Published in final edited form as:

Br J Dermatol. 2020 January ; 182(1): 190–196. doi:10.1111/bjd.17941.

Health-related quality of life and economic implications of cutaneous T-cell lymphoma

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Abstract

Background: Cutaneous T-cell lymphoma (CTCL) has been associated with considerable physical, psychological, and financial burden in recent literature. Despite these findings, its impact on health-related quality of life (QoL) and economic cost have not been well-studied.

Objectives: To measure the overall QoL impact and financial burden of CTCL.

Methods: A cross-sectional survey of 67 adult CTCL patients was conducted at an academic medical center. Normative population data (N=3310) was obtained from the 2002–2003 Joint Canada/United States Survey of Health (JCUSH). QoL was measured using the Ontario Health Utilities Index Mark III (HUI3) questionnaire. Economic cost was estimated using quality-adjusted life year (QALY) loss derived from HUI3 scores.

Results: Compared to the U.S. general population, CTCL patients had significantly lower unadjusted aggregate HUI3 scores (0.68 vs 0.87, $p < 0.01$). Multivariable regression analysis controlling for demographics and comorbidities showed CTCL was associated with significantly poorer performance overall (–0.13) and in the domains of hearing (–0.04), speech (–0.03), ambulation (–0.04), dexterity (–0.02), emotion (–0.07), and pain (–0.07). These health utility decrements yielded an average lifetime loss of 1.47 QALYs per patient. Using a \$50,000/QALY willingness to pay threshold, CTCL was associated with a lifetime burden of \$73,389 per patient and a U.S. societal burden of \$2.84 billion.

Conclusions: These findings suggest CTCL has a pervasive impact on QoL, comparable to other debilitating conditions such as end-stage renal disease. Additionally, the substantial economic burden underscores the potential societal benefit of prompt diagnosis and aggressive management of CTCL.

Introduction

Cutaneous T-cell lymphoma (CTCL) is a primary cutaneous malignancy with an estimated incidence of approximately 6.4 cases per million persons in the United States.¹ Patients

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Conflicts of interest: None declared

diagnosed with CTCL often report physical and psychological distress related to pruritus, treatment side effects, financial burden, social consequences, and prognostic concerns.^{2–4} From a financial perspective, CTCL has also been associated with a higher annual incremental cost than any other skin disease,^{3,5} though the long-term economic burden of CTCL to patients and society at large remains to be quantified. Despite the potential for this condition to compromise various aspects of patient well-being, few studies have investigated the impact of CTCL on overall health-related quality of life (QoL).⁶

Previous studies have relied on survey instruments which are designed to measure QoL specifically in patients with skin disease or cancer. These disease-specific QoL instruments contain items which may be particularly relevant to the population of interest and are useful in determining risk factors for poor QoL within the population of interest. Thus, existing studies have focused on variations in QoL within the CTCL patient population, stratified by demographic and clinical characteristics. For instance, it has been suggested that predictors of poor QoL include female gender, Sézary syndrome subtype, advanced stage, and treatment with systemic steroids or interferon.^{2–4,7,8}

In contrast, disease-specific QoL instruments are less useful in comparing overall QoL in the population of interest to that of the age- and gender-matched general population or other chronic disease states. In order to quantify, interpret, and compare the overall impact of CTCL on QoL, it is necessary to use a generic health utility instrument. Health utilities are a measure of preference for various health states. A lower health utility score means that compared to living a given amount of time in perfect health, a patient would have to be allowed to live a longer amount of time in the current state of health in order to be equally preferable. Health utility scores are easily compared between populations and can be used to calculate quality-adjusted life years (QALYs), which in turn can be used to estimate the economic cost of disease and cost-effectiveness of treatment.⁹ Given the unique advantages of generic health utility instruments, we designed a study utilizing the Ontario Health Utilities Index Mark III (HUI3) instrument. The purpose of this study is to quantify the health utility decrement associated with CTCL in order to add to existing knowledge about the QoL impact of the disease and to calculate the lifetime financial burden for individual CTCL patients and the United States healthcare system.

Materials and Methods

Recruitment and Data Collection

Approval for this study was obtained from the Institutional Review Board at Washington University in St. Louis. Eligible participants were English-speaking adults who presented to the dedicated CTCL clinic between July 6, 2017 and November 28, 2017.

Participants were asked to complete a paper-based version of the Health Utilities Index Mark 3 (HUI3) questionnaire. The HUI3 is a 15-item, population-based, validated health utility instrument that measures the respondent's general health status and quality of life along 8 specific domains of function: vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain.¹⁰ It has been widely used in quality of life and economic analyses of numerous cancers and chronic diseases.^{11–16} Each participant's individual domain and

overall health utility scores were calculated according to the published methods for HUI3 data analysis. HUI3 scores range from 1 (“perfect health”) to 0 (“death”) on the individual domains and 1 (“perfect health”) to - 0.36 (a state “worse than death”) on the overall index.¹⁰ The unit for health utility is the quality-adjusted life year (QALY).

Normative data from the general US population was collected from the 2002–2003 Joint Canada/United States Survey of Health (JCUSH), a cross-sectional random-digit-dialed telephone survey which includes the HUI3.¹⁷ Of the 8,145 individuals who participated in JCUSH, 5,859 lived in the U.S. Among these participants, we excluded those who were less than 21 years of age, did not complete the HUI3, or were missing data on history of stroke, depression, cardiovascular disease, hypertension, arthritis, or smoking. The remaining general population sample size was 3,310.

Patient demographics, CTCL stage, and medical comorbidity data were collected from each patient’s clinical records. In the normative population, history of smoking was defined in JCUSH as smoking greater than 100 cigarettes in one’s lifetime.¹⁸ Hypertension was determined in JCUSH based on the question “Have you ever been told by a doctor or other health professional that you have high blood pressure, also called hypertension?” Cardiovascular disease was assessed by the question “Have you ever been told by a doctor or other health professional that you have heart disease?” History of stroke was determined in JCUSH based on the question “What condition or health problem causes you to have difficulty?” with the patient’s answer as “Stroke problem.” Depression was evaluated based on the question “during the past 12 months, was there ever a time when you felt sad, blue, or depressed for 2 weeks or more in a row?” Arthritis was defined based on the question “have you ever been told by a doctor or other health professional that you have arthritis, not including fibromyalgia?”¹⁸

Statistical analysis

Baseline demographic and medical history factors (Table 1) were characterized by mean and standard error for continuous variables and by frequency distributions and percentage of total for categorical variables. Baseline differences in health utilities were explored using a multivariable generalized linear model, allowing for response variables that have both Gaussian and non-Gaussian distributions. Covariates included demographic (age, gender, race, marital status) and clinical characteristics (history of smoking, hypertension, cardiovascular disease, stroke, depression, arthritis). STATA 13 (Stata Corp, College Station, TX) was used for all statistical analyses.

Economic Analysis

Total individual QALYs lost due to CTCL were calculated and averaged across all study patients by compounding the yearly adjusted health utility loss associated with CTCL across an individual’s remaining life expectancy stratified by disease stage.¹⁹ A discount rate of 3% was utilized in all base QALY estimates based on the government’s borrowing rate.²⁰ The discount rate is the factor by which individuals preferentially value costs and benefits incurred in the present to those incurred in the future. A 3% discount rate implies that the

magnitude of the QALY loss associated with CTCL will decrease each year by a factor of 1/1.03 of the prior year's value.

A societal perspective analysis was performed to calculate the overall economic burden of CTCL using a widely accepted \$50,000 willingness to pay (WTP) threshold to gain one QALY.²¹ The economic burden associated with QALY loss in our CTCL patient sample was then generalized to the overall susceptible U.S. adult population using estimated CTCL prevalence and U.S. census data. CTCL prevalence was calculated based on the literature-derived incidence of 6.4 cases per 1,000,000 persons and a stage-weighted average years to life expectancy of 18.7 years.^{1,19}

Base case results were calculated for each age group using a 3% discount rate, a \$50,000 WTP threshold, a weighted CTCL prevalence of 120 per 1,000,000 persons, and an annual health utility decrease of 0.12, equivalent to the CTCL coefficient derived from the adjusted generalized linear model of overall HUI3 score. Sensitivity analyses were performed by varying these four parameters.

Results

Among 80 consecutive CTCL patients, 3 were not recruited due to mental status or language barrier preventing completion of the study questionnaire. Of the 77 eligible patients, 5 declined participation. Five of the 72 patients who consented did not ultimately complete the questionnaire. Thus, the final study sample consisted of the 67 patients. Baseline demographic characteristics and comorbidity status of the study population and general population (n=3,310) are presented in Table 1. Among the CTCL patients, 47.8% were female and 80.6% were non-Hispanic white. Ages ranged from 24 to 90 years, with a mean age of 65 (SD 12.8) years, and the mean time elapsed since definitive diagnosis of CTCL was 7 months (SD 15). Compared to the CTCL patient population at large, the age distribution was similar, although females were overrepresented in the study sample.²²

Mean overall HUI3 scores were compared between CTCL patients and the general population as shown in Table 1. The mean overall HUI3 score in the study population was significantly lower than that of the general population (0.68 vs. 0.87, respectively; $p<0.01$). Overall HUI3 scores were generally lower in the CTCL population across age, gender, race, income, and marital status strata. Mean scores in each functional domain were also reduced in the CTCL patients, as shown in Table 2. Compared to the general population, the study population exhibited significant health utility reductions in the domains of hearing (0.93 vs. 0.98, respectively), speech (0.97 vs. 1.0, respectively), ambulation (0.89 vs. 0.97, respectively), dexterity (0.96 vs. 0.99, respectively), emotion (0.90 vs. 0.97, respectively), and pain (0.83 vs. 0.93, respectively).

A multivariable linear regression model illustrating the association between overall HUI3 score, CTCL, and demographic and medical history variables is presented in Table 3. All models were adjusted for age, gender, race, income category, marital status, current or past smoking status, and history of hypertension, cardiovascular disease (including angina, coronary artery disease, myocardial infarction, or congestive heart failure), stroke,

depression, and, arthritis. CTCL was associated with a significant reduction in overall HUI3 score by 0.13 points compared to the general population (95% CI -0.18 to -0.09 , $p<0.01$). Other factors associated with a significant decrease in overall health utility included increasing age (-0.01 , $p=0.03$), estimated income less than \$40,000 (-0.04 , $p<0.01$), widowed marital status (compared to single reference group; -0.05 , 95% CI -0.08 to -0.02 , $p<0.01$), hypertension (-0.02 , $p<0.01$), stroke (-0.34 , 95% CI -0.41 to -0.26 , $p<0.01$), depression, (-0.19 , 95% CI -0.21 to -0.17 , $p<0.01$), cardiovascular disease (-0.10 , 95% CI -0.12 to -0.07 , $p<0.001$), arthritis (-0.12 , 95% CI -0.014 to -0.10 , $p<0.01$), and smoking (-0.02 , 95% CI -0.03 to -0.01 , $p<0.01$).

Similar multivariable linear regression models were performed to assess the association between CTCL and individual HUI3 domains is shown in Table 4. CTCL was associated with a significant decline in all functional domains except for vision and cognition. The affected domains included hearing (-0.04 , 95% CI -0.07 to -0.02 , $p<0.01$), speech (-0.03 , 95% CI -0.04 to -0.03 , $p<0.01$), ambulation (-0.03 , 95% CI -0.06 to 0.00 , $p=0.03$), dexterity (-0.02 , 95% CI -0.04 to 0.00 , $p=0.02$), emotion (-0.06 , 95% -0.08 to -0.03 , $p<0.01$), and pain (-0.05 , 95% CI -0.11 to 0.00 , $p=0.04$).

The health utility decline associated with CTCL was used to calculate the economic burden of the disease in the U.S. The steps required to perform this calculation are represented in Table 5. A CTCL prevalence of 120 cases per million persons was calculated by multiplying an incidence of 6.4 cases per million persons by the stage-weighted average survival times.^{1,19} Applying U.S. Census data, 38,765 persons were estimated to be living with CTCL.²³ Given an annual health utility loss of 0.13 at a discount rate of 3% across the years to life expectancy, CTCL was found to be responsible for an average loss of 1.47 QALYs per patient, or 56,899 QALYs for the entire U.S. CTCL patient population. Using a highly conservative WTP threshold of \$50,000 per QALY, this corresponds to an individual CTCL patient burden of \$73,389 and a societal burden of \$2.84 billion.²¹ Sensitivity analyses were performed for discount rate range of 0–6%, annual HUI loss of 0.08–0.18, CTCL prevalence of 60 to 180 cases per million persons, and WTP threshold of \$25,000–\$75,000 per QALY. The widest economic burden ranges found by these analyses were \$36,695–\$110,084 individually and \$1.42–\$4.27 billion societally, sensitive to changes in WTP threshold.

Discussion

The results suggest that CTCL in adults is strongly associated with poor QoL outcomes. The mean overall HUI3 score in our CTCL patient population was 0.68, which corresponds to severe disability.²⁴ This is greater than the level of QoL impairment associated with hemodialysis (0.73),¹⁴ diabetes mellitus (0.78),¹⁶ and the all-cancer patient population (0.78).¹⁶ In contrast, it is not as large as the QoL decline associated with osteoarthritis (0.46),¹² stroke (0.60),¹⁵ or heart failure with an implantable cardioverter defibrillator (0.64).¹³ Further, CTCL was found to have an independent influence on QoL after adjusting for age, gender, race, income, marital status, and history of hypertension, stroke, depression, and arthritis. In fact, CTCL was associated with the third largest QoL decrement of all variables considered, behind only stroke and depression.

As anticipated, CTCL was associated with a large health utility decrement in the emotional domain. Previous studies have shown that CTCL is associated with decreased psychological well-being, especially in patients with advanced-stage disease.^{3,8} CTCL patients frequently report embarrassment, frustration, depression, anxiety, and fear of death.³ Self-consciousness about rash appearance or scratching behavior may lead to social withdrawal and impaired sexual activity. Social support has been shown to be an important factor in the emotional well-being of patients with cancer²⁵ or chronic skin diseases,²⁶ and CTCL patients who are reluctant to be around other people may be particularly susceptible to poor coping.

The results also confirmed our expectation that CTCL patients would experience a substantial reduction in health utility in the pain domain. The majority of patients with CTCL experience pruritus, which is often severe and distressing enough to be perceived as pain.^{2,27–29} Because there are no HUI3 items that specifically address pruritus, it is likely that this common symptom is reflected by the pain domain score. Treatments aimed at controlling CTCL have had variable success in reducing itching,^{29–31} and patients may report symptomatic pruritus even when the skin appears to be clear.³¹ Thus, refractory pruritus can be not only physically uncomfortable but psychologically upsetting. Pruritus has similarly been associated with reduced QoL in patients with psoriasis and atopic dermatitis, and in the atopic dermatitis population, it has been independently associated with psychological distress.²⁶ These results highlight the importance of finding effective treatments specifically for pruritus in order to maximize QoL in the CTCL patient population.

Additionally, we found a significant decline in ambulation and dexterity among CTCL patients. These effects likely vary based on the body areas involved, though we did not have a large enough sample size to conduct sub-analyses by anatomical location. Patients with lower extremity disease may experience difficulty ambulating, and involvement of the soles of the feet may even result in some patients becoming wheelchair-bound. Similarly, dexterity may be particularly reduced in cases of hand involvement. Ambulation and dexterity could also be compromised in cases of peripheral neuropathy, which has been associated with certain chemotherapeutic agents including brentuximab,³² and rarely with the disease itself.³³ Finally, health utility in the domains of hearing and speech were found to be significantly reduced in association with CTCL. The mechanism for these findings is unclear.

Though not specifically addressed by the HUI3 questionnaire, financial stress is another commonly reported concern among CTCL patients.³ In cancer survivors, financial hardship related to cancer treatment has been strongly associated with poor QoL outcomes in physical, emotional, and social domains.³⁴ CTCL patients may incur substantial direct and indirect expenses of treatment, such as transportation to medical appointments and light therapy sessions, and they may be forced to take time off from work as a result of their therapeutic regimen or severe symptoms. The individual annual cost of CTCL has been previously estimated as \$3,948.⁵ In this context, our estimate of \$73,389 over the lifetime of an individual patient would have to correspond to an average life expectancy of 18.6 years after CTCL diagnosis. In fact, the stage-weighted CTCL-specific life expectancy in our patient population was 18.7 years.¹⁹ Thus, our individual lifetime economic burden estimate

is fairly consistent with this recent annual estimate. Despite its relatively low prevalence, CTCL is also associated with a sizable lifetime financial burden to the U.S. overall (\$2.84 billion), suggesting that improvements in CTCL management have the potential to result in considerable societal benefit.

The generalizability of this study is limited by its single-institutional design. Relatively small sample size precluded sub-analyses by clinical characteristics such as stage and treatment regimen, which have previously been shown to be significant predictors of QoL.^{3,8} Based on the most advanced stage documented since time of diagnosis, there were 45 patients with early disease (stage IA-IIA) and 22 patients with advanced disease (stage IIB-IVB). Despite the low absolute number of patients with advanced CTCL, these patients constituted 31.3% of our study sample, which is similar to the early- versus advanced-stage distribution in the overall CTCL patient population.¹⁹ Further, the cross-sectional nature of this study did not allow us to trend QoL with treatment over time. Finally, the HUI3 is a generic health utility instrument which is not designed to evaluate aspects of QoL that may be of particular significance in the CTCL population. Unlike many other types of cancer and chronic skin diseases, there is currently no validated CTCL-specific QoL questionnaire.^{35–37} The advantage of our decision to use the HUI3, rather than a cancer- or skin-directed questionnaire, is that it facilitates comparison of health utility in the CTCL patient population to that of other populations, and allows for calculation of economic burden.

Conclusions

The CTCL patient population has significantly reduced overall health-related QoL compared to the general U.S. population. The largest CTCL-associated QoL reductions are seen in the domains of emotion and pain. Additionally, significant deficits are apparent in the domains of hearing, speech, ambulation, and dexterity. These findings suggest that CTCL is associated with a profound decline in QoL and individual financial burden akin to other debilitating chronic diseases. Further, the total U.S. economic burden of CTCL demonstrates the potential societal benefits of prompt diagnosis and effective management of this condition.

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What's known/what's new:

- Cutaneous T-cell lymphoma is associated with physical, psychological, and financial burden.
- The overall quality of life impact of cutaneous T-cell lymphoma has not previously been measured using a generic health utility instrument.
- In this study, we compare the overall quality of life burden of cutaneous T-cell lymphoma to that of other populations and calculate the economic burden of the disease.

Table 1.

Quality of life attainment in patients with CTCL by demographic and medical history factors.

Characteristic	CTCL (n=67)		General Population (n=3310)	
	N (%)	HUI3 Mean (SE)	N (%)	HUI3 Mean (SE)
Gender				
Male	35 (52.2)	0.71 (0.26)	1476 (44.6)	0.88 (0.20)
Female	32 (47.8)	0.65 (0.33)	1834 (55.4)	0.85 (0.23)
Age				
21–29 years	1 (1.5)	0.67 (0.00)	442 (13.4)	0.91 (0.17)
30–39 years	1 (1.5)	0.92 (0.00)	728 (22.0)	0.91 (0.16)
40–49 years	6 (9.0)	0.72 (0.26)	778 (23.5)	0.88 (0.19)
50–59 years	12 (17.9)	0.63 (0.42)	601 (18.2)	0.84 (0.23)
60–69 years	24 (35.8)	0.75 (0.22)	389 (11.8)	0.83 (0.24)
70–79 years	16 (23.9)	0.68 (0.29)	266 (8.0)	0.78 (0.26)
≥80 years	7 (10.4)	0.48 (0.29)	106 (3.2)	0.70 (0.31)
Race				
Non-Hispanic White	54 (80.6)	0.72 (0.27)	2517 (76.0)	0.87 (0.21)
Non-Hispanic Black	12 (17.9)	0.50 (0.35)	242 (7.3)	0.82 (0.27)
Hispanic	1 (1.5)	0.97 (0.00)	332 (10.0)	0.85 (0.22)
Asian	NA	NA	94 (2.8)	0.91 (0.15)
Other	NA	NA	125 (3.8)	0.85 (0.22)
Annual Household income				
<\$40,000	11 (16.4)	0.51 (0.37)	1336 (40.4)	0.80 (0.26)
\$40,000–\$80,000	47 (70.1)	0.72 (0.26)	1213 (36.6)	0.90 (0.17)
≥\$80,000	9 (13.4)	0.66 (0.32)	761 (23.0)	0.93 (0.13)
Marital Status				
Single	11 (16.4)	0.69 (0.34)	543 (16.4)	0.88 (0.19)
Married	48 (71.6)	0.71 (0.27)	1955 (59.1)	0.89 (0.19)
Widowed	7 (10.4)	0.53 (0.40)	267 (8.1)	0.73 (0.30)
Divorced	1 (2.5)	0.45 (0.00)	542 (16.4)	0.83 (0.24)
Smoking				
Yes	9 (13.4)	0.78 (0.22)	1601 (48.4)	0.84 (0.23)
No	58 (86.6)	0.67 (0.30)	1709 (51.6)	0.89 (0.18)
Hypertension				
Yes	40 (59.7)	0.62 (0.30)	814 (24.6)	0.79 (0.28)
No	27 (40.3)	0.77 (0.27)	2496 (75.4)	0.89 (0.18)
Cardiovascular disease				
Yes	15 (22.4)	0.66 (0.24)	219 (6.6)	0.66 (0.32)
No	52 (77.6)	0.69 (0.31)	3090 (93.4)	0.88 (0.19)
Stroke				
Yes	5 (7.5)	0.55 (0.11)	18 (0.5)	0.30 (0.26)
No	62 (92.5)	0.69 (0.30)	3292 (99.5)	0.87 (0.21)

Characteristic	CTCL (n=67)		General Population (n=3310)	
	N (%)	HUI3 Mean (SE)	N (%)	HUI3 Mean (SE)
Depression/Anxiety				
Yes	7 (10.4)	0.65 (0.32)	379 (11.5)	0.66 (0.32)
No	60 (89.6)	0.68 (0.29)	2931 (88.5)	0.89 (0.18)
Arthritis				
Yes	22 (32.8)	0.63 (0.25)	687 (20.8)	0.71 (0.29)
No	45 (67.2)	0.70 (0.31)	2623 (79.2)	0.90 (0.16)

Abbreviations: HUI3, Health Utilities Index Mark III; SE, Standard Error; NA, Not Applicable.

Table 2.

Mean unadjusted HUI3 domain and overall scores for participants with CTCL and the general population.

Domain	Vision	Hearing ^a	Speech ^a	Ambulation ^a	Dexterity ^a	Emotion ^a	Cognition	Pain ^a	Overall ^a
Patients	0.96	0.93	0.97	0.89	0.96	0.90	0.93	0.83	0.68
Controls	0.96	0.98	1.00	0.97	0.99	0.97	0.95	0.93	0.87

^aDenotes p-value <0.05

Table 3.

Multivariable adjusted generalized linear model on the association of overall HUI3 score with CTCL.

Health Utilities Index Mark III Overall Score			
Variable	Coefficient	95% Confidence Interval	p-value
CTCL	-0.13	-0.18, -0.09	<0.01
Female	0.00	-0.01, 0.02	0.64
Age	-0.01	-0.01, 0.00	0.03
Race			
Non-Hispanic White	ref [‡]	ref [‡]	ref [‡]
Non-Hispanic Black	-0.03	-0.05, 0.01	0.02
Hispanic	-0.02	-0.04, 0.00	0.12
Asian	-0.02	-0.05, 0.02	0.40
Other	0.01	-0.03, 0.04	0.76
Income			
<\$40,000	ref [‡]	ref [‡]	ref [‡]
\$40,000-\$80,000	0.04	0.03, 0.06	<0.01
>=\$80,000	0.06	0.05, 0.08	<0.01
Marital Status			
Single	ref [‡]	ref [‡]	ref [‡]
Married	0.00	-0.02, 0.02	0.87
Widowed	-0.05	-0.08, -0.02	<0.01
Divorced	-0.01	-0.03, 0.02	0.65
Hypertension	-0.02	-0.04, 0.01	<0.01
Smoking	-0.02	-0.03, -0.01	<0.01
Cardiovascular disease	-0.10	-0.12, -0.07	<0.01
Stroke	-0.34	-0.41, -0.26	<0.01
Depression	-0.19	-0.21, -0.17	<0.01
Arthritis	-0.12	-0.14, -0.10	<0.01

[‡]Reference group

Table 4.

Multivariable adjusted generalized linear models on the association of CTCL with individual HUI3 domains

Outcome Variable ^a	Coefficient	95% Confidence Interval	p-value
Vision	0.01	−0.01, 0.02	0.48
Hearing	−0.04	−0.06, −0.01	<0.01
Speech	−0.03	−0.04, −0.02	<0.01
Ambulation	−0.04	−0.07, −0.02	<0.01
Dexterity	−0.02	−0.04, −0.01	<0.01
Emotion	−0.07	−0.09, −0.05	<0.01
Cognition	−0.01	−0.04, 0.02	0.47
Pain	−0.07	−0.12, −0.02	<0.01

Abbreviations: HUI3, Health Utilities Index Mark III.

^a All models adjusted for age, gender, race, income category, marital status, smoking status, and history of hypertension, cardiovascular disease, stroke, depression, and arthritis.

Table 5.

Economic burden of CTCL and sensitivity analyses

Base Case							
	CTCL Prevalence ^a	Affected Population ^b	Average QALYs Lost ^c	Population QALYs Lost ^d	\$/QALY ^e	Individual Burden ^f	Societal Burden (billions) ^g
	0.000120	38,765	1.47	52,899	\$50,000	\$73,389	\$2.84
Sensitivity Analysis							
	Base Estimate	Range of Estimate	Individual Burden	Societal Burden			
Variables							
Discount rate	3%	0–6	\$59,407-\$94,672	\$2.30-\$3.67			
Annual HUI Loss	0.12	0.08–0.18	\$47,470-\$99,308	\$1.84-\$3.85			
Average Prevalence	0.000120	0.00006–0.00018	Unchanged	\$1.42-\$4.27			
\$/QALY	\$50,000	\$25,000-\$75,000	\$36,695-\$110,084	\$1.42-\$4.27			

Abbreviations: CTCL, cutaneous T-cell lymphoma; QALY, quality-adjusted life year; HUI, Health Utilities Index.

^aUsing literature-derived CTCL incidence of 6.4 per million¹ multiplied by stage-weighted average years to life expectancy¹⁹

^bDerived using 2016 US Census data stratified by age; www.census.gov

^cUsing an annual health-utility loss of 0.13 at a discount rate of 3% across the years to life expectancy in the CTCL study group

^dProduct of discounted average QALYs lost and affected population

^eUsing highly conservative willingness to pay (WTP) thresholds²¹

^fLifetime economic burden of CTCL per affected individual, product of population QALYs lost and \$/QALY divided by affected population.

^gLifetime societal burden of CTCL, product of population QALYs lost and \$/QALY.