User Guide

Personal Support Worker Microsimulation Model

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Health Workforce Canada | Effectif de la santé Canada

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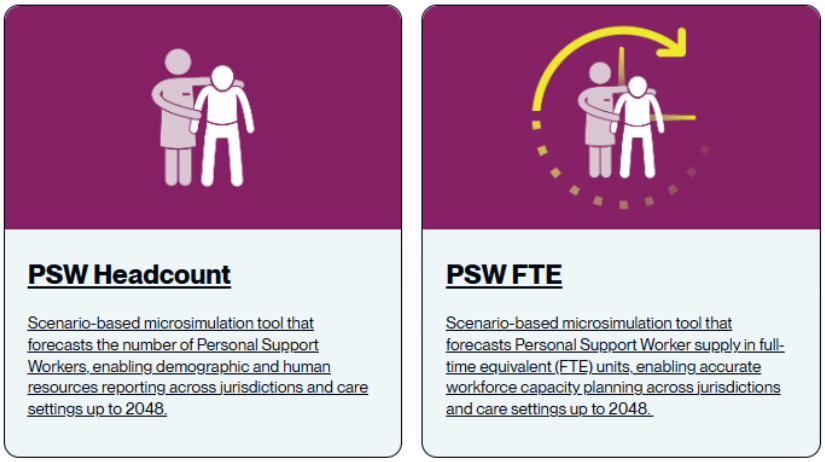
1. Introduction

1.1 Purpose of the Tool

Health Workforce Canada's (HWC) Personal Support Worker Microsimulation Modelling Tool is designed to support evidence-informed workforce planning by forecasting the possible supply of personal support workers (PSWs) across Canada up to the year 2050. This interactive, web-based tool allows users to explore various supply and demand scenarios by adjusting key parameters such as population projection scenarios and the rates of PSW employment in three broad health care delivery settings across Canadian jurisdictions. The tool offers two output versions to accommodate different planning needs: one that generates forecasts in full-time equivalents (FTEs) for capacity planning, and another that provides headcount projections for service capacity. The primary objective of the tool is to provide planners, policymakers, and stakeholders with a flexible resource for testing the implications of different workforce strategies and demographic changes on the availability of PSWs.



1.2 Overview of the PSW Workforce in Canada

PSWs are essential health providers in Canada's health system, delivering frontline support in long-term care homes, hospitals, home, and other care settings. With an estimated workforce of over 300,000 individuals (Kralj, et al., 2024), PSWs represent a significant portion of the health care sector. The demand for PSWs is projected to rise steadily in response to Canada's rapidly aging population, particularly among those aged 75 years and older.

Despite their importance, PSWs are an unregulated profession and operate under different names across jurisdictions, can integrate into the workforce using a range of educational qualifications, and are represented by inconsistent occupational

classification codes in administrative databases, making workforce planning more complex. This tool helps address these challenges by introducing a transparent methodology that supports standardization and open-source code for a scalable approach to PSW modelling.

1.3 Key Features of the Tool

Interactive Parameter Adjustments: Users can select from ten population projection scenarios and adjust PSW per 100 persons rates by province/territory and care setting.

Complementary Workforce Metrics: This tool provides PSW supply and demand forecasts in both FTEs for capacity planning, as well as headcounts for service capacity, allowing users to select the metric most relevant to their planning needs. Standardized estimates, adjusted per capita, are available for both FTEs and headcounts.

Stratification by Care Setting: Historical and projected values are available across three distinct care settings: residential care (RC), encompassing long-term care services provided in residential facilities, where individuals live while receiving daily living support and healthcare; home care (HC), involving healthcare and supportive services delivered in a person's own residence; and hospital care (HS), referring to health services provided within hospital settings, primarily for acute medical conditions requiring short-term treatment.

Real-Time Simulations: This tool dynamically updates projections based on user-selected parameter settings, offering immediate insights into workforce trends.

Data-Driven Forecasting: Built using a microsimulation methodology (see *Section 3. Understanding the Microsimulation Model* for more details), the tool integrates Labour Force Survey data and Statistics Canada projections to generate robust estimates.

Export Capabilities: Users can download outputs such as customized charts, data tables, and model code for further analysis and documentation.

Publicly Accessible: Hosted on HealthWorkforce.ca, this tool promotes transparency and accessibility for both experts and non-experts.

1.4 Scope and Limitations

This version of the model focuses specifically on forecasting the number of PSWs needed based on population trends among Canadians aged 75 and older. It includes data disaggregated by province, territory, and care setting (home care, hospitals, residential care). The model's source code, data, and methodology are available to anyone wishing to further develop the tool on their own.

2. Getting Started

The PSW Microsimulation Modelling Tool is publicly accessible at HealthWorkforce.ca (or its French counterpart, Effectifdelasante.ca). No login or special software is required: users only need an internet connection and a modern web browser (e.g., Chrome, Firefox, Safari) to access the tool.

To launch the tool:

1. Visit **HealthWorkforce.ca**.
2. On the top menu bar, click **Data & Insights.**
3. Then click **Modelling & Forecasting**.
4. Select the version of the model you wish to explore **PSW FTE** or **PSW Headcount**.

Upon launch, users are directed to an interactive parameter table where they can begin exploring scenarios.

2.1 Using the Tool

The user interface is designed to be intuitive and accessible for both technical and non-technical users. It consists of three main sections: **Parameters**, **Outputs**, and **Visualizations**.

2.1.1 Parameter Section Layout

This section allows users to adjust the three key variables that direct the real-time simulation. The image below shows the tool's customizable elements.

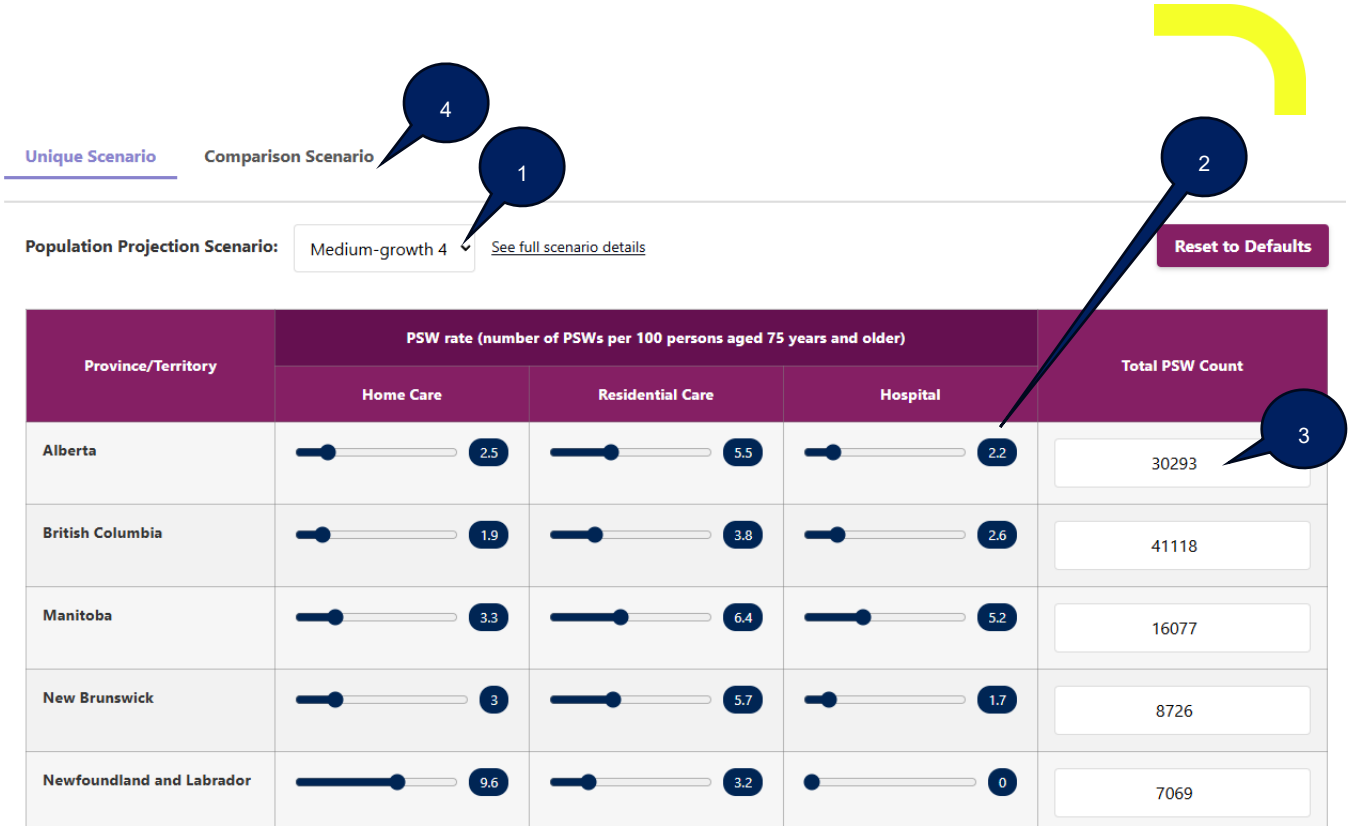


***Figure A**: Parameter settings*

- **Population Projection Scenario (*#1 in* Figure A)**: Choose from 10 population projection scenarios developed by Statistics Canada (e.g., slow growth, medium growth, high growth, slow aging, fast aging). Medium-growth 4 is the currently recommended baseline scenario. To see a description of each scenario, hover over "*See full scenario details*". A detailed description of each scenario is available in *Section 2.2.1.2 Total Workforce Adjustments*.

- **PSW Rate per 100 Canadians 75 years and older (*#2 in* Figure A)**: Adjust rates within each care setting (home care, residential care, hospital) of the provinces and territories. This modification will automatically update the total PSW count for the associated province or territory. The default rates are based on the annualized counts and the care setting estimates of PSWs released by Statistics Canada's Labour Force Survey for 2024/25.

- **Total PSW Count (*#3 in* Figure A)**: Users can also modify the default 2024/25 total count of PSWs in a province or territory. Modifying this parameter will automatically and proportionally increase or decrease the PSW rates (using the default setting) for the associated province or territory and care setting. Total PSW counts for each province reflect the annualized estimates released by Statistics Canada's for the Labour Force Survey for 2024/25.

  To return all user-modifiable parameter inputs to their original values, simply click the "**Reset to Defaults**" button. If you wish to create a new set of comparisons, refresh the browser page. Warning, this action will delete all current results.

Note, parameter selection for the FTE and headcount microsimulation models works in the same way as for the headcount model.

2.1.2 Outputs

Once the parameters have been set, click the "**Run Simulation**" button to generate the updated projections. The principal outputs include a customizable chart and their underlying data points. The following chart will be populated (see ***Error! Reference source not found.***) following a unique scenario simulation run.

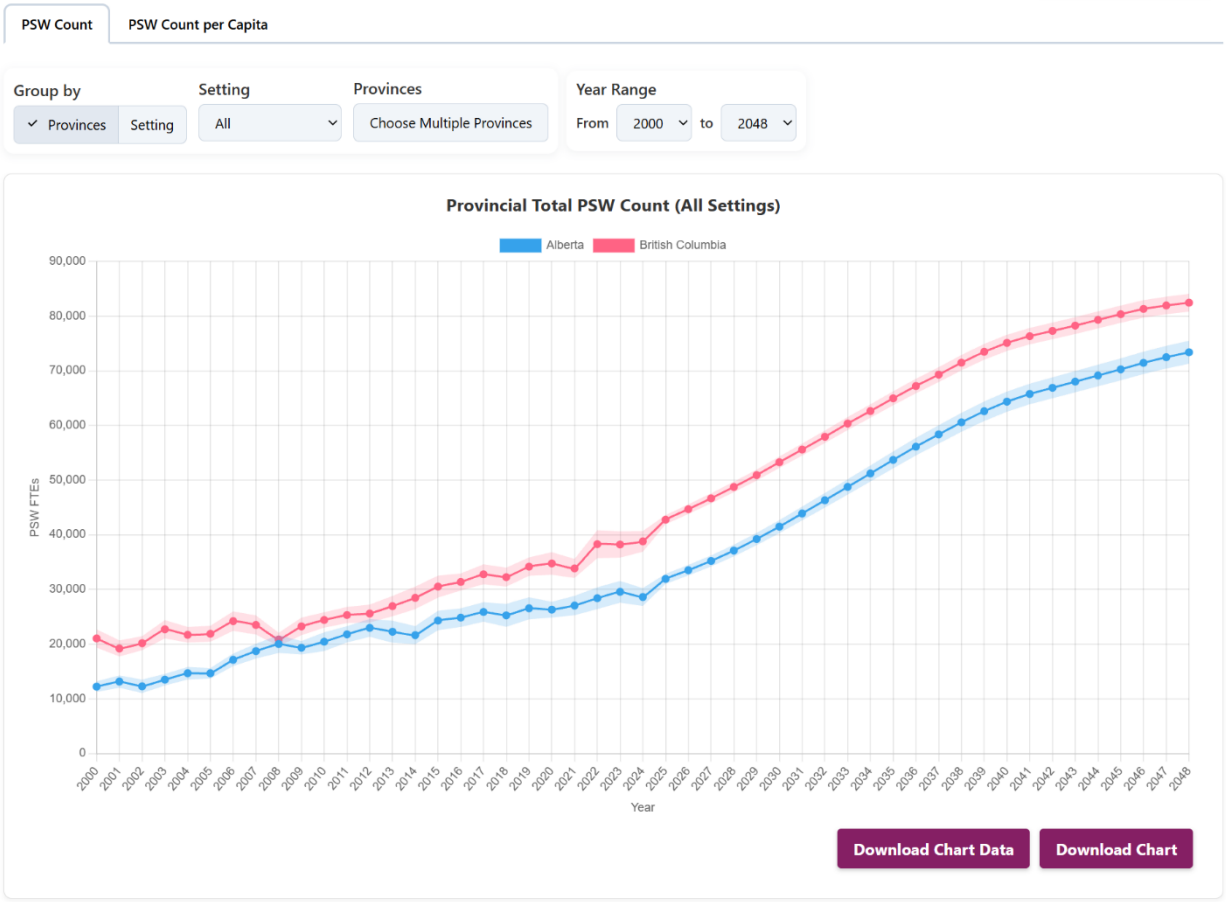


Figure B: *Output of plot in Unique Scenario Mode with two provinces selected.*

Users may adjust the chart results by specifying a range of report years, Canadian jurisdictions of interest, or health care settings (see *Section 2.4 Comparing Scenarios*). Charts include a combination of estimates based on historical PSW counts (2024/25 and earlier) and projected PSW counts (Y-axis) by year. The shading above and below the estimated PSW count (or FTEs) shows the 95% confidence intervals (CIs) for each year of the reported data. The CIs for the historical data ending in 2024/25 are those generated as part of the LFS estimates and those for the projected years (>2024/25) are based on the average values derived from 30 iterations of the simulation model.

Outputs refresh automatically when new parameters are applied.

2.1.3 Key Components and Visualizations

The main display area provides several types of dynamic visualizations:

- **Unique scenario line charts** for time-series projections
- **Comparative line charts** including baseline and alternative health workforce scenarios
- **Downloadable tables** summarizing annual values across jurisdictions and care settings

Users can switch between the **unique scenario mode** and the **scenario comparison mode** (#4 in **Figure A**: Parameter settings**Figure A**: Parameter settings)**.** The latter includes a summary of the selected parameter differences between scenarios.

2.2 Scenario Building and Customization

The PSW Microsimulation Tool enables users to build and test alternative workforce futures by modifying a range of input parameters, i.e., PSW rate by province/territory, total PSW count, and population projection scenarios. This section outlines how to create and compare different scenarios to explore potential impacts on PSW supply and demand across provinces, territories, and care settings.

2.2.1 Adjusting Parameters

Users can fine-tune the simulation by modifying several categories of parameters:

2.2.1.1 Health Employment Sector

Users can specify how PSWs are distributed across **three care settings**:

- **Hospitals (HS)**
- **Home Care (HC)**
- **Residential Care (RC)**

Each setting can be adjusted independently by province or territory. This is useful for modelling shifts in service delivery (e.g., increased investment in home care).

The following North American Industry Classification System (NAICS) codes were used to identify PSWs in each care setting from historical LFS data:

Home Care: 6216, 6241
Hospital Care: 622
Residential Care: 623

2.2.1.2 Total Workforce Adjustments

Two workforce supply parameters can be adjusted:

PSW per 100 people 75 years and older: This reflects the context-specific number of PSWs relative to the senior population and is based on 2024/25 estimates obtained as custom tabulations from Statistics Canada. Modifying the rate can be used to test the impacts of increasing or decreasing the number (or FTEs) of PSWs relative to the population in a specific care setting. When these rates are adjusted by the user, the total PSW count will also be automatically increased or decreased using the jurisdiction's population of persons 75 years and older.

Total PSW counts: Users can modify the default PSW total count (or FTEs) for any of the jurisdictions available in the total workforce column. When this is done, an algorithm will determine the difference between the existing and revised PSW counts and update the PSW rates in each care setting based on the relative distribution of PSWs across care settings to reflect the proportions in base year 2024/25.

One workforce demand parameter, **population projection scenario** (10 in total), can be adjusted:

The tool includes ten projection scenarios to account for uncertainty about the future. These projection scenarios were developed by Statistics Canada and combine different assumptions about population growth and demographic trends to show a range of possible outcomes. These include:

Medium growth (6 scenarios): These scenarios illustrate a medium level of population growth, reflecting a continuation of current trends in the short term and plausible trajectories in the long term. Each scenario assumes different levels of interprovincial migration to capture the volatility of this component.

Low-growth and high-growth (2 scenarios): These scenarios assume either lower or higher population growth compared to the medium-growth scenarios at the national level. The high-growth scenario, for example, assumes high fertility, low mortality, high immigration, low emigration and high numbers of non-permanent residents.

Fast-aging and slow-aging (2 scenarios): These scenarios include assumptions associated with faster or slower population aging compared to the medium-growth scenarios. The slow-aging scenario, for example, assumes high fertility, high mortality, high immigration and high numbers of non-permanent residents.

Selecting a scenario updates the projected size of the 75 years and older population for each jurisdiction, impacting workforce demand.

2.3 Unique Scenario

In *Unique Scenario Mode*, users define one set of assumptions and view projections for a single scenario. To begin, a user may select one of ten population projection scenarios and may set the PSW rate per province/territory and/or care setting (or keep the default settings). Once the parameters are set, the model can be run to simulate outputs showing anticipated PSW headcounts (or FTEs) for each jurisdiction and care setting by year (See ***Error! Reference source not found.***).

This mode is ideal for:

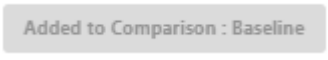
- Testing a policy or investment assumption (e.g., increasing the number of PSWs entering the workforce)
- Understanding baseline trends based on default inputs
- Estimating the possible impacts of changes in population growth and aging on the PSW workforce needs of the future.

2.4 Comparing Scenarios

In *Comparison Scenario Mode*, users can compare up to four scenarios simultaneously, one baseline scenario and three others. Each scenario may have distinct sets of assumptions, allowing users to visualize the differences between them. Users may also toggle on-or-off their chosen scenarios to view certain comparisons.

To use Comparison Mode (See **Figure C**):

1. Select your *Population Projection Scenario*. If desired, set the PSW rates per province/territory and/or care setting, and the PSW count per province/territory (or keep default settings).
2. Click '**Run Simulation**'.
3. Your plot will appear below the parameter settings table. To add to comparison, click '**Add to Comparison**'. The plot has been added if the '**Add Comparison**' button turns from yellow to grey and the text updates to '**Added to Comparison: Baseline**'.



4. To add any further comparisons, repeat Steps 1-3. You may compare up to 4 scenarios including the baseline scenario.
5. To view your comparison plot, click '**Comparison Scenario**'.
6. You may toggle on-or-off any of the comparison plots to view a subset of the plots. Additionally, you may filter the year range, setting, or provinces/territories.

Key comparison outputs include:

- Line plots for each scenario over time (PSW supply and 75 years and older population)
- Care setting comparisons across provinces and territories

This mode is ideal for analyzing:

- The impact of different policy interventions
- Workforce differences across jurisdictions
- Sensitivity to demographic uncertainty

Users can export comparative results for reports or presentations.

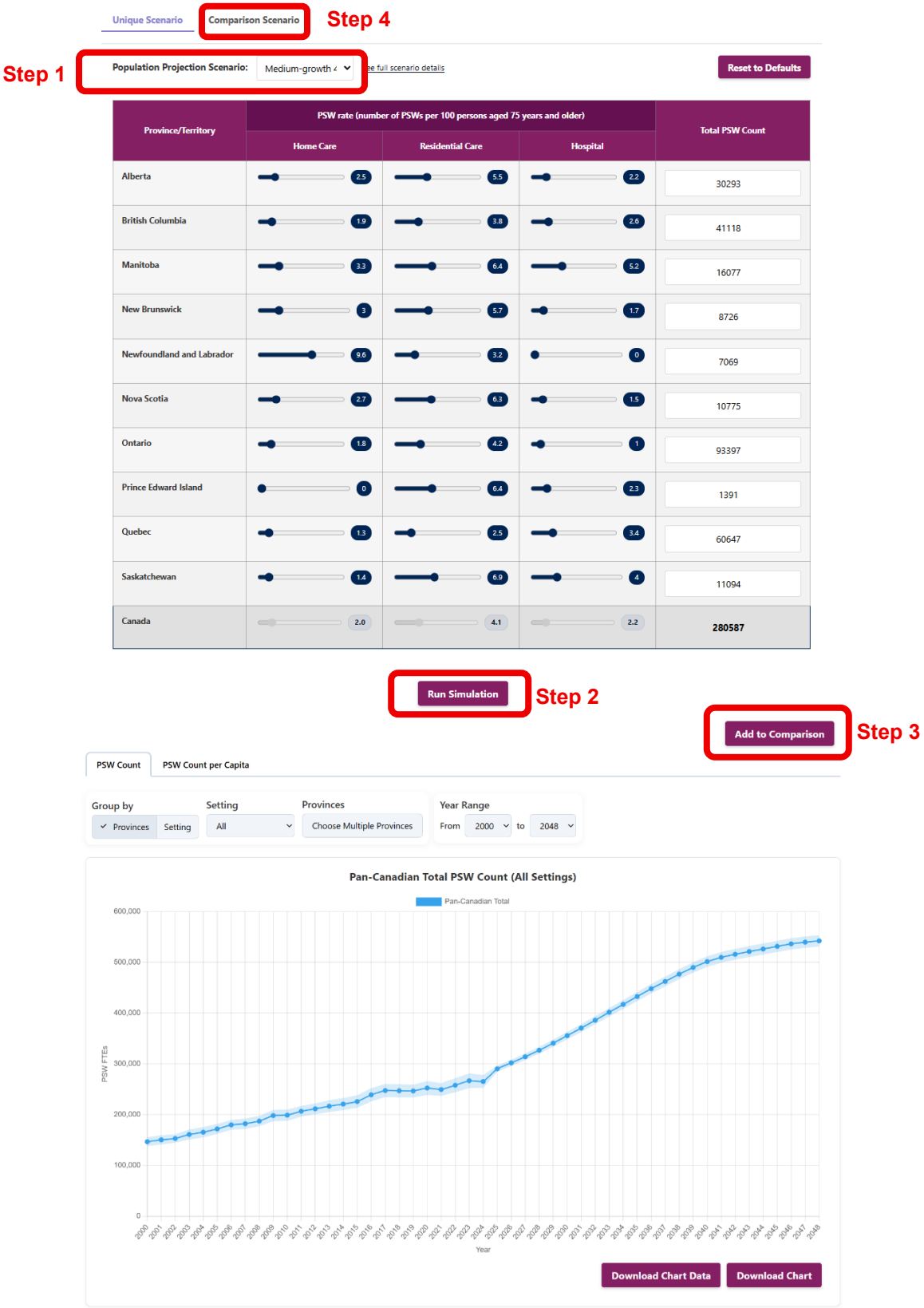


Figure C: *Using comparison mode*

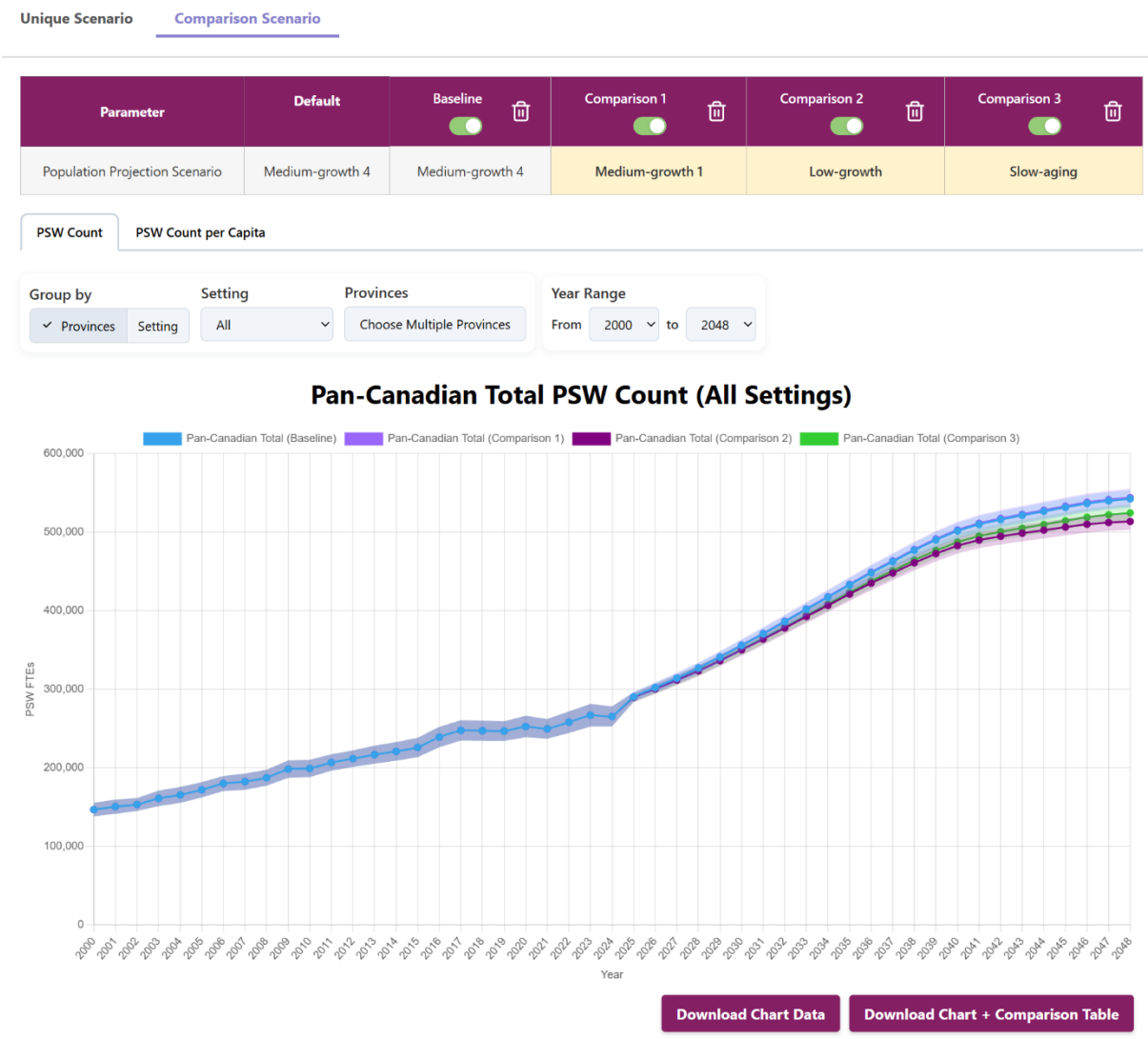


Figure D: *Output in Comparison Mode with four scenario comparisons and one province selected.*

2.5 Results and Outputs

The PSW Microsimulation Tool provides a range of output formats to help users interpret the results of their scenario testing. Model outputs are designed to support evidence-based decision-making and can be exported for further analysis or reporting.

- **Understanding the numbers:** The outputs show a plot illustrating the estimated count of PSWs in the workforce up to 2048/50. This represents the number of PSWs that would be needed to maintain current service levels, based on existing ratios of PSWs per 100 persons aged 75 years or older in each care setting and jurisdiction according to 2024/25 estimates, and given the projected population growth scenario selected. A separate model is also available to produce similar outputs whereby PSW counts are replaced by full-time equivalent (FTE) totals. Historical and

projected values, for both headcounts and FTEs, can also be viewed graphically in a standardized manner by selecting the *per 10,000 population* tab where PSW estimates are available per 10,000 Canadians: of all ages; aged 65 years, and; aged 75 years and over. The latter outputs and visualizations enable direct comparisons between jurisdictions by providing relative measures. Counts per 10,000 based on Canadian of all ages, for those aged 65 years and over, and for those aged 75 years or over were selected with the intent of providing insights that better reflect patients treated in hospital, in home care, and in residential care settings, respectively (#5 in **Figure E**).

- **Comparing scenarios:** When viewing multiple population projection scenarios, the differences illustrate how varying assumptions about the distribution of the population by age, fertility rates, mortality rates, and immigration affect PSW demand. Higher population growth scenarios and an increasing proportion of older adults would translate into greater demand for PSW care.

- **Planning perspective:** Use the projections as relative measures rather than precise estimates. Repeating a simulation using the same parameters could produce minor differences in estimates due to the algorithm's reliance on probabilistic (random and stochastic) processes. Our modelling outputs aim to indicate trends and may help identify potential workforce gaps, but actual needs may vary based on policy changes or shifts in service delivery over time.

Figure E: *Chart filtering options*

2.5.1 Chart Adjustments

The results are primarily presented as interactive charts, which automatically update based on user-defined parameters.

Chart functionalities differ in the unique scenario option versus the comparison scenario plot option. Users can:

• **Set range of years (#1 in Figure E):** View PSW projections for preferred range of years.

• **Select specific care settings (#2 in Figure E):** View PSW projections for hospitals, home care, residential care or all care settings.

• **View by care setting or province/territory (#3 in Figure E):** Toggle between two viewing modes:

(1) ***By care setting*** – Compare multiple care settings (hospitals, home care, residential care) within a single province/territory, or

(2) ***By province/territory*** – Compare multiple jurisdictions for a single care setting or all care settings combined.

• **Filter by province/territory (#4 in Figure E):** Focus on a single jurisdiction, compare multiple between provinces and te rritories, and select a pan-Canadian view.

• **Confidence Intervals:** View confidence intervals around estimated counts (i.e., mean value of 30 microsimulations).

• **View by total count or per capita (#5 in Figure E):** PSW projections can be viewed in two modes:

(1) ***Total count*** – Shows the absolute number of PSWs (headcounts of FTEs) over time.

(2) ***Per 10,000 population*** – Shows PSWs estimates relative to the population, enabling direct comparisons across jurisdictions. Three base populations are available: whole population (all ages), 65 years and over, and 75 years and over –reflecting populations typically served in hospital, home care, and residential care settings respectively.

Charts include:

• Single line plot to visualize time-series between 2000 and 2048/50 (range is adjustable)

• Scenario comparison plots showing differences in outcomes across the above time-series

Charts are responsive and update instantly as parameter values change.

3. Understanding the Microsimulation Model

3.1 What is Microsimulation?

Microsimulation is a computational modelling technique that simulates the behavior and outcomes of individual entities—known as agents—over time within a system to understand broader population-level patterns and their policy implications. In workforce planning, this means modelling how individuals (e.g., workers, patients) of different ages, backgrounds, career paths, and life circumstances interact with demographic and policy environments over time. Unlike traditional aggregate models that treat populations as homogenous groups, microsimulation captures heterogeneity in the population—differences in individual characteristics, behaviours, and responses to policy changes--allowing for more detailed and dynamic projections.

In this tool, microsimulation is used to estimate the annual supply of PSWs in Canada using both headcounts and FTEs, from 2000 to 2048/50, using the projected size of the population aged 75 years and older as a proxy for demand.

3.2 Overview of the Agent-based Modelling Approach

This tool is based on an agent-based modelling (ABM) approach implemented using AnyLogic, a powerful simulation platform. Agent-based microsimulation modelling uses real-world aggregated data to create a simulation of individual agents—such as health workers—and how they behave and interact with each other. In this model, PSWs are simulated as individuals based on province/territory of residence, and the care setting in which they work. Using this microsimulation approach allows the model to use aggregated data to create a synthetic population of individuals evolving across time to better estimate the impact of policy decisions, as well as emergent effects of the individuals' interactions within a system.

Key advantages of this approach:

- No need for individual-level data, avoiding privacy issues.
- Flexible and scalable, easily adapted to unregulated professions like PSWs where there is a reliance on general assumptions and limited availability of high-quality data sources.
- Real-time interactivity, allowing users to change assumptions, immediately simulate, and view the results.
- The model simulates year-by-year transitions for both the population and the PSW workforce under varying assumptions.

The projection methodology for this ABM model is a dynamic adaptation of the Kralj, Sweetman and AGE-WELL National Innovation Hub – Advancing Policies and Practices in Technology and Aging (APPTA) methodology[1, 2].

3.3 Model Structure

The PSW model operates in two key streams—**supply** and **demand**—with a linking mechanism to calculate alignment between them.

3.3.1 Supply: Labour Force Survey Statistics

Supply projections are based on data from the Statistic's Canada **Labour Force Survey (LFS)**, including:

- Historical PSW employment trends (counts and FTEs) and their distribution across provinces, territories, and care settings

Excluding:

- Unemployed PSWs

Users can adjust PSW-to-population ratios or amend the total number of PSWs in each province and territory for the baseline year (2024/25).

Counts of PSWs for 2024/25 (the model's base year), by province/territory and by care setting (or industry), were estimated from Statistics Canada's monthly LFS data, aggregated into annualized LFS estimates using the following case selection criteria:

> Canadians whose primary job is included in the National Occupation Codes (NOC) 44101 and 33102 and whose work setting is included in the North American Industry Classification System (NAICS) codes beginning with 6216, 6241, 622 and 623. The inclusion of NOC 33109 was considered but excluded after expert consultation.

A few limitations of this approach should be noted. First, while it is possible to know if LFS respondents have more than one job, NOC and NAICS classifications are not available beyond an individual's stated primary occupation. This means that respondents who work as PSWs but not as their primary occupation would be excluded from our PSW counts. Our PSW estimates are therefore likely to underestimate the true number of PSWs working in Canada. Another limitation of survey-based methods of data collection, including the LFS, is that estimates for smaller provinces and territories may not always be releasable due to confidentiality or data quality concerns. This is the case for territorial counts of PSWs in each of the care settings, which explains why we pooled and assigned uniform PSW-to-population ratios across all territories.

The LFS data was processed using a 5-year moving average to smooth large volatility in the survey data. The 5-year moving average was applied using the previous two years, the current year, and the two years following the current time window. This approach was chosen to retain any data features and annual trends, while reducing large volatility.

Tables 1 & 2 summarize the estimated count of PSWs in each province and territory and the ratios that were derived using Statistics Canada's population projection for the 2024/25 calendar year using a 5-year moving average.

Table 1: Headcount PSW Rates & Counts				
Province/Territory	Home Care Ratio	Residential Care Ratio	Hospital Ratio	Total PSW Count in 2024
	Number of PSWs per 100 Canadians age 75 years and older in 2024			
Newfoundland and Labrador	12.1	3.6	3.2	10,400
Nova Scotia	3.7	7.7	1.9	13,600
Prince Edward Island	1.0	8.2	3.4	2,067
New Brunswick	4.1	6.7	2.0	10,700
Quebec	1.9	3.1	4.9	83,467
Ontario	2.4	5.3	1.4	118,400
Manitoba	3.9	7.6	6.0	18,833
Saskatchewan	1.7	8.6	5.1	13,967
Alberta	3.0	6.4	2.9	36,400
British Columbia	2.3	4.4	3.1	48,500
Yukon*	7.8	7.1	7.1	433
Northwest Territories*	7.8	7.1	7.1	233
Nunavut*	7.8	7.1	7.1	233
Canada	2.6	5.0	3.0	357,233

* For headcounts, territorial PSW-to-population ratios reflect aggregated territorial PSW estimates because care setting level values on the number of PSWs in the three territories could not be released due to confidentiality and data quality concerns. As such, the PSW-to-population ratios for each territory were set to be the same as the ratios for all three territories combined. The total PSW count for each territory based on the LFS that was available and releasable.

Table 2: Full-Time Equivalent PSW Rates & Counts				
Province/Territory	Home Care Ratio	Residential Care Ratio	Hospital Ratio	Total PSW Count in 2025
	Number of PSWs per 100 Canadians age 75 years and older in 2025			
Newfoundland and Labrador	9.8	3.0	0.0	7,509
Nova Scotia	2.6	5.8	1.4	10,488
Prince Edward Island	0.0	6.9	2.6	1,576
New Brunswick	3.4	5.5	1.7	9,300
Quebec	1.3	2.7	3.4	64,779
Ontario	1.7	4.1	1.0	94,866
Manitoba	3.6	5.6	5.2	16,153
Saskatchewan	1.4	6.3	4.2	11,265
Alberta	2.8	5.3	2.0	31,804
British Columbia	1.6	3.3	2.5	38,457
Yukon**	-	-	-	-
Northwest Territories**	-	-	-	-
Nunavut**	-	-	-	-
Canada	2.0	3.9	2.1	286197

** LFS data for territories were not available for analysis in Statistics Canada's virtual Data Lab, which is Health Workforce Canada's source of information for full-time equivalent estimates. Therefore, territorial PSW-to-population ratios for full-time equivalents could not be included in the FTE microsimulation model.

3.3.1.1 Full-Time Equivalent Methodology

To estimate the full-time equivalent (FTE) supply of PSWs, both the number of workers and their weekly hours are considered. The LFS data includes some extremely high weekly hour values; to mitigate this, any hours exceeding the 99th percentile were capped at that level. Weekly hours were then divided by a standard 37.5-hour work week to calculate individual FTEs (for details of FTE, please refer to Health workforce: Practice patterns | CIHI). These individual FTEs were summed up to determine the total supply.

This method accounts for variations in employment types, including part-time, full-time, and overtime— providing a more accurate measure of workforce capacity than headcount alone. Standard errors and confidence intervals were calculated using bootstrap weights provided in the LFS data, capturing individual-level variation in FTEs.

Illustrative Example: This table illustrates how FTEs adjust for differences in hours worked, offering a more nuanced view of workforce capacity than headcount.

Type of Employment	Overtime	Headcount	Weekly Hours	FTE	FTE/Count
Full-time	No	1	37.50	1 (= 37.50/37.50)	1.00 (= 1/1)
Part-time	No	1	22.50	0.6 (=22.50/37.50)	0.6 (= 0.6/1)
Full-time	Yes	1	45.00	1.2 (=45.00/37.50)	1.20 (= 1.20/1)
Total	**-**	**3**	**-**	**2.8**	**0.93 (2.8/3)**

At the care-setting level, insufficient observations prevented data release for two settings: hospitals in Newfoundland & Labrador and residential care in Prince Edward Island, as these did not meet Statistics Canada's minimum cell size requirements. To address this gap, we estimated values for these settings by year using a residual approach: subtracting the combined FTEs of the other two sectors from the provincial total to derive the missing sector's FTEs. Due to these estimates violating the independence assumption and the unavailability of the covariance estimates, confidence intervals could not be calculated.

3.3.2 Demand: Historical and Projected Population Data

Demand is approximated by calculating a base ratio of PSWs-to-Canadians. This ratio is derived by dividing the number of PSWs in 2024/25 (the latest available historical estimates) in each population stratum by the number of Canadians 75 years and older—a population segment with high need for PSW support. This base ratio is then applied to projections beyond 2024/25 according to the user-selected population projection scenario (e.g., low-, medium-, high-growth; slow/fast aging).

Key features:

- Choice of ten population projection scenarios from Statistics Canada.
- Disaggregated by province/territory, sex, and age group.
- Annual updates from 2000 to 2048/50.

3.3.3 Supply and Demand Interaction

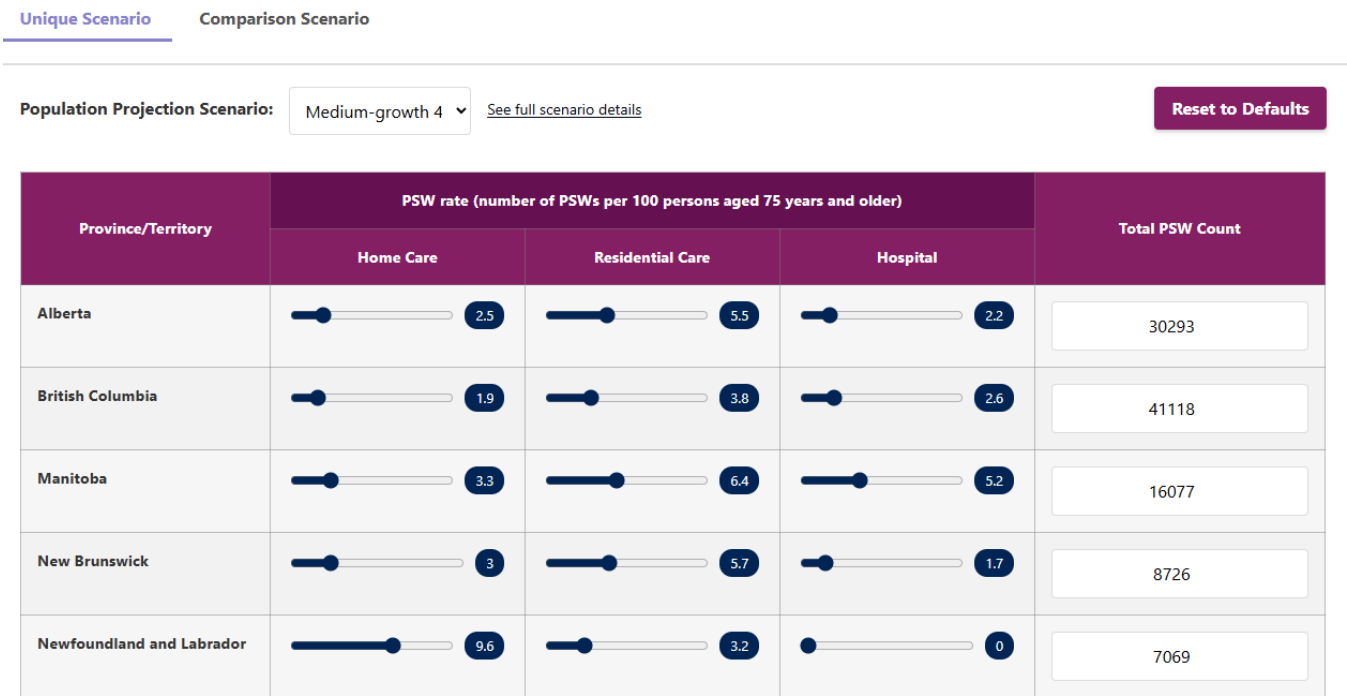


Figure F: *Parameter settings*

The model calculates and plots the number of PSWs needed to maintain a PSW-to-Population ratio (i.e., PSWs per 100 Canadians 75 years and older) across each Canadian province and territory. The default ratio, based on Statistics Canada data from 2024/25, can be replaced by user-defined ratios.

3.3.4 Five-Year Moving Average and Distribution Calculation

Preliminary inspection of historical annual PSW counts showed the Labour Force Survey (LFS) estimates had noticeable volatility year-over-year. To reduce this volatility, a 5-year moving average was applied to the LFS data. This 5-year moving average was calculated using a time window that included the two years preceding and following each annual estimate. The 5-year moving average was then used for the PSW counts and to calculate the PSW rates used in the model.

Normal distributions were calculated and drawn from the various PSW rates for each iteration of the model. To calculate the Normal distributions, the LFS 5-year moving average data was utilized. The standard deviation (SD) was calculated using the PSW count estimate, lower bound, and upper bound provided in the LFS dataset with default 95% confidence intervals. Upper and lower bounds were used to calculate two separate SD values, which were then averaged to obtain one SD value. Due to rounding in the released LFS dataset, the mean of both SD values was calculated to consider both bounds. Using the count estimate and SD, a Normal distribution was set-up to sample the parameter space for the PSW rates and PSW counts. The Normal distributions are set-up using the AnyLogic provided distribution function. The generated Normal distributions were truncated using minimum and maximum limits set at four times the SD, with the minimum bound being limited to positive values.

3.4 Limitations and Uncertainties in the Model

While robust, the model includes several limitations:

- **Demand is a proxy**: Using the 75 years and older population does not fully capture health system complexity or service utilization patterns. In reality, PSWs provide services to individuals across all age groups, and population projections that account for different growth rates among various age categories would yield more refined estimates of future demand.
- **Applicability of LFS estimates for specific professions:** One of the principal purposes of the Labour Force Survey is the estimation of broad key indicators, like the unemployment rate. The methodological design is not optimized for the estimation of very specific job groupings, through non-response adjustment or calibration, for instance. As a result, there can be relatively high variation across report years for PSWs.
- **Care delivery assumptions:** While the model incorporates different population growth scenarios (see below for more details), the model does not allow the user to adjust care setting ratios at different points in time (e.g., assign a different PSW to Population ratio in 2026 and after 2030). This assumes that the relative proportion of PSWs across care settings will not vary over time, which may not account for changes in workplace preferences, policy, or care approaches.

- **PSW Case Selection:** There are differing opinions on which combination of NOC and NAICS yields the most accurate PSWs estimates (lowest proportion of false negatives and false positives). We selected a combination of 2 NOC (44101, 33102) and 4 NAICS (6216, 6241, 622, 623) to identify individuals whose primary occupation is a PSW per the LFS.
- **Static assumptions**: Relevant variables like urban-rural differences, job vacancies, wage effects, or the impacts of evolving scopes of practice of professions adjacent to PSWs (e.g., Licensed Practical Nurses) are not yet incorporated in the model.

The limitations described above create uncertainty in the model's outputs that vary by geography and context. Estimates for provinces and territories with smaller populations carry greater uncertainty due to limited sample sizes. Additionally, the lack of accepted 'gold standard' for measuring PSW supply means there is inherent uncertainty about whether the model captures the true scope of the workforce. Users are encouraged to interpret the resulting estimates for **scenario exploration** rather than definitive forecasts, with an understanding that these constraints introduce uncertainty ranges into the projections.

4. Exporting Results and Visuals

Users can export their custom model simulation scenario results in various formats:

Downloadable Charts: Export line plots as PNG, JPG, or SVG files for inclusion in reports or presentations.

Data Tables: Export annual values for selected variables in CSV and JSON.

The JSON file contains the raw output from the AnyLogic Cloud simulation run. This information can be parsed for verification purposes as needed. However, all data in the JSON file are available in the CSV files from the download package.

The following columns and data are included in the CSV file downloads:

- **Province:** The province abbreviation for the output
- **Category:** The output dataset with four options
  - "all count DS" – All care settings dataset
  - "HC count DS" – Home care only dataset
  - "HS count DS" – Hospital care only dataset
  - "RC count DS" – Residential care only dataset
- **Year:** Year of the modelled estimates.
- **Type:** An AnyLogic descriptor of the output statistics type for the Monte Carlo simulation
- **Count:** The number of iterations (simulations) ran for each parameter set
- **Min:** The minimum value generated in the set of iterations
- **Max:** The maximum value generated in the set of iterations
- **Mean:** The mean value generated for the set of iterations
- **Variance:** The variance of the iteration set
- **StdDev:** The standard deviation of the iteration set
- **LowerBound:** The lower bound of the 95% confidence interval around the mean
- **UpperBound:** The upper bound of the 95% confidence interval around the mean
- **Scenario:** The identifier for the comparison scenario that generated the output. ***This Scenario output column is only included in the data download tables for the "Comparison Scenario".***

Province	Category	Year	Type	Count	Min	Max	Mean	Variance	StdDev	LowerBound	UpperBound	Scenario
ON	all count DS	2000	DISCRETE	10	40444	55070	47142.2	27642059	5257.57	36837.36	57447.04	
ON	all count DS	2001	DISCRETE	10	40440	60957	50203	40063037	6329.54	37797.11	62608.89	
ON	all count DS	2002	DISCRETE	10	44232	57676	52079.6	22541061	4747.74	42774.02	61385.18	
ON	all count DS	2003	DISCRETE	10	41325	65613	54914.5	69982299	8365.54	38518.04	71310.96	
ON	all count DS	2004	DISCRETE	10	45776	71354	56820.3	71791212	8472.97	40213.28	73427.32	Baseline
ON	all count DS	2005	DISCRETE	10	52954	73666	60296.4	50227757	7087.15	46405.58	74187.22	
ON	all count DS	2006	DISCRETE	10	51050	69038	60467.2	37889849	6155.47	48402.47	72531.93	
ON	all count DS	2007	DISCRETE	10	54473	78470	63187.4	57360565	7573.68	48343	78031.8	
ON	all count DS	2008	DISCRETE	10	55649	82215	62680.7	66490094	8154.15	46698.57	78662.83	

Figure F: *Example output of the CSV file download generated using the Comparison Scenario view*

Scenario Summaries: Capture the full set of parameters used during scenario simulations for documentation and reproducibility.

The export functionality supports easy sharing of results with colleagues, stakeholders, and advisory groups.

4.1 Accessing Raw Data and Model Files

For users interested in further analysis, improving upon the HWC model, or integrating with other modelling efforts, all underlying resources of the PSW model are open-access and available for download. This includes:

Raw Model Data: Including baseline PSW rates, historical labour force data, historical and projected population projection variants.

Model Code and Documentation: AnyLogic code and accompanying documentation are available for download for those looking to replicate or modify the model. *Note*: AnyLogic model files can be opened in a text editor but are more easily viewed and edited using AnyLogic Software. AnyLogic files are coded in **Java**. A free trial version of the AnyLogic software is available here.

These resources are intended to promote transparency, encourage feedback, and support continued development by other researchers or planning bodies.

5. Sensitivity Analysis and Validation

The model underwent a series of internal and external validation procedures.

Internal validation steps included:

- Conducting a code review to check the model source code for errors.
- Checking input parameters in the model against the intended inputs provided.
- Checking the model and website to ensure output data aligns with the model generated values and is presented correctly.

External validation steps included:

- Comparing historical PSW estimates from the LFS against annual Alberta PSW counts from the HWC Provider Profile dashboard.
  - Comparing historical PSW estimates from the LFS against payroll data from the Government of Nova Scotia Department of Health and Wellness, report years 2022 to 2024. *Note*: The payroll data referenced is not currently publicly available.
  - Comparing PSW output data against existing publications, including two reports by Kralj, Sweetman and AGE-WELL National Innovation Hub Advancing Policies and Practices in Technology and Aging (APPTA). See *Section 7. Key References and Further Reading* below.

6. Troubleshooting and Support

Questions, comments, and suggestions pertaining to the PSW model and the source datasets can be sent to: Modelling Team Support

7. Key References and Further Reading

National Occupational Standard for Personal Care Providers: A guide for Canadian employers, educators, and job seekers to make informed decisions about hiring, skills training, and career choices. (2022). https://nos-nnp.ca/wp-content/uploads/2023/10/CICan_NationalOccupationalStandard_PersonalCareProviders-2.pdf

Canadian Institute for Health Information. *Recommendations for Advancing Pan-Canadian Data Capture for Personal Support Workers* (Updated July 2023). Ottawa, ON: CIHI; July 2023

Kralj, B., Sweetman, A. and AGE-WELL National Innovation Hub. *Residential Care Sector Personal Support Worker (PSW) Work Force: Characteristics, Trends and Projection.* 2022. Fredericton, NB: AGE-WELL National Innovation Hub, APPTA.

Kralj, B., Sweetman, A. and AGE-WELL National Innovation Hub. *Personal Support Worker (PSW) Workforce Characteristics, Trends and Projections: Focus on the Home Care and Hospital Sectors.* 2024. Fredericton, NB: AGE-WELL National Innovation Hub, APPTA.