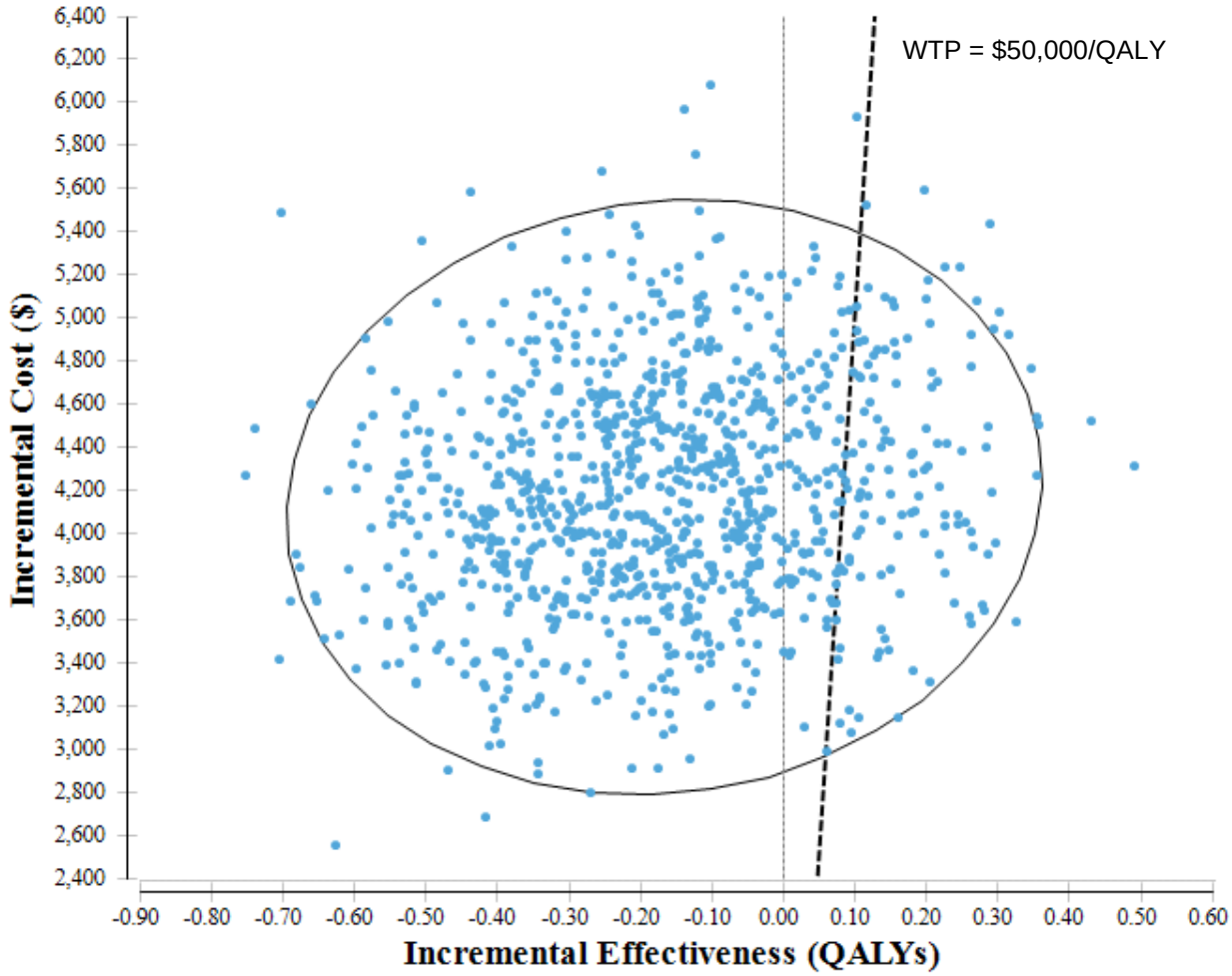

Figure A2: Scatter Plot of 1,000 Simulated Pairs of Incremental Costs and Effects in the Cost-Effectiveness Plane: Home NB-UVB With Higher Switching Compared to Outpatient Clinic NB-UVB Phototherapy

Abbreviations: QALY, quality-adjusted life year; WTP, willingness-to-pay.

Home NB-UVB Phototherapy With Equal Switching Compared to Outpatient Clinic NB-UVB Phototherapy

When home NB-UVB phototherapy has the same adherence as outpatient clinic NB-UVB phototherapy, there are slightly more simulated ICERs that fall below the willingness-to-pay of $50,000 (Figure A3).

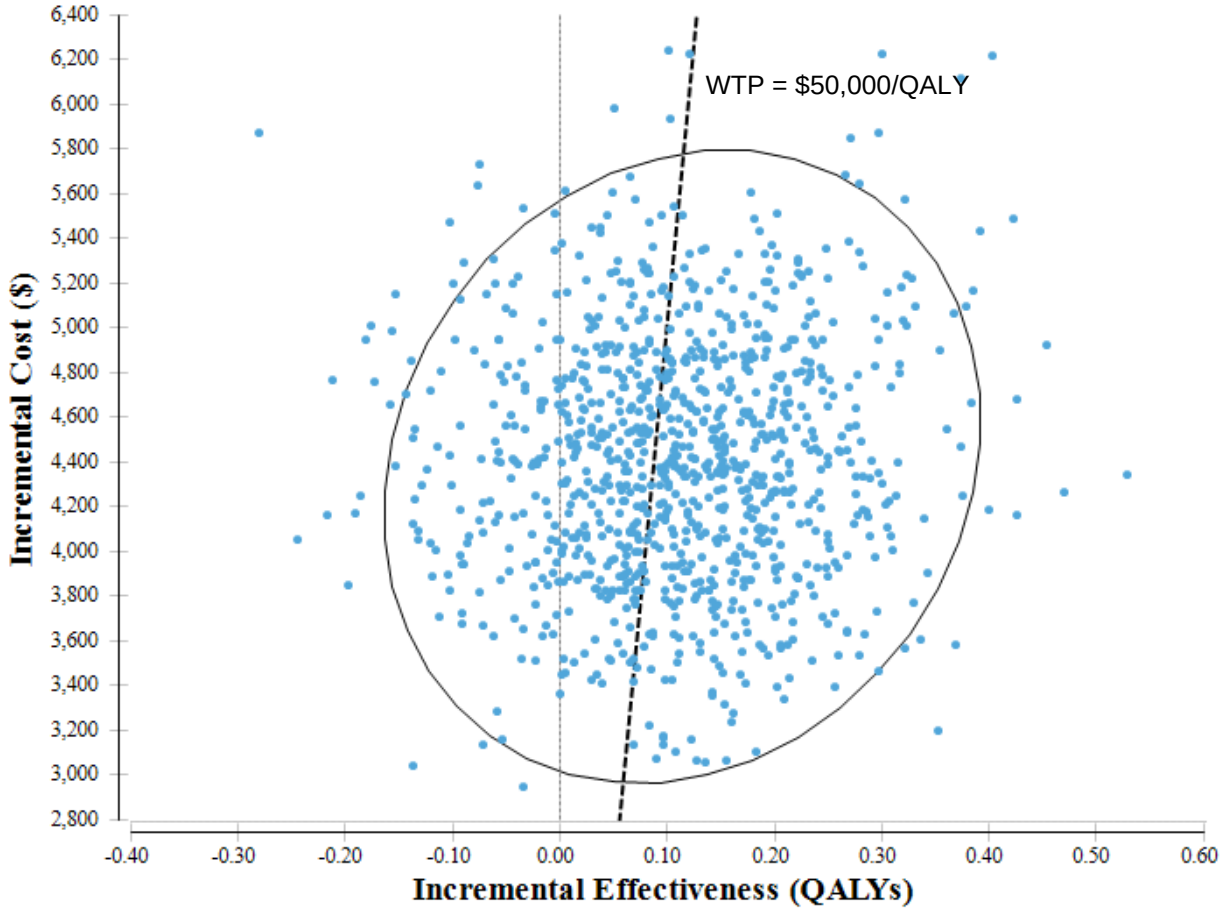

Figure A3: Scatter Plot of 1,000 Simulated Pairs of Incremental Costs and Effects in the Cost-Effectiveness Plane: Home NB-UVB With Equal Switching Compared to Outpatient Clinic NB-UVB Phototherapy

Abbreviations: QALY, quality-adjusted life year; WTP, willingness-to-pay.

Home NB-UVB Phototherapy With Lower Switching Compared to Outpatient Clinic NB-UVB Phototherapy

When home NB-UVB phototherapy has better adherence than outpatient clinic NB-UVB phototherapy, more simulated ICERs fall below the willingness-to-pay of $50,000 per QALY (Figure A4).

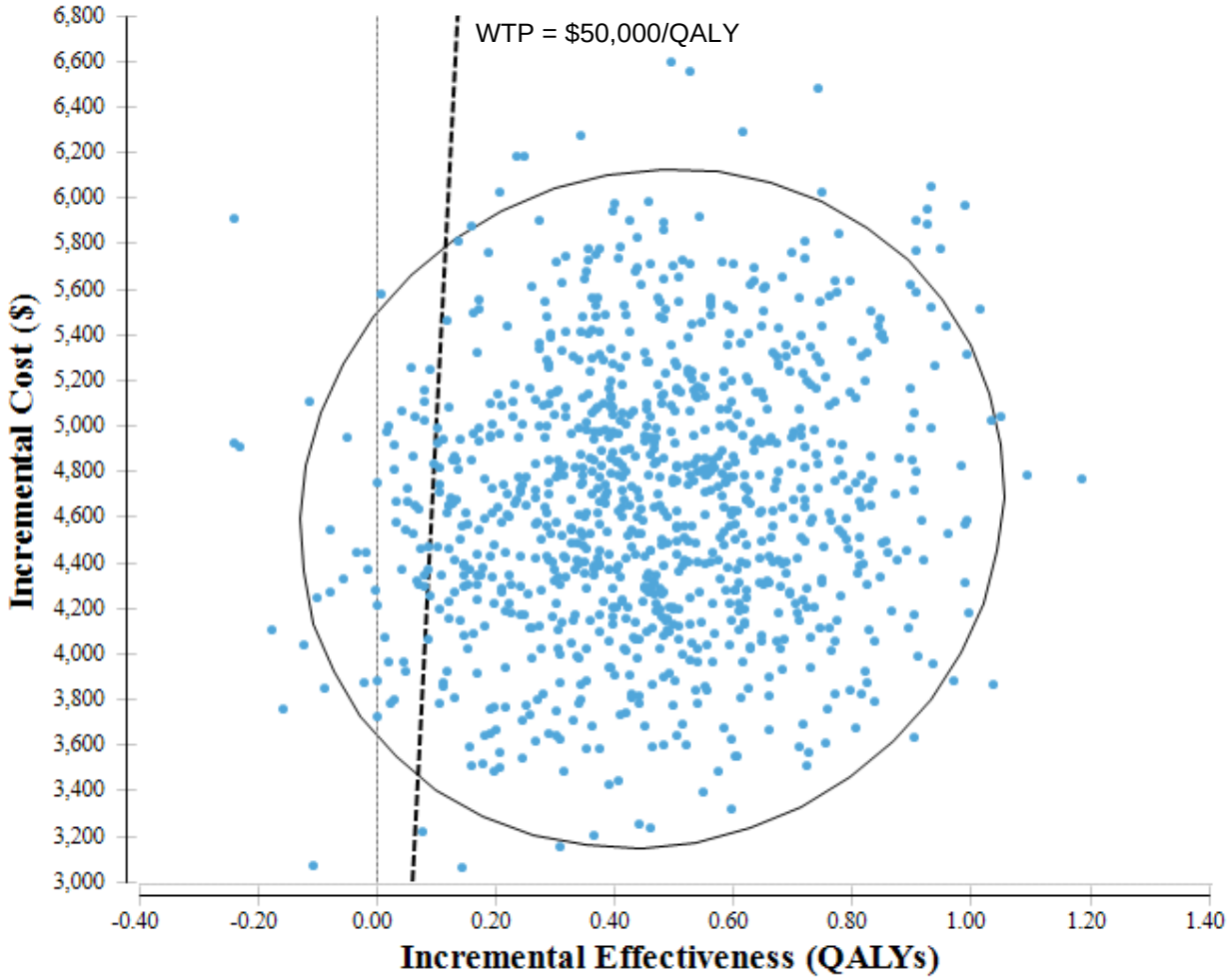

Figure A4: Scatter Plot of 1,000 Simulated Pairs of Incremental Costs and Effects in the Cost-Effectiveness Plane: Home NB-UVB With Lower Switching Compared to Outpatient Clinic NB-UVB Phototherapy

Abbreviations: QALY, quality-adjusted life year; WTP, willingness-to-pay.

Appendix 7: Budget Impact Analysis

Appendix 7A: Eczema

Target Population

Based on the same approach as in the reference case, we used IntelliHealth data to estimate the number of eczema patients eligible for home NB-UVB phototherapy using the OHIP fee code G470 and diagnosis codes 690_1, 691_1, 692_1). Table A9 presents the estimation of target population.

Table A9: Estimation of the Target Populations (Eczema)—IntelliHealth Data

	Eczema (N, annual)
Total number of adults[a] receiving outpatient clinic NB-UVB phototherapy[b]	2,138
Proportion of people who may have access or mobility issues[c]	50%
Total suitable for home NB-UVB phototherapy (***target population***):	**1,069**
100% coverage[d]	562
75% coverage[e]	507

[a]Twenty years and older. We assumed that the number of NB-UVB phototherapy users who are ages 18 and 19 is negligible.
[b]We assumed that roughly equal numbers of people were using private offices as were using hospital-based clinics.
[c]This percentage was assumed.
[d]This group includes those under 25 or over 65 years of age and those receiving social assistance between 25 to 65 years of age.
[e]This group includes those between 25 and 65 years of age who are not receiving social assistance.
Source: Data provided by Ontario IntelliHealth.

Uptake of the New Intervention and New Intervention Mix

Using the same approach as in the reference case, the potential new intervention uptake for eczema is presented in the tables below.

Table A10: Uptake of Home NB-UVB Phototherapy—Scenario Analysis, Eczema

	Year 1	Year 2	Year 3	Year 4	Year 5	Total[a]
Target Population (n)	1,069	1,069	1,069	1,069	1,069	
Current Scenario						
Proportion funded (home)	0%	0%	0%	0%	0%	—
Number of people (home)	0	0	0	0	0	0
Number of people (outpatient clinic)	1,069	1,069	1,069	1,069	1,069	—
New Scenario						
Proportion funded (home)	5%	5%	5%	5%	5%	—
Number of people (home)	53	53	53	53	53	267
100% coverage	28	28	28	28	28	141
75% coverage	25	25	25	25	25	127
Number of people (remaining in outpatient clinic)	1,016	962	909	855	802	—

Abbreviation: NB-UVB, narrowband ultraviolet B.
[a]Numbers may not add correctly due to rounding.

Resources and Costs

We included only the cost of phototherapy in estimating the budget impact for the eczema population. This is due to the heterogeneity of the condition, which made it difficult to accurately estimate all the condition-specific medical costs (e.g., number of physician visits, medications, potential laboratory tests).

For outpatient clinic phototherapy, we applied the OHIP fee ($7.85 per visit) multiplied by the average number of visits, as reported by the 2011–2016 data from IntelliHealth. Similar to the reference case, only 50% of the outpatient clinic phototherapy cost was accounted for in the budget impact analysis because 50% of treatments were performed in hospital clinics. Hospital costs are covered by the hospital's global budget. See Table A11 for the annual per-patient cost for eczema in outpatient clinic and home settings.

Table A11: Annual Per-Patient Cost—Scenario Analysis, Eczema

	Year 1	Year 2	Year 3	Year 4	Year 5
Home NB-UVB					
Phototherapy[a]	3,580	132	132	132	132
100% cost coverage	4,062	149	149	149	149
75% cost coverage	3,046	112	112	112	112
Outpatient Clinic NB-UVB					
Phototherapy	35	35	35	35	35

Abbreviation: NB-UVB, narrowband ultraviolet B phototherapy.
[a]Weighted average cost.

Budget Impact Analysis Results

Table A12: Budget Impact Analysis Results—Scenario Analysis, Eczema

	Budget Impact, $[a,b]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Current Scenario	37,762	37,762	37,762	37,762	37,762	188,812
New Scenario	227,240	232,381	237,523	242,665	247,806	1,187,616
Net Budget Impact	**189,477**	**194,619**	**199,761**	**204,902**	**210,044**	**998,803**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Appendix 7B: Scenario Analyses for Psoriasis Population

Resources and Costs

Table A13: Annual Per-Patient Cost—Scenario Analysis, Psoriasis, Societal Perspective

	Year 1	Year 2	Year 3	Year 4	Year 5
Outpatient Clinic NB-UVB					
Non-medical costs	1,646	1,397	1,255	1,128	1,013

Abbreviation: NB-UVB, narrowband ultraviolet B phototherapy.

Table A14: Annual Per-Patient Cost—Scenario Analysis, Psoriasis Incorporating Subsequent Lines of Treatments

	Year 1	Year 2	Year 3	Year 4	Year 5
Home NB-UVB					
Other medical costs	730	1,019	1,209	1,384	1,545
Outpatient Clinic NB-UVB					
Other medical costs	771	1,185	1,422	1,634	1,825

Abbreviations: NB-UVB, narrowband ultraviolet B phototherapy.

Budget Impact Analysis Results

Table A15: Budget Impact Analysis Results—Scenario Analysis, Psoriasis, Societal Perspective

	Budget Impact, $[a,b]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Current Scenario, Budget Impact						
Phototherapy	378,859	321,633	289,001	259,640	233,222	1,482,355
Other medical costs	2,049,162	2,115,962	2,152,103	2,183,832	2,211,518	10,712,577
Non-medical costs	5,661,546	4,806,390	4,318,747	3,879,978	3,485,197	22,151,858
Total	**8,089,567**	**7,243,985**	**6,759,851**	**6,323,450**	**5,929,937**	**34,346,789**
New Scenario, Budget Impact						
Phototherapy	990,790	958,806	950,508	945,366	942,850	4,788,320
Other medical costs	2,052,226	2,117,351	2,150,921	2,178,409	2,200,638	10,699,545
Non-medical costs	5,378,469	4,325,751	3,670,935	3,103,983	2,613,898	19,093,035
Total	**8,421,485**	**7,401,908**	**6,772,363**	**6,227,758**	**5,757,386**	**34,580,899**
Net Budget Impact						
Phototherapy	611,931	637,173	661,506	685,726	709,628	3,305,965
Other medical costs	3,064	1,389	−1,182	−5,423	−10,880	−13,032
Non-medical costs	−283,077	−480,639	−647,812	−775,996	−871,299	−3,058,823
Total	**331,918**	**157,923**	**12,512**	**−95,692**	**−172,552**	**234,110**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Table A16: Budget Impact Analysis Results—Scenario Analysis, Psoriasis, Incorporating Subsequent Lines of Treatments

	Budget Impact, $[a]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Current Scenario, Budget Impact						
Phototherapy	378,859	321,633	289,001	259,640	233,222	1,482,355
Other medical costs	2,653,170	4,075,081	4,892,318	5,622,615	6,278,366	23,521,551
Total	**3,032,029**	**4,396,715**	**5,181,320**	**5,882,255**	**6,511,588**	**25,003,906**
New Scenario, Budget Impact						
Phototherapy	990,790	958,806	950,508	945,366	942,850	4,788,320
Other medical costs	2,646,001	3,968,352	4,667,215	5,244,863	5,721,314	22,247,745
Total	**3,636,790**	**4,927,158**	**5,617,723**	**6,190,229**	**6,664,164**	**27,036,065**
Net Budget Impact						
Phototherapy	611,931	637,173	661,506	685,726	709,628	3,305,965
Other medical costs	−7,170	−106,729	−225,103	−377,752	−557,052	−1,273,806
Total	**604,762**	**530,444**	**436,403**	**307,974**	**152,576**	**2,032,159**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Table A17: Budget Impact Analysis Results—Scenario Analysis, Psoriasis, 5% Annual Increase in Uptake

	Budget Impact, $[a,b]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Current Scenario, Budget Impact						
Phototherapy	378,859	321,633	289,001	259,640	233,222	1,482,355
Other medical costs	2,049,162	2,115,962	2,152,103	2,183,832	2,211,518	10,712,577
Total	**2,428,021**	**2,437,595**	**2,441,104**	**2,443,472**	**2,444,740**	**12,194,931**
New Scenario, Budget Impact						
Phototherapy	990,790	1,573,599	2,207,368	2,872,541	3,568,960	11,213,258
Other medical costs	2,052,226	2,117,075	2,146,613	2,163,400	2,166,363	10,645,678
Total	**3,043,016**	**3,690,674**	**4,353,981**	**5,035,942**	**5,735,324**	**21,858,936**
Net Budget Impact						
Phototherapy	611,931	1,251,966	1,918,367	2,612,902	3,335,739	9,730,904
Other medical costs	3,064	1,113	−5,490	−20,431	−45,155	−66,899
Total	**614,995**	**1,253,079**	**1,912,877**	**2,592,470**	**3,290,584**	**9,664,005**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Table A18: Budget Impact Analysis Results—Scenario Analysis, Psoriasis, 25% Suitable for Home NB-UVB Phototherapy

	Budget Impact, $[a,b]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Current Scenario, Budget Impact						
Phototherapy	189,429	160,817	144,501	129,820	116,611	741,177
Other medical costs	1,024,581	1,057,981	1,076,051	1,091,916	1,105,759	5,356,288
Total	**1,214,010**	**1,218,798**	**1,220,552**	**1,221,736**	**1,222,370**	**6,097,466**
New Scenario, Budget Impact						
Phototherapy	495,395	479,403	475,254	472,683	471,425	2,394,160
Other medical costs	1,026,113	1,058,675	1,075,460	1,089,205	1,100,319	5,349,772
Total	**1,521,508**	**1,538,079**	**1,550,714**	**1,561,888**	**1,571,744**	**7,743,932**
Net Budget Impact						
Phototherapy	305,966	318,587	330,753	342,863	354,814	1,652,983
Other medical costs	1,532	695	−591	−2,711	−5,440	−6,516
Total	**307,498**	**319,281**	**330,162**	**340,152**	**349,374**	**1,646,467**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Table A19: Budget Impact Analysis Results—Scenario Analysis, Psoriasis, 75% Suitable for Home NB-UVB Phototherapy

	Budget Impact, $[a,b]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Current Scenario, Budget Impact						
Phototherapy	568,288	482,450	433,502	389,460	349,833	2,223,532
Other medical costs	3,073,743	3,173,943	3,228,154	3,275,748	3,317,277	16,068,865
Total	**3,642,031**	**3,656,393**	**3,661,656**	**3,665,207**	**3,667,110**	**18,292,397**
New Scenario, Budget Impact						
Phototherapy	1,486,184	1,438,210	1,425,762	1,418,049	1,414,275	7,182,480
Other medical costs	3,078,339	3,176,026	3,226,381	3,267,614	3,300,957	16,049,317
Total	**4,564,524**	**4,614,236**	**4,652,142**	**4,685,663**	**4,715,232**	**23,231,797**
Net Budget Impact						
Phototherapy	917,897	955,760	992,260	1,028,590	1,064,442	4,958,948
Other medical costs	4,596	2,084	−1,773	−8,134	−16,320	−19,548
Total	**922,493**	**957,843**	**990,487**	**1,020,456**	**1,048,122**	**4,939,400**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Table A20: Budget Impact Analysis Results—Scenario Analysis, Psoriasis, IntelliHealth Assumption (Include Proportion of People with Unknown Diagnosis)

	Budget Impact, $[a,b]					
Scenario	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Current Scenario, Budget Impact						
Phototherapy	485,004	411,746	369,971	332,384	298,564	1,897,668
Other medical costs	2,623,279	2,708,794	2,755,060	2,795,679	2,831,123	13,713,935
Total	**3,108,283**	**3,120,540**	**3,125,032**	**3,128,063**	**3,129,687**	**15,611,603**
New Scenario, Budget Impact						
Phototherapy	1,268,381	1,227,437	1,216,813	1,210,231	1,207,010	6,129,871
Other medical costs	2,627,201	2,710,572	2,753,547	2,788,737	2,817,194	13,697,252
Total	**3,895,582**	**3,938,009**	**3,970,360**	**3,998,968**	**4,024,203**	**19,827,123**
Net Budget Impact						
Phototherapy	783,377	815,691	846,842	877,847	908,445	4,232,202
Other medical costs	3,923	1,778	−1,513	−6,942	−13,929	−16,683
Total	**787,299**	**817,469**	**845,328**	**870,905**	**894,517**	**4,215,519**

[a]In 2019 Canadian dollars.
[b]Numbers may not add correctly due to rounding.

Appendix 8: Letter of Information

Health Quality Ontario is conducting a review of **Home-based Narrowband Ultraviolet B Therapy for Photosensitive skin conditions.**

An important part of this review involves gathering perspectives of patients and caregivers with photosensitive skin conditions. They could have considered or received home-based narrowband ultraviolet B therapy.

The purpose is to understand whether this therapy should be publicly funded in Ontario.

What Your Participation Involves
If you agree to share your experiences, you will be asked:

- ✓ To share your story over phone or in-person interview
- ✓ Interview takes 20-30 minutes of your time in a private location
- ✓ Permission to audio (not video) record the interview

Participation is voluntary. You may refuse to participate, refuse to answer any questions or withdraw before or at any point during your interview. Withdrawal will in no way affect the care you receive.

Confidentiality
All information you share will be kept confidential and your privacy will be protected except as required by law. The results of this review will be published, however no identifying information will be released or published. Any records containing information from your interview will be stored securely until project completion. After the project completion, the records will be destroyed.

Risks to participation
There are no known physical risks to participating. Some participants may experience discomfort or anxiety after speaking about their experience. Please share as much or as little as you are comfortable sharing.

If you are interested, please contact us before JULY 31, 2019:
Arshia Ali
Patient and Public Partnering
Tel: 1-866-623-6868 ext. 662
Email: Arshia.Ali@hqontario.ca

Appendix 9: Interview Guide

Background

Provided information on Health Quality Ontario's mandate.

Explained the Health Technology Assessment Program, the three aspects of the review are: Clinical, Economic, and Patient and Public partnering. Explained the purpose of the interview is related to the Patient and Public Partnering aspect of the review.

Confirmed consent for audio-recording.

Restated options of withdrawal, freedom of sharing, and not-sharing of information.

Lived- Experience

What kind of condition do you have experience with? And how long did you have it?

What are the biggest challenges of living/caring for someone with this condition?

Therapies

What are the current therapies/treatments that you aware of?

What therapies/treatments are accessible to you? Did you face any barriers?

Which therapies/treatments have you explored? And why did you explore these?

How did the therapies/treatments meet your needs?

How did the therapies impact your quality of life?

What were the side-effects and benefits?

Were there any equity issues related to cost, access, knowledge of healthcare system?

Narrowband UVB Phototherapy

How do you receive Narrowband UVB phototherapy and what is your process of treatment?

How did this therapy meet/not meet your needs? How was it adequate/inadequate? Quality of life? Empowerment? Ownership? Adherence? Lifestyle?

What were the side-effects and benefits? Aging? Burns? Rashes?

Were there equity issues related to cost, access, knowledge of health care system etc? Travel, repeat visits

What challenges did this procedure address?

REFERENCES

(1) Muekusch G, Pitman J, Smiljanic D. Photoresponsive diseases. Dermatol Nurs. 2007;19(1):43-7.
(2) Holland K. Everything you need to know about psoriasis [Internet]. San Fransisco (CA): Healthline; 2019 [cited 2019 Jan 16]. Available from: https://www.healthline.com/health/psoriasis
(3) What is psoriasis? [Internet]. Toronto (ON): Canadian Psoriasis Network; c2019 [cited 2019 Jan 16]. Available from: https://www.canadianpsoriasisnetwork.com/psoriasis-2/
(4) Krueger JG, Bowcock A. Psoriasis pathophysiology: current concepts of pathogenesis. Ann Rheum Dis. 2005;64 Suppl 2:ii30-6.
(5) Alexis AF, Blackcloud P. Psoriasis in skin of color: epidemiology, genetics, clinical presentation, and treatment nuances. J Clin Aesthet Dermatol. 2014;7(11):16-24.
(6) Eder L, Widdifield J, Rosen CF, Cook R, Lee K-A, Alhusayen R, et al. Trends in the prevalence and incidence of psoriasis and psoriatic arthritis in Ontario, Canada: a population-based study. Arthritis Care Res (Hoboken). 2018.
(7) Palfreeman AC, McNamee KE, McCann FE. New developments in the management of psoriasis and psoriatic arthritis: a focus on apremilast. Drug Des Devel Ther. 2013;7:201-10.
(8) Schlager JG, Rosumeck S, Werner RN, Jacobs A, Schmitt J, Schlager C, et al. Topical treatments for scalp psoriasis. Cochrane Database Syst Rev. 2016.
(9) Rustin MHA. Long-term safety of biologics in the treatment of moderate-to-severe plaque psoriasis: review of current data. Br J Dermatol. 2012;167(S3):3-11.
(10) Ezzedine K, Eleftheriadou V, Whitton M, van Geel N. Vitiligo. Lancet. 2015;386(9988):74-84.
(11) Fitzpatrick TB. Mechanisms of phototherapy of vitiligo. Arch Dermatol. 1997;133:1591-2.
(12) Taïeb A, Picardo M. Vitiligo. N Engl J Med. 2009;360:160-9.
(13) Alikhan A, Felsten LM, Daly M, Petronic-Rosic V. Vitiligo: a comprehensive overview part I. Introduction, epidemiology, quality of life, diagnosis, differential diagnosis, associations, histopathology, etiology, and work-up. J Am Acad Dermatol. 2011;65:473-91.
(14) Zhang Y, Cai Y, Shi M, Jiang S, Cui S, Wu Y, et al. The prevalence of vitiligo: a meta-analysis. PLoS One. 2016;11(9):e0163806.
(15) Eczema Society of Canada. What is eczema? [Internet]. Keswick (ON): Eczema Society of Canada; 2019 [cited 2019 Jan 16]. Available from: https://eczemahelp.ca/about-eczema/
(16) Kim BS. Atopic dermatitis [Internet]. New York: Medscape; 2019 [cited 2019 Jan 16]. Available from: https://emedicine.medscape.com/article/1049085-overview
(17) Oyoshi MK, He R, Kumar L, Yoon J, Geha RS. Chapter 3: cellular and molecular mechanisms in atopic dermatitis. Adv Immunol. 2009;102:135-226.
(18) Lynde C, Barber K, Claveau J, Gratton D, Ho V, Krafchik B, et al. Canadian practical guide for the treatment and management of atopic dermatitis. J Cutan Med Surg. 2005;8 (Suppl 5):1-9.
(19) Dermatitis: diagnosis & treatment [Internet]. Cleveland (OH): Mayo Foundation for Medical Education and Research (MFMER); c1998-2019 [updated 2019 July 11; cited 2019 Jun 21]. Available from: https://www.mayoclinic.org/diseases-conditions/dermatitis-eczema/diagnosis-treatment/drc-20352386
(20) Eczema treatment [Internet]. Novato (CA): National Eczema Association; c2002-2019 [cited 2019 May 27]. Available from: https://nationaleczema.org/eczema/treatment

(21) Trautinger F. Phototherapy of cutaneous T-cell lymphomas. Photochem Photobiol Sci. 2018;17:1904-12.
(22) Ghazawi FM, Netchiporouk E, Rahme E, Tsang M, Moreau L, Glassman S, et al. Comprehensive analysis of cutaneous T-cell lymphoma (CTCL) incidence and mortality in Canada reveals changing trends and geographic clustering for this malignancy. Cancer. 2017;123:3550-67.
(23) National Cancer Institute. Mycosis fungoides (including Sézary syndrome) treatment (PDQ®)–patient version [Internet]. Bethesda (MD): U.S. Department of Health and Human Services; 2019 [cited 2019 May 27]. Available from: https://www.cancer.gov/types/lymphoma/patient/mycosis-fungoides-treatment-pdq
(24) Nakamura M, Farahnik B, Bhutani T. Recent advances in phototherapy for psoriasis. F1000Res. 2016;5(F1000 Faculty Rev):1-6.
(25) Singh RK, Lee KM, Jose MV, Nakamura M, Ucmak D, Farahnik B, et al. The patient's guide to psoriasis treatment. Part 1: UVB phototherapy. Dermatol Ther (Heidelb). 2016;6(3):307-13.
(26) Pugashetti R, Lim HW, Koo J. Broadband UVB revisited: is the narrowband UVB fad limiting our therapeutic options? J Dermatolog Treat. 2010;21(6):326-30.
(27) Ibbotson SH. A perspective on the use of NB-UVB phototherapy vs. PUVA photochemotherapy. Front Med. 2018;5:184.
(28) Koek MB, Buskens E, van Weelden H, Steegmans PH, Bruijnzeel-Koomen CA, Sigurdsson V. Home versus outpatient ultraviolet B phototherapy for mild to severe psoriasis: pragmatic multicentre randomised controlled non-inferiority trial (PLUTO study). BMJ. 2009;338:b1542.
(29) Cohen JL, Makino E, Sonti S, Mehta P. Synergistic combination of an in-office procedure and home regimen for the treatment of facial hyperpigmentation. J Clin Aesthet Dermatol. 2012;5(4):33-5.
(30) Patrizi A, Raone B, Ravaioli GM. Management of atopic dermatitis: safety and efficacy of phototherapy. Clin Cosmet Investig Dermatol. 2015;8:511-20.
(31) Kim EJ, Hess S, Richardson SK, Newton S, Showe LC, Benoit BM, et al. Immunopathogenesis and therapy of cutaneous T cell lymphoma. J Clin Invest. 2005;115(4):798-812.
(32) Hum M, Kalia S, Gniadecki R. Prescribing home narrowband UVB phototherapy: a review of current approaches. J Cutan Med Surg. 2018:1203475418800947.
(33) Medical devices active licence listing [Internet]. Ottawa: Health Canada; c2019 [cited 2019 June 22]. Available from: https://health-products.canada.ca/mdall-limh/dispatch-repartition.do?type=active
(34) Medical Advisory Secretariat. Ultraviolet phototherapy management of moderate-to-severe plaque psoriasis: OHTAC recommendation. Toronto (ON): The Secretariat; 2009.
(35) Ministry of Health and Long-Term Care. Schedule of benefits: physician services under the Health Insurance Act. Toronto (ON): Queen's Printer for Ontario; 2015. p. 746.
(36) Light therapy centre list [Internet]. Ajax (ON): The Dermatology Association of Ontario; c2013 [cited 2019 May 21]. Available from: http://www.daontario.com/light-therapy-centre-list-3.pdf
(37) Alberta health care insurance plan (AHCIP) [Internet]. Edmonton (AB): Government of Alberta; c2019 [cited 2017 Apr]. Available from: https://www.alberta.ca/ahcip.aspx
(38) Payment Schedule for insured services provided by a physician. Regina (SK): Saskatchewan Ministry of Health; 2015 Oct.
(39) Manitoba physician's manual [Internet]. Winnipeg (MB): Manitoba Ministry of Health; 2019 Apr 1. Available from: https://www.gov.mb.ca/health/documents/physmanual.pdf

(40) New Brunswick physicians' manual [Internet]. Fredericton (NB): New Brunswick Department of Health; 2015 Mar 3.
(41) Master agreement between The Medical Society of Prince Edward Island and The Government of Prince Edward Island and Health PEI [Internet]. Charlottetown (PE): Department of Health and Wellness, Prince Edward Island; 2019 Mar 31. Available from: https://www.princeedwardisland.ca/sites/default/files/publications/master_agreement.pdf
(42) MedicareMD. Ultraviolet light therapy panels are covered under Medicare part B [Internet]. Nashville (TN): MedicareMD; 2013 [cited 2019 May 21]. Available from: https://www.medicaremd.com/what-medicare-covers/ultraviolet-light-therapy-panels-are-covered-under-medicare-part-b.html
(43) Psoriasis: assessment and management. Clinical guideline CG153 [Internet]. London: National Institute for Health and Care Excellence; c2012 Oct [cited 2019 May 21]. Available from: https://www.nice.org.uk/guidance/cg153/chapter/1-Guidance#phototherapy-broad--or-narrow-band-uvb-light-and-puva
(44) McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS peer review of electronic search strategies: 2015 guideline statement. J Clin Epidemiol. 2016;75:40-6.
(45) Covidence systematic review software. Veritas Health Innovation. Melbourne (Australia). Available from: https://www.covidence.org/home.
(46) Higgins JPT, Sterne JAC, Savović J, Page MJ, Hróbjartsson A, Boutron I, et al. A revised tool for assessing risk of bias in randomized trials. In: Chandler J, McKenzie J, Boutron I, Welch V, editors. Cochrane Methods. London: Cochrane; 2016.
(47) Schünemann H, Brożek J, Guyatt G, Oxman A, editors. GRADE handbook [Internet]. Hamilton (ON): GRADE Working Group; 2013 [cited 2017 Dec]. Available from http://gdt.guidelinedevelopment.org/app/handbook/handbook.html.
(48) Moher D, Liberati A, Tetzlaff J, Altman DG, The PG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;6(7):e1000097.
(49) Koek MB, Buskens E, Steegmans PH, van Weelden H, Bruijnzeel-Koomen CA, Sigurdsson V. UVB phototherapy in an outpatient setting or at home: a pragmatic randomised single-blind trial designed to settle the discussion. The PLUTO study. BMC Med Res Methodol. 2006;6:39.
(50) Light treatment effectiveness (LITE) study [Internet]. Bethesda (MD): U.S. National Library of Medicine. c2018-19 [cited 2019 May 21]. Available from: https://clinicaltrials.gov/ct2/show/NCT03726489?term=home+ultraviolet+phototherapy&rank=1
(51) National Institute for Health and Care Excellence. Appendix I: Quality appraisal checklist—economic evaluations. 2012 [cited 2016 Jan]. In: Methods for the development of NICE public health guidance, 3rd ed [Internet]. London: The Institute. Available from: https://www.nice.org.uk/process/pmg4/chapter/appendix-i-quality-appraisal-checklist-economic-evaluations
(52) Koek MB, Sigurdsson V, van Weelden H, Steegmans PH, Bruijnzeel-Koomen CA, Buskens E. Cost effectiveness of home ultraviolet B phototherapy for psoriasis: economic evaluation of a randomised controlled trial (PLUTO study). BMJ. 2010;340:c1490.
(53) Yentzer BA, Gustafson CJ, Feldman SR. Explicit and implicit copayments for phototherapy: examining the cost of commuting. Dermatol Online J. 2013;19(6):18563.
(54) Yelverton CB, Kulkarni AS, Balkrishnan R, Feldman SR. Home ultraviolet B phototherapy: a cost-effective option for severe psoriasis. Manag Care Interface. 2006;19(1):33-6, 9.

(55) Vano-Galvan S, Garate MT, Fleta-Asin B, Hidalgo A, Fernandez-Guarino M, Bermejo T, et al. [Analysis of the cost effectiveness of home-based phototherapy with narrow-band UV-B radiation compared with biological drugs for the treatment of moderate to severe psoriasis]. Actas dermo-sifiliograficas. 2012;103(2):127-37.
(56) Thng TG, Theng C, Chang A. Bringing therapy to the patient: a study on the efficacy, compliance and cost-effectiveness of home-based phototherapy as opposed to institution-based phototherapy for the treatment of patients with focal Vitiligo. Ann Acad Med Singapore. 2015;44(10):S29.
(57) Staidle JP, Dabade TS, Feldman SR. A pharmacoeconomic analysis of severe psoriasis therapy: a review of treatment choices and cost efficiency. Expert Opin Pharmacother. 2011;12(13):2041-54.
(58) Mikhael D, Babcock K, DesGroseilliers JP. Cost comparison of psoriasis treatments. J Cutan Med Surg. 2009;13(6):303-7.
(59) Medical Advisory Secretariat. Ultraviolet phototherapy management of moderate-to-severe plaque psoriasis: an evidence-based analysis. Ontario Health Technology Assessment Series. 2009;9(27):1-66.
(60) Hyde K, Cardwell LA, Stotts R, Feldman SR. Psoriasis treatment cost comparison: biologics versus home phototherapy. Am J Pharm Benefits. 2018;10(1):18-21.
(61) Haykal KA, DesGroseilliers JP. Are narrow-band ultraviolet B home units a viable option for continuous or maintenance therapy of photoresponsive diseases? Journal of cutaneous medicine and surgery. 2006;10(5):234-40.
(62) Cameron H, Yule S, Dawe RS, Ibbotson SH, Moseley H, Ferguson J. Review of an established UK home phototherapy service 1998-2011: improving access to a cost-effective treatment for chronic skin disease. Public Health. 2014;128(4):317-24.
(63) Cameron H, Yule S, Moseley H, Dawe RS, Ferguson J. Taking treatment to the patient: development of a home TL-01 ultraviolet B phototherapy service. Br J Dermatol. 2002;147(5):957-65.
(64) Haykal KA, DesGroseilliers JP. Are narrow-band ultraviolet B home units a viable option for continuous or maintenance therapy of photoresponsive diseases? J Cutan Med Surg. 2006;10(5):234-40.
(65) Husereau D, Drummond M, Petrou S, Carswell C, Moher D, Greenberg D, et al. Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—explanation and elaboration: a report of the ISPOR health economic evaluation publication guidelines good reporting practices task force. Value Health. 2013;16(2):231-50.
(66) National Institute for Health and Care Excellence. Phototherapy for psoriasis - NICE pathways [Internet]. London (UK): National Institute for Health and Care Excellence; c2019 [cited 2019 Mar 20]. Available from: https://pathways.nice.org.uk/pathways/psoriasis#path=view%3A/pathways/psoriasis/phototherapy-for-psoriasis.xml&content=view-index
(67) Canadian Agency for Drugs and Technologies in Health. Guidelines for the economic evaluation of health technologies: Canada. 4th ed. Ottawa (ON): The Agency; 2017. p. 76.
(68) Statistics Canada. Tables 84-537-X life tables, Canada, provinces and territories [Internet]. Ottawa (ON): Statistics Canada; 2019 [cited 2019 Jul 23]. Available from: https://www150.statcan.gc.ca/n1/en/catalogue/84-537-X
(69) Canadian Psoriasis Guidelines Committee. Canadian guidelines for the management of plaque psoriasis [Internet]. Ottawa (ON): Canadian Psoriasis Guidelines Committee; 2009 [cited 2019 Apr 11]. Available from: https://www.dermatology.ca/wp-content/uploads/2012/01/cdnpsoriasisguidelines.pdf

(70) Langley RGB, Krueger GG, Griffiths CEM. Psoriasis: epidemiology, clinical features, and quality of life. Ann Rheum Dis. 2005;64(suppl 2):ii18-ii23.
(71) Kimball AB, Gauthier G, Hiscock R, Zhang HF. Psoriasis treatment patterns: phototherapy, oral nonbiologic, and biologic therapies. Am J Pharm Benefits. 2015;7(2):e44-e52.
(72) Hendrix N, Ollendorf DA, Chapman RH, Loos A, Liu S, Kumar V, et al. Cost-effectiveness of targeted pharmacotherapy for moderate to severe plaque psoriasis. J Manag Care Spec Pharm. 2018;24(12):1210-7.
(73) Menter A, Korman NJ, Elmets CA, Feldman SR, Gelfand JM, Gordon KB, et al. Guidelines of care for the management of psoriasis and psoriatic arthritis: section 6. Guidelines of care for the treatment of psoriasis and psoriatic arthritis: case-based presentations and evidence-based conclusions. J Am Acad Dermatol. 2011;65(1):137-74.
(74) Rajpara AN, O'Neill JL, Nolan BV, Yentzer BA, Feldman SR. Review of home phototherapy. Dermatol Online J. 2010;16(12):2.
(75) Institute for Clinical and Economic Review. Targeted immunomodulators for the treatment of moderate-to-severe plaque psoriasis: effectiveness and value [Internet]. Boston (MA): Institute for Clinical and Economic Review; 2016 [cited 2019 Apr 23]. Available from: https://icer-review.org/wp-content/uploads/2016/11/NE_CEPAC_Psoriasis_Evidence_Report_FINAL_012317.pdf
(76) Hearn RM, Kerr AC, Rahim KF, Ferguson J, Dawe RS. Incidence of skin cancers in 3867 patients treated with narrow-band ultraviolet B phototherapy. Br J Dermatol. 2008;159(4):931-5.
(77) Solarc Systems Inc. UV replacement bulbs for SolRx devices [Internet]. Minesing (ON): Solarc Systems Inc; c2018 [cited 2019 Mar 1]. Available from: https://solarcsystems.ca/en/products/bulbs/
(78) Daavlin. Phototherapy solutions for psoriasis, vitiligo, and other skin diseases [Internet]. Bryan (OH): Daavlin International; c2019 [cited 2019 Mar 27]. Available from: https://www.daavlininternational.com
(79) Canadian Built Home Phototherapy Equipment [Internet]. Minesing (ON): Solarc Systems Inc,; c1995-2018 [cited 2019 Mar 27]. Available from: https://solarcsystems.ca
(80) Papp K, Gulliver W, Lynde C, Poulin Y, Ashkenas J. Canadian guidelines for the management of plaque psoriasis: overview. J Cutan Med Surg. 2011;15(4):210-9.
(81) Canada Revenue Agency. Automobile allowance rates [Internet]. 2019 [cited 2019 Mar 1]. Available from: https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/payroll/benefits-allowances/automobile/automobile-motor-vehicle-allowances/automobile-allowance-rates.html
(82) Women's College Hospital. Women's College Hospital - parking & patient drop-off [Internet]. Toronto (ON): Women's College Hospital; c2019 [cited 2019 Jul 2]. Available from: https://www.womenscollegehospital.ca/patients-and-visitors/parking/
(83) Statistics Canada. Table 14-10-0018-01 labour force characteristics by sex and detailed age group, annual, inactive [Internet]. Ottawa (ON): Statistics Canada; 2019 [cited 2019 Jul 2]. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1410001801
(84) Statistics Canada. Table 14-10-0222-01 employment, average hourly and weekly earnings (including overtime), and average weekly hours for the industrial aggregate excluding unclassified businesses, monthly, seasonally adjusted [Internet]. Ottawa (ON): Statistics Canada; 2019 [cited 2019 Feb 26]. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410022201

(85) Krahn M, Miller F, Bayoumi A, Brooker AS, Wagner F, Winsor S, et al. Development of the Ontario decision framework: a values based framework for health technology assessment. Int J Technol Assess Health Care. 2018;34(3):290-9.
(86) TreeAge Software. TreeAge Pro 2019, R1 [Internet]. Williamstown (MA): TreeAge Software, Inc; c2019 [cited 2019 Feb 5]. Available from: https://www.treeage.com/
(87) Ministry of Health and Long-Term Care. Home oxygen therapy [Internet]. Toronto (ON): Queen's Printer for Ontario; 2019 [cited 2019 Mar 3]. Available from: https://www.ontario.ca/page/home-oxygen-therapy#section-4
(88) Franken SM, Vierstra CL, Rustemeyer T. Improving access to home phototherapy for patients with psoriasis: Current challenges and future prospects. Psoriasis: Targets and Therapy. 2016;6:55-64.
(89) Franken SM, Vierstra CL, Rustemeyer T. Improving access to home phototherapy for patients with psoriasis: current challenges and future prospects. Psoriasis (Auckl). 2016;6:55-64.
(90) Women's College Hospital. Psoriatic Arthritis (PsA) Clinic [Internet]. Toronto (ON): Women's College Hospital; [cited 2019 Apr 24]. Available from: https://www.womenscollegehospital.ca/programs-and-services/psoriatic-arthritis/
(91) Menter A, Korman NJ, Elmets CA, Feldman SR, Gelfand JM, Gordon KB, et al. Guidelines of care for the management of psoriasis and psoriatic arthritis: Section 5. Guidelines of care for the treatment of psoriasis with phototherapy and photochemotherapy. J Am Acad Dermatol. 2010;62(1):114-35.
(92) Ministry of Health and Long-Term Care. IntelliHealth [Internet]. Troonto (ON): Queen's Printer for Ontario; c2015 [cited 2019 Mar 20]. Available from: https://intellihealth.moh.gov.on.ca/
(93) Sutherland G, Dinh T. Understanding the gap: a pan-Canadian Analysis of Prescription Drug Insurance Coverage [Internet]. Ottawa (ON): Conference Board of Canada; 2017 [cited 2019 Mar 7]. Available from: http://innovativemedicines.ca/wp-content/uploads/2017/12/20170712-understanding-the-gap.pdf
(94) Ministry of Finance. 2019 Ontario Budget | Chapter 1C [Internet]. Toronto (ON): Queen's Printer for Ontario; 2019 [cited 2019 Jun 28]. Available from: http://budget.ontario.ca/2019/chapter-1c.html#s-14
(95) Barham L. Public and patient involvement at the UK National Institute for Health and Clinical Excellence. The patient. 2011;4(1):1-10.
(96) Messina J, Grainger DL. A pilot study to identify areas for further improvements in patient and public involvement in health technology assessments for medicines. The patient. 2012;5(3):199-211.
(97) Ontario Health Technology Advisory Committee Public Engagement Subcommittee. Public engagement for health technology assessment at Health Quality Ontario—final report from the Ontario Health Technology Advisory Committee Public Engagement Subcommittee [Internet]. Toronto (ON): Queen's Printer for Ontario; 2015 Apr [cited 2018 Apr 30]. Available from: http://www.hqontario.ca/Portals/0/documents/evidence/special-reports/report-subcommittee-20150407-en.pdf
(98) Selva A, Sola I, Zhang Y, Pardo-Hernandez H, Haynes RB, Martinez Garcia L, et al. Development and use of a content search strategy for retrieving studies on patients' views and preferences. Health Qual Life Outcomes. 2017;15(1):126.
(99) Koek MBG, Buskens E, van Weelden H, Steegmans PHA, Bruijnzeel-Koomen CAFM, Sigurdsson V. Home versus outpatient ultraviolet B phototherapy for mild to severe psoriasis: pragmatic multicentre randomised controlled non-inferiority trial (PLUTO study). BMJ. 2009;338:b1542.

(100) Kvale S. Interviews: an introduction to qualitative research interviewing. Thousand Oaks (CA): Sage; 1996.
(101) Kuzel AJ. Sampling in qualitative inquiry. In: Miller WL, Crabtree BF, editors. Doing qualitative research. Thousand Oaks (CA): Sage; 1999. p. 33-45.
(102) Morse J. Emerging from the data: cognitive processes of analysis in qualitative research. In: Morse J, editor. Critical issues in qualitative research methods. Thousand Oaks (CA): Sage; 1994. p. 23-41.
(103) Patton MQ. Qualitative research and evaluation methods. 3rd ed. Thousand Oaks (CA): Sage; 2002.
(104) Strauss AL, Corbin JM. Basics of qualitative research: techniques and procedures of developing a grounded theory. 2nd ed. Thousand Oaks (CA): Sage; 1998.
(105) Health Technology Assessment International. Introduction to health technology assessment [Internet]. Edmonton (AB): Health Technology Assessment International; 2015 [cited 2018 Apr 30]. Available from: http://www.htai.org/fileadmin/HTAi_Files/ISG/PatientInvolvement/v2_files/Resource/PCISG-Resource-Intro_to_HTA__KFacey__Jun13.pdf
(106) Strauss AL, Corbin JM. Grounded theory research: procedures, canons, and evaluative criteria. Qual Sociol. 1990;13(1):3-21.
(107) Strauss AL, Corbin JM. Grounded theory methodology: an overview. In: Denzin NK, Lincoln YS, editors. Handbook of qualitative research. Thousand Oaks (CA): Sage; 1994. p. 273-85.
(108) NVivo qualitative data analysis software. QSR International. Doncaster, Victoria (Australia). Available at: https://www.qsrinternational.com/nvivo/home.
(109) Gulliver WP, Randell S, Gulliver S, Gregory V, Nagle S, Chambenoit O. Biologic therapy utilization in patients with moderate to severe psoriasis and psoriatic arthritis: an observational summary of biologic therapy use in a clinical setting. J Cutan Med Surg. 2018;22(6):567-76.
(110) Saurat JH, Stingl G, Dubertret L, Papp K, Langley RG, Ortonne JP, et al. Efficacy and safety results from the randomized controlled comparative study of adalimumab vs. methotrexate vs. placebo in patients with psoriasis (CHAMPION). Br J Dermatol. 2008;158(3):558-66.
(111) Caproni M, Antiga E, Melani L, Volpi W, Del Bianco E, Fabbri P. Serum levels of IL-17 and IL-22 are reduced by etanercept, but not by acitretin, in patients with psoriasis: a randomized-controlled trial. J Clin Immunol. 2009;29(2):210-4.
(112) Reich K, Mrowietz U, Radtke MA, Thaci D, Rustenbach SJ, Spehr C, et al. Drug safety of systemic treatments for psoriasis: results from The German Psoriasis Registry PsoBest. Arch Dermatol Res. 2015;307(10):875-83.
(113) Institute for Clinical and Economic Review. Targeted immunomodulators for the treatment of moderate-to-severe plaque psoriasis: effectiveness and value: condition update [Internet]. Boston (MA): Institute for Clinical and Economic Review; 2018 [cited 2019 Mar 13]. Available from: https://icer-review.org/wp-content/uploads/2017/11/ICER_Psoriasis_Update_Draft_Report_04272018.pdf
(114) Ministry of Health and Long-Term Care. Ontario drug benefit formulary/comparative drug index [Internet]. Toronto (ON): Queen's Printer for Ontario. 2016. Available from: https://www.formulary.health.gov.on.ca/formulary

About Health Quality Ontario

Health Quality Ontario is the provincial lead on the quality of health care. We help nurses, doctors and other health care professionals working hard on the frontlines be more effective in what they do—by providing objective advice and data, and by supporting them and government in improving health care for the people of Ontario.

We focus on making health care more effective, efficient and affordable through a legislative mandate of:

- Reporting to the public, organizations, government and health care providers on how the health system is performing,
- Finding the best evidence of what works, and
- Translating this evidence into clinical standards, recommendations to health care professionals and funders, and tools that health care providers can easily put into practice to make improvements.

For more information about Health Quality Ontario, visit hqontario.ca.

Health Quality Ontario
130 Bloor Street West, 10th Floor
Toronto, Ontario
M5S 1N5
Tel: 416-323-6868
Toll Free: 1-866-623-6868
Fax: 416-323-9261
Email: EvidenceInfo@hqontario.ca
www.hqontario.ca

ISSN 1915-7398 (online)
ISBN TBA (PDF)