

# Weighting Strategy in the Quebec Survey on the Experience of Health Care

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## Abstract

The Québec Survey on the Experience of Health Care is a telephone survey conducted between October 2010 and December 2011 among 48,100 respondents aged 15 and over living in a non-institutional dwelling in the province of Quebec. This paper focuses on the survey weighting strategy, which incorporates the use of paradata in the nonresponse adjustment. The idea was to take into account the difficulty in contacting each person from the sample, because this information is linked to the probability of response and to some of our main survey indicators, such as health condition. To achieve this goal, the number of phone calls was included in the logistic regression models used to create the weighting classes. Another distinctive feature of the nonresponse adjustment strategy was the idea of treating the people who were unable to respond to the questionnaire due to illness or disability differently from other nonrespondents. This type of nonresponse occurred when no proxy respondent could answer for the selected person. For that reason, it was decided to use only the proxy respondents to account for these nonrespondents.

**Key Words:** Weighting, nonresponse adjustment, paradata, proxy respondents

## 1. Survey Overview

The main objective of the Québec Survey on the Experience of Health Care (EQES)<sup>1</sup> is to document certain aspects of the performance of the Québec health system, including service accessibility, continuity, effectiveness, responsiveness and safety. It aims to produce estimates at the provincial, regional (16 health regions) and local (95 local services networks) levels. The target population of the study includes all persons aged 15 and over who are eligible under the public and universal Québec Health Insurance Plan and are living in a non-institutional dwelling in Québec. The sample frame was obtained from the insured persons' registration database of the Régie de l'assurance maladie du Québec. The sample frame provides excellent coverage of the target population and contains all the information necessary for stratification as well as the contact information of the persons selected (telephone number, address, name of spouse, etc.). The initial sample size was 77,436 persons distributed across 1,893 strata formed by crossing the 95 local services networks with the 10 age groups and with sex.<sup>2</sup>

Data collection for the EQES took place from October 28, 2010 to December 4, 2011. Letters were first sent to all persons included in the sample to inform them of the conduct and objectives of the survey. The interviews lasted a little longer than 22 minutes on average and were conducted over the phone. The eligibility rate for the survey was very

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<sup>1</sup> All publications based on the Québec Survey on the Experience of Health Care are available on the website of the Institut de la statistique du Québec at [www.stat.gouv.qc.ca](http://www.stat.gouv.qc.ca).

<sup>2</sup> Certain strata had to be combined because of their small size.

high at about 99%, and the province-wide response rate stood at 63%. The number of respondents was 48,100 persons. Please note that when the person selected was unable to respond to the questionnaire because of language or health reasons, the interviewer tried to find a proxy respondent who would answer for that person. Slightly over 2,000 interviews were conducted with proxy respondents, most of them for health reasons.

## 2. Main steps of the weighting strategy

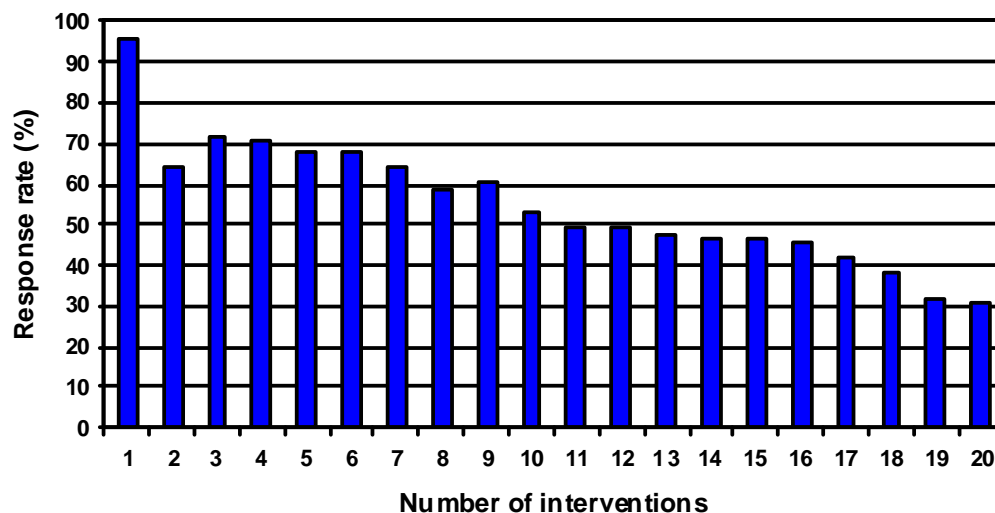
The first weighting step consisted in calculating the inverse of the probability of selection for each individual. This probability varied by stratum. Adjustment for eligibility then had to be performed, as some nonrespondents had an unknown eligibility status. The weight of individuals whose eligibility status was unknown was therefore reduced by a factor corresponding to the proportion of eligible individuals among those whose eligibility status was known. The next step was total nonresponse adjustment, which is detailed in section 3. A review of extreme weights was then performed, leading to the truncation of less than 1% of weights. The last weighting step was poststratification. This adjustment ensured that the sum of weights for all survey respondents corresponded to the target population, by local services network, age group and sex.

## 3. Total nonresponse analysis

### 3.1 Objective and issues related to the use of paradata in nonresponse analysis

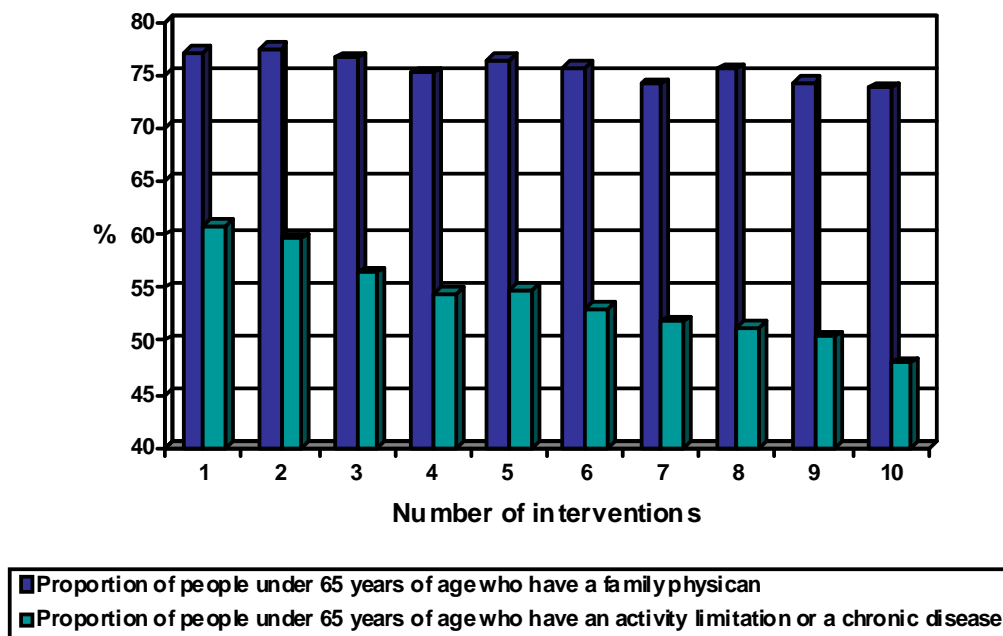
As with most surveys, the response rate was lower among hard-to-reach individuals (those who required more phone calls). Graph 1 shows the survey response rate by number of interventions in a case. This number was generally equal to the number of calls, but was sometimes slightly higher when an intervention corresponded to a change made by an interviewer in a case. The link between both variables is quite strong, although it appears unusual when the number of interventions is small. This phenomenon may be caused by wrong telephone numbers. This hypothesis will be verified later.

**Graph 1: Response Rate by Total Number of Interventions**



The characteristics of the most difficult-to-reach individuals seem different from those of other individuals, and these characteristics also seem to be associated with the variables measured in the survey. For example, two of the main EQES indicators are the proportion of people who have a family physician and the proportion of people who have an activity limitation or a chronic disease. It can be hypothesized that people with limitations or frail health are easier to reach. This relationship can be observed in the survey results, but only among people under 65 years of age. Graph 2 illustrates the relationship between the number of interventions and the two variables of interest previously mentioned.

**Graph 2:** Estimations for Two Variables of Interest by Number of Interventions



Since the number of interventions was associated with both the response rate and with the variables of interest of the survey, it was determined that taking it into account would reduce the risk of bias in the estimates. However, use of this paradata in nonresponse adjustment posed a problem, since in the case of wrong or non-working numbers, the number of interventions was low, but that did not mean that the person was easy to reach. In this type of situation, it was very likely that the attempted calls were not targeting the right person, which meant that there was no link between the number of interventions and the inability to reach the person selected. To work around this problem, nonresponse adjustment had to be performed in two steps.

### 3.2 Integration of paradata in nonresponse adjustment

Since relying on the number of interventions in a case seemed sensible only if the telephone number on file enabled us to reach the person selected, we only took this variable into account if we had reason to believe that this was the case. Prior adjustment was therefore required to retain only individuals for whom we had a confirmed telephone number.

#### 3.2.1 Adjustment for unconfirmed telephone numbers

The first step of nonresponse adjustment was adjustment for unconfirmed telephone numbers (UTN), i.e. for all cases where we had no indication that the telephone number

was correct. This adjustment was performed without using a variable based on the number of interventions.

More specifically, a telephone number was deemed to be confirmed (CTN) when contact was made with the selected individual or a member of their household, suggesting that the number was correct. In contrast, a telephone number was deemed unconfirmed (UTN) when we had an indication that it was a wrong or non-working number. Since survey data collection took place over a very long period of time (over a year), cases where no contact was made over the whole collection period—for example when there was no answer or the line was busy every time we called—were also considered as unconfirmed telephone numbers. It is important to note that this hypothesis could be questionable in the case of surveys with shorter data collection periods. For the EQES, 79% of UTNs were wrong or non-working numbers, which was reassuring since this accounted for most cases.

Adjustment for UTNs was performed using the score method.<sup>3</sup> This method consists in performing logistic regression and using non-hierarchical classification methods to combine predicted values obtained by regression in order to create weighting classes. In this instance, logistic regression was used to determine the variables or characteristics that could affect the probability of having a confirmed telephone number. Among these variables, the best ones to use were those that were also associated with the analysis variables. In the final model, the dependent variable was having or not having a CTN, and the independent variables were living in Montréal or Laval versus elsewhere in Québec, sex, language of correspondence, presence or absence of a telephone number at the start of the survey, presence or absence of a spouse in the sample frame, number of people living at the same address, as well as the material and social deprivation index.

Using non-hierarchical classification methods, the values predicted using logistic regression were combined to build several weighting classes, i.e. groups of individuals with similar characteristics and CTN proportions. Weight adjustment was performed inside each of these classes: the weights of individuals with a CTN were adjusted using the inverse of the proportion of CTNs in their weighting class. The number of people and the rate of CTNs per weighting class are shown in Table 1.

**Table 1:** Number of People and Weighted CTN Rate per Weighting Class Used in the First Step of Total Nonresponse Analysis

<i>Class</i>	<i>Number of people</i>	<i>CTN rate (%)</i>
1	37,507	94
2	29,427	85
3	7,655	72
4	2,168	55
<i>Total</i>	76,757 <sup>4</sup>	87

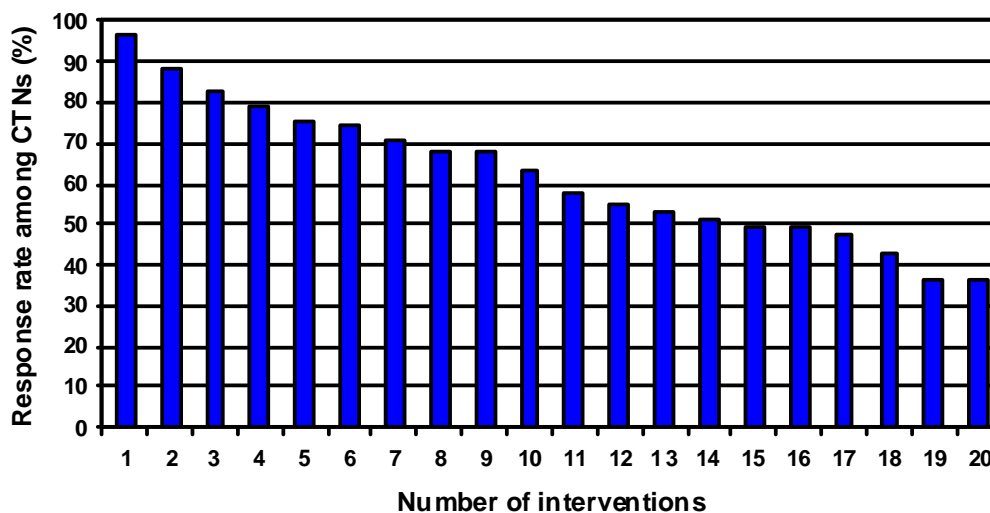
<sup>3</sup> For more details on the score method, see Haziza and Beaumont (2007) as well as Eltinge and Yansaneh (1997).

<sup>4</sup> This number corresponds to the number of people eligible for the survey.

### 3.2.2 Adjustment for nonresponse among people with a confirmed telephone number

Among people for whom we had evidence that the telephone number was correct, there were still some nonrespondents. As opposed to the first adjustment step, this second step was done using the number of interventions in order to take into account the difficulty in reaching the people selected. When looking only at people with a CTN, the relationship between the response rate and the number of interventions is clear, even when the number of interventions is small. Graph 3 illustrates this relationship.

**Graph 3:** Response Rate by Number of Interventions Among CTNs



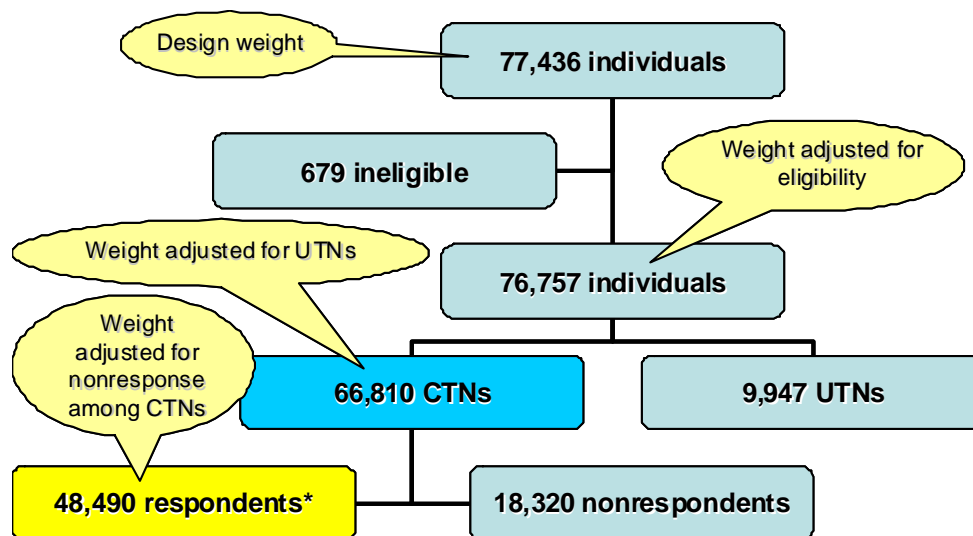
Once again, the score method was used to build weighting classes. This time, the dependent variable for logistic regression was being or not being a respondent in the survey, and the independent variables were the health region, several of the variables used in the model for the previous step, as well as interaction between age and the number of interventions. To simplify modeling, the variable regarding the number of interventions in a case was divided into two possible values, namely “Fewer than three interventions” and “Three or more interventions”. Moreover, since the link between the response rate and this variable only seemed significant among those under 65 years of age, the variable selected for the logistic regression model was the interaction of the number of interventions (two possible values) with age, which reflected this situation.

The weighting classes created using the values predicted from logistic regression therefore bring together individuals with similar characteristics and proportions of respondents. Respondents’ weight was adjusted by the inverse of the response rate in each class. The number of people and the response rate per weighting class are shown in Table 2.

**Table 2:** Number of People and Weighted Response Rate per Weighting Class Used in the Second Step of Total Nonresponse Analysis

<i>Class</i>	<i>Number of people</i>	<i>Response rate (%)</i>
1	13,220	93
2	6,960	81
3	22,602	71
4	19,198	62
5	4,830	53
<i>Total</i>	66,810	73

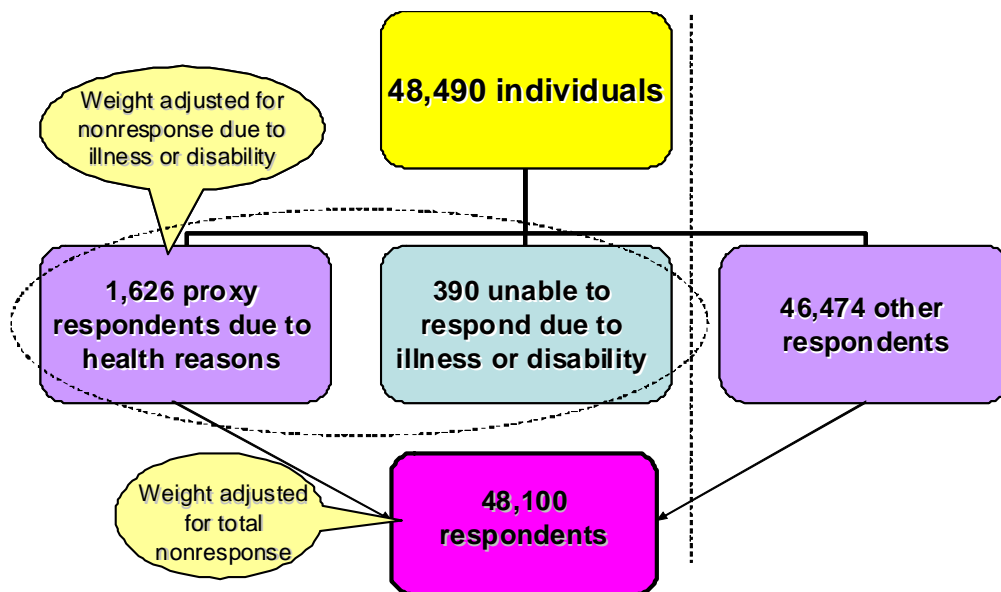
Figure 1 summarizes the first weighting steps, including both steps of the nonresponse adjustment process described in sections 3.2.1 and 3.2.2. It shows that among the 77,436 individuals initially selected, 679 were deemed ineligible. Telephone numbers could not be confirmed for 9,947 of the 76,757 eligible individuals. Finally, among the 66,810 individuals with a confirmed telephone number, 48,490 were considered as respondents. Up to this point, nonrespondents due to illness or disability were considered as respondents, since an adjustment was performed later for this type of nonresponse.

**Figure 1:** Summary of the First Steps of Weighting and Nonresponse Analysis

### 3.3 Nonresponse adjustment for nonrespondents due to illness or disability

For a number of individuals unable to respond to the questionnaire because of illness or disability, it was impossible to find a proxy respondent. These individuals were therefore considered as nonrespondents. Their characteristics were different from those of other nonrespondents, since their questionnaires would have been answered by a third party. We hypothesized that these nonrespondents shared characteristics with people whose questionnaire was answered by a third party due to illness or disability. Weights for proxy respondents due to health reasons were therefore adjusted to represent the nonrespondents for whom no proxy respondent could be found. Two weighting classes were used for adjustment: persons aged 15 to 34 versus those aged 35 and over. Among the 48,490 individuals considered as respondents in the previous nonresponse processing step, 390 were actually nonrespondents due to illness or disability and 1,626 were proxy

respondents due to health reasons. Their weights were therefore adjusted, and the final number of respondents was 48,100. The first weighting class included 108 people and had a 97% response rate, while the second one contained 1,908 people and had a 77% response rate. Figure 2 summarizes this last step of the total nonresponse adjustment. The 46,474 other survey respondents were not impacted by this step. In reality, they belonged to a weighting class with a 100% response rate.



**Figure 2:** Summary of Adjustment for Nonresponse due to Illness or Disability

In summary, the weight of each respondent following adjustment for total nonresponse was calculated using this formula:

$$Weight\_nr = Weight\_d_h * \frac{1}{R\_ctn_i} * \frac{1}{R\_resp_j} * \frac{1}{R\_resp_k}$$

Where  $Weight\_nr$ : Weight adjusted for nonresponse;

$Weight\_d_h$ : Design weight in the stratum  $h = N_h / n_h$ ;

$R\_ctn_i$ : Rate of CTNs in weighting class  $i, i = 1, \dots, 4$ ;

$R\_resp_j$ : Response rate among CTNs<sup>5</sup> in weighting class  $j, j = 1, \dots, 5$ ;

$R\_resp_k$ : Response rate in age group  $k, k = 1, 2, 3$ <sup>6</sup>.

#### 4. Conclusion

The nonresponse adjustment steps helped reduce the risk of bias in the estimates. The very strong association between the number of interventions in a case—which corresponded in most cases to the number of calls made—and the survey response rate prompted us to take this variable into account in the nonresponse adjustment, especially since this variable was also associated with the main survey estimates. Performing the adjustment first to account for people without a confirmed telephone number made it

<sup>5</sup> Nonrespondents due to illness or disability were considered as respondents at this stage.

<sup>6</sup> All respondents who were not proxy respondents due to health reasons were in the group  $k = 3$  and  $R\_resp3 = 1$ .

possible to work around cases where there was no such association, since the calls made were not attempts to reach the person selected.

Furthermore, performing a separate adjustment for individuals whose questionnaire was answered by a third party because of illness or disability to ensure that they represented people in such a situation for whom no proxy respondent could be found also reduced the risk of bias, since these people exhibited characteristics that were different from those of other survey respondents, especially with regard to their health characteristics, which were directly linked to the subject matter of the survey.

### References

- TREMBLAY, M.-E., G. Dubé, and R. Baraldi. (2013). *Enquête québécoise sur l'expérience de soins 2010-2011 : Méthodologie et description de la population visée*, Vol. 1, Institut de la statistique du Québec.
- HAZIZA, D., and J.-F. Beaumont. (2007). On the Construction of Imputation Classes in Surveys. *International Statistical Review*, 75: 25-43.
- ELTINGE, J.L., and I.S. Yansaheh (1997). Diagnostics for Formation of Nonresponse Adjustment Cells, With an Application to Income Nonresponse in the U.S. Consumer Expenditure Survey. *Survey Methodology*, 23: 33-40.