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December 22, 2025

Chair, Michael J. Rodrigues
Senate Committee on Ways and Means
State House, Room 212
Boston, MA 02133

Chair, Aaron Michlewitz
House Committee on Ways and Means
State House, Room 243
Boston, MA 02133

Dear Chairs Rodrigues and Michlewitz,

Line item 4000-0300 of Chapter 140 of the Acts of 2024 requires the Executive Office of Health and Human Services to submit a report to the House and Senate Committees on Ways and Means outlining the agency's methodology for projecting caseload and utilization. To comply with this requirement, we describe below the methodology that has been employed for fiscal year 2025.

MassHealth enrollment expanded dramatically from 2013 to 2015. During the 2014 launch of the Affordable Care Act, the Commonwealth's Health Insurance Exchange ("HIX") – the eligibility system serving both MassHealth and the Massachusetts Health Connector - failed, resulting in our inability to determine eligibility for most applicants to MassHealth. Temporary MassHealth eligibility was granted to all applicants in the period following this failure and enrollment surged to over 2 million members in December 2014. Since this time, MassHealth implemented a functioning HIX system and resumed annual redeterminations on all members. MassHealth has also implemented a series of eligibility integrity initiatives, including reducing HIX functionality defects, implementing new automated data matches with the Department of Revenue and other sources, and enforcing mandatory premium assistance for adults when other insurance (e.g., employer health insurance) is available and cost-effective.

In March 2020, MassHealth suspended eligibility redeterminations and began protecting members' coverage, in response to the federal COVID-19 public health emergency and in accordance with federal maintenance of effort (MOE) requirements. MassHealth restarted the process of redeterminations in May 2021 but has been protecting members' coverage if they are determined ineligible. As a result of the MOE, MassHealth membership grew by 650,000 members from March 2020 to the peak of 2.4 million members in spring 2023. Regular

redetermination processes started again in April 2023 in accordance with federal requirements. Since full MOE redeterminations resumed, MassHealth's primary priority has been to right-size the caseload while ensuring individuals are in the appropriate coverage and minimizing administrative eligibility "churn" that results in health care coverage loss. MassHealth's redetermination process occurred over a year-long period and concluded in May 2024. As of May 2024, MassHealth's caseload was approximately 2.1 million members. MassHealth's caseload remains at approximately 2.1 million members as of December 2024.

Caseload Forecast Methodology

In early 2013, MassHealth worked with Alan Clayton-Matthews, a professor at Northeastern University, to review our existing caseload forecasting methodology and to advise whether improved methodology was possible. Professor Clayton-Matthews tested two methodologies against the existing methodology (see attachment A for technical details of these models and the testing process) by feeding data from June 2006 to July 2009 into the models, using the models to forecast the caseload from July 2009 to June 2011, and comparing these forecasts to actual enrollment over the same period. Professor Clayton-Matthews found that both models presented a lower error rate than the existing methodology and recommended a switch. Based on these findings, MassHealth worked with Professor Clayton-Matthews to implement a new methodology, which is described below.

The caseload forecast begins with historical snapshots of enrollment data. An enrollment snapshot is a report of member eligibility at the time/date the report is run. The eligibility data in a snapshot is broken down by month and population group (there are over 100 population groups which are broken down using program type, managed care status, and demographic factors). Some examples of these groups are "PCC (Primary Care Clinician) Non-Disabled Children", "SCO (Senior Care Organization) Institutional", and "Standard Non-Disabled Children-Premium Assistance." A new enrollment snapshot is produced each month, adding the most recent month's data and updating previous months to account for any enrollment changes. As an example, the snapshot produced in December 2023 contains data through November 30, 2023. Similarly, the snapshot produced in January 2024 will contain data through December 31, 2023.

We use the snapshots to capture the pattern of enrollment for each population group over time and calculate completion factors. Completion factors are multipliers that address the issue of variance in eligibility data based on the effects of redeterminations, retroactive eligibility determinations, application verification eligibility appeals, and member movement among aid categories. See Step 1 of Attachment C for technical details about the completion process.

Once completion factors have been applied, we begin our statistical analysis using STATA, which is a data analysis and statistical software package. This program uses statistical calculations (see page 2 of Attachment A) to find the trend level and builds a trend line off the most recent month of enrollment data, extending through the next fiscal year, for each population group. Next, we adjust for impacts that cannot be captured by the historical trends alone and confirm forecast is consistent with long-term trends reported by CHIA. Finally, we sum all population groups to project the overall MassHealth caseload.

Implementation of this methodology was completed in mid-2013, and we intend to return to using this methodology once the MOE redetermination period concludes. However, due to the unprecedented experience during the MOE period (March 2020 – April 2023), we could not rely on recent historical trends to inform FY25 caseload projections. For FY25, we developed projections based on the number of members going through redeterminations each month and assumed closure rates for different demographic groups. We also considered counts of members becoming newly eligible for MassHealth (i.e., no history of enrollment for 12+ months) and assumed reopening rates for different demographic groups (i.e., members re-enrolling within 12 months of being disenrolled). We used a similar methodology to forecast caseload in FY24.

Utilization and Price Methodology

For MassHealth's managed care capitation programs, MassHealth is mandated to develop actuarially sound capitation rates. MassHealth contracts with Mercer, a health care consulting firm, for this purpose. Mercer uses historical utilization and cost data from MassHealth and trends it forward into the current rate year. Mercer also makes various additional price and utilization adjustments (for example, an adjustment for the cost of new drug therapies coming to market). MassHealth then applies these rates to enrollment projections for each program to estimate total managed care spend for the fiscal year.

MassHealth contracts with the Center for Health Information and Analysis (CHIA) for its Fee-for-Service rate-setting activities. These rates are developed using historical utilization and cost data. MassHealth uses historical spending and enrollment data to calculate historical utilization patterns for each provider type and population group. MassHealth then projects future utilization by applying a best fit trend line using the method of least squares. Additional adjustments are then incorporated to capture the impacts of rate, policy, and regulatory changes. This projected utilization is combined with our caseload forecast to project total spend for the fiscal year.

I hope you find this report useful and informative. If you have any questions, please feel free to contact Sarah Nordberg at Sarah.Nordberg@mass.gov.

Sincerely,

Mike Levine

cc: Kiame Mahaniah, MD, MBA

Attachment A

Test of Three Methodologies for Forecasting MassHealth Caseloads

This document describes:

- Three methodologies for forecasting MassHealth caseloads;
- A pseudo out-of-sample forecast test of the relative effectiveness of the methodologies;
- Interpretation of the findings; and
- Suggestions for proceeding.

Three Modeling Methodologies

The Existing Methodology, Method B

The existing methodology, developed by the Center for Health Policy & Research at the University of Massachusetts Medical School in 2004, assumes that future caseload growth for each population group is best modeled as a continuation of recent growth. This very simple approach was settled on because caseloads did not – and still do not – appear to be statistically related to indicators of trends in either demographics or the economy. In fact, the total caseload in recent years has exhibited essentially constant linear growth, with only minor fluctuations around the trend which appear to be random.

Although the total caseload has exhibited constant growth, individual population group caseloads have not. For most population groups, rates of growth change frequently, often with abrupt discontinuities. Therefore the critical strategy of the existing method involves selecting the most recent period of time for which growth rates were stable, using a method called compounded monthly growth rates (CMGRs) (Center for Health & Policy Analysis, 2004). The method involves a graphical analysis and a subjective choice of choosing the beginning month for the most recent period of stable growth. Although the choice is subjective, and can result in different choices by different analysts, our experience is that the differences between analysts' choices are minor, usually a few months or less.

Once the time period for estimation of the model has been chosen, the current methodology involves estimating a linear regression of the caseload on a time trend. The forecast of the caseload is simply the extrapolation of the estimated linear relationship.

The Autoregressive Model, Method A

An alternative strategy for estimating simple growth models is a time series autoregression. Since caseloads tend to grow over time, the autoregressive model is estimated on the first difference of the natural logarithm of the caseload. The key parameter in this model, the constant, is the trend growth

rate. The autoregressive terms, if any, account for the dynamics of short-run deviations from the trend rate of growth. Autoregressive models produce forecasts in which the growth in the initial periods (initial months, in this context) of the forecast is influenced by recent deviations from the trend rate of growth. After several periods, growth returns to the estimated trend rate.

As in the existing methodology, a key strategy in estimating the autoregressive model is to select the period of recent history for which the growth rate is estimated. In this case, we used the QLR test statistic to select the longest period of time for which the growth rate was statistically constant (Stock and Watson, section 14.7). This strategy typically resulted in selecting an historical period for estimation that was much longer than that selected using Method B.

The autoregressive order of the model was chosen using the AIC and BIC criteria, as described in Stock and Watson, section 14.5.

The Linear Model, Method C

A second alternative strategy involves selecting the time period for estimation using the QLR statistic as in Method A, and then estimating a linear regression of caseload on time as in Method B. Like Method B, the forecast is constructed as a linear extrapolation of the estimated regression line, and the constant of the regression line is adjusted so that the extrapolation proceeds from the caseload level at the end of the estimation period.

The Differences between the Methods

The most important difference between the methods, based upon our analysis, was that the alternative methods A and C selected much longer time periods than the existing methodology, Method B. Methods A and C selected an average estimation period of 33 months over which to estimate the model, while method B only selected an average of 11 months.

There are two differences between methods A and C. One is that Method A assumes that the best simple model for caseload growth is a constant growth *rate* – a result of using the logarithm of the caseload rather than the caseload itself, while Method C (and the existing methodology B) assumes that the best simple model for caseload growth is a constant *change* per period in the caseload. We would expect this to be a minor difference.

The second difference is that Method A, because of its autoregressive structure, will produce forecasts whose rates of growth in the first several periods of the forecast may differ from the trend rate estimated by the model, while Method C (and the existing methodology B) will produce forecasts with constant changes throughout the forecast period. We would also expect these differences to be minor over the course of a two-year forecast, especially given the low-order of autoregressivity exhibited in

the models. Twenty-eight of 58 population groups in our analysis did not exhibit any autoregressivity, and 21 of the remaining groups exhibited only first-order autoregressivity.[1]

Comparing the Methods Using Pseudo Out-of-Sample Forecasts

The relative effectiveness of the methodologies was compared using pseudo out-of-sample forecasts (Stock and Watson, pp. 561-563). The idea is to estimate the models over a period of history that ends in the past, say, at time T, and then to use the estimated models to forecast the "future" past, say from T+1 to T+24. Since the actual caseloads are known over this pseudo forecast period, the errors in the forecasts can be calculated and the competing methods can be compared. The extent to which a forecast is in error is summarized in a single number, the root mean squared forecast error (RMSFE). This is calculated by summing the squared deviations of each period's forecast caseload from the actual caseload, taking the average of this sum, and then taking its square root. The RMSFE can be interpreted as the "average" or "typical" error in each period that can be expected in a forecast. In comparing two alternative models – or methodologies – the one with the lower RMSFE is preferred.

In implementing this strategy, for "history" we used the period July 2006 – the earliest period for which caseload month data were available – to June 2009, so that T=June 2009. For each population group, we then estimated three models, one using Method A, one using the existing methodology B, and a third using Method C; and then used each to forecast caseload over the period July 2009 to June 2011. The RMSFE for each forecast was then computed. The results are displayed in Table 1.

According to these out-of-sample forecasts, no methodology clearly dominates. Method A just barely out-performed the existing Method B, with a lower RMSFE than Method B in 30 of the 58 population groups. Method C's advantage over Method B was somewhat larger, with a lower RMSFE in 35 of the 58 population groups. In comparing Methods A and C against each other, each had a lower RMSFE than the other in 29 of the 58 population groups.

Comparing the Forecast of the Total Caseload versus the Sum of the Forecasts of the Population Groups

Once forecasts of the individual population groups are obtained, these can be summed to obtain a single forecast of the total MassHealth caseload. However, the forecast of the total caseload could also be obtained by estimating a model on the total caseload, and then by using the total caseload model to forecast total caseload. We have no a priori reason to prefer one method over the other in making a forecast of the total caseload, so we also performed pseudo out-of-sample forecasts for the total

[1] Three of MassHealth's 61 population groups have very few or no members assigned to them. For this reason, only 58 of the population groups were included in this analysis.

caseload by constructing a total caseload model using each methodology. We then constructed the RMSFE's for each of these three total models and also calculated the RMSFE's for the sum of the 58 population group forecasts. The RMSFE's are displayed in Table 2.

Comparing the pseudo out-of-sample forecasts of the total caseload model versus the sum of population groups, the total caseload model performed better for both Methods A and C, but not for Method B. Among the three total caseload models, Method A had the lowest RMSFE, followed by Method C.

Interpretation of these Findings

The pseudo out-of-sample forecasts suggest a slight preference for either of the "new" Methods A or C over B, but the preference is slight. The primary finding is that all three methods performed badly in forecasting many of the population groups. In many cases, this is because the forecast period exhibited discontinuous changes. In some cases, this involved shifting of cases from one population group to another within the same budget group cluster. Using the QLR statistic to choose the beginning period of model estimation is helpful, but there were a few population groups in which the indicated estimation period appeared to contain a significant change in trend. In these cases expert judgment should be used in addition to the QLR statistic to choose the estimation period. There were also a few population groups in which the BIC and AIC criteria indicated a high autoregressive order. In two of the three cases, this appeared to result from a very short estimation period, and in those cases the BIC and AIC criteria should not be trusted. A zero-order autoregressive model should be estimated instead.

The experience of this exercise suggests that the best procedure for estimating simple growth models would be to combine Methods A or C with expert judgment, and therefore to use the statistical diagnostics as guides rather than rigid rules.

It is very likely that the total caseload model out-performed the sum of individual population groups in Method A and Method C because of large forecast errors in a few population groups for which expert judgment in the selection of the estimation period may have substantially improved the forecast. This means that a more definitive pseudo out-of-sample test would involve comparing the total caseload model against individual population group models estimated with a combination of expert judgment and Method A or Method C.

For forecasting purposes, use of the total caseload model would still require the estimation of individual population group models in order to distribute the total caseload forecast to the individual population groups. The best procedure is probably to compare the total caseload forecast to the sum of the population groups to see if the forecasts are consistent with each other; and if not, to inspect the individual population group models to identify groups with suspect forecasts.

The most striking observation from this exercise has been the instability of the trends of the individual population groups, even after accounting for shifting from one population group to another within budget group. One would expect caseload trends to respond gradually to changes in demographics, with changes around these trends that are coherent with cyclical changes in the economy. The changes in trend, however, appear to be too abrupt and too short in duration to be the result of demographic trends and business cycles. The changes in trend may be dominated by changes in policy and administrative actions, such as changes in rates of re-determinations and processing. These could account for the frequency and (lack of) duration of trends that we are observing, and also explain why the time series methodology, which happens to be suggesting longer estimation periods, tends to perform marginally better than the existing methodology.

Suggestions for Proceeding

What we have learned suggests two courses of action for improving caseload forecasts:

1. Investigate what information is available about changes in rates of re-determinations and processing, and case openings and closings, and see if these help explain changes in caseloads. If these do, then it is possible that the caseloads adjusted for these administrative actions might correlate better with economic indicators.
2. Use existing data sources, such as the American Community Survey, the Current Population Survey, national surveys of health, and information from the Division of Employment and Training and the Health Connector to estimate the size and characteristics of the eligible population and likely trends in the size of the eligible population. These may be very helpful in forecasting changes in the trend of caseload growth.

Alan Clayton-Matthews , Susan Jureidini, and Mohamed Sesay

March 7, 2013

References

Center for Health Policy & Research, University of Massachusetts Medical School. (2004). Stepwise Methodology for Creating the MassHealth Caseload Member Month Forecast.

Stock, J. H., & Watson, Mark W. (2011). *Introduction to Econometrics* (3rd ed). Boston: Pearson Education, Addison Wesley.

Attachment A

Table 1: Pseudo Out-of-Sample Forecast Results, Three Methods

Pop Group	Title	Pseudo Out-of-Sample Forecast									
		Method A				Method B			Method C		
		AR Order	Beginning Date for Stable Mean Difference	Mean Error	RMSFE	Begin Date for Stable Trend	Mean Error	RMSFE	Break in Trend	Mean Error	RMSFE
0	Other	0	2006m8	181.1	214.2	2008m10	-114.3	120.9	2006m8	872.8	1,015.4
1	HMO Disabled Children	0	2006m8	253.0	452.4	2007m12	701.9	906.4	2006m8	795.4	1,006.3
2	HMO Disabled Adults	1	2006m9	213.7	1,890.8	2008m1	511.6	2,130.2	2006m8	1,089.4	2,555.7
3	PCC Disabled Children	0	2006m8	487.3	506.2	2008m4	577.0	604.9	2006m8	552.7	578.0
4	PCC Disabled Adults	1	2006m9	-455.4	736.7	2008m9	-1,116.0	1,296.1	2006m8	22.7	631.6
5	TPL Disabled Children	0	2006m8	-86.9	173.1	2008m8	-70.9	156.6	2006m8	-52.9	140.8
6	TPL Disabled Adults	0	2006m8	-1,152.0	1,289.2	2008m6	-1,020.3	1,120.2	2006m8	-786.3	861.2
7	FFS Disabled Children	0	2008m7	-1,264.0	1,631.8	2008m8	-1,334.8	1,708.4	2008m7	-1,289.8	1,658.7
8	FFS Disabled Adults	2	2007m1	-1,759.4	4,000.3	2008m10	-2,568.4	4,695.1	2006m1	-1,821.7	4,018.0
9	HMO Non-Disabled Children	1	2006m9	-5,472.4	6,750.1	2008m7	-2,440.5	4,210.8	2006m8	768.2	2,653.1
10	HMO Non-Disabled Adults	1	2006m9	-4,371.5	5,696.9	2008m7	-1,861.7	3,547.9	2006m8	983.2	2,227.2
11	PCC Non-Disabled Children	1	2006m9	7,775.0	8,284.1	2008m7	10,067.0	10,751.2	2006m8	9,332.6	9,930.7
12	PCC Non-Disabled Adults	1	2006m10	1,610.6	2,042.6	2008m11	3,382.5	3,896.0	2006m9	2,233.0	2,619.9
13	TPL Non-Disabled Children	0	2006m10	925.7	1,308.6	2008m11	2,731.7	3,323.2	2006m1	963.1	1,352.1
14	TPL Non-Disabled Adults	0	2007m12	1,840.6	2,437.5	2008m8	2,732.7	3,454.9	2007m1	2,434.3	3,120.3
15	FFS Non-Disabled Children	1	2006m9	-1,088.6	2,090.8	2008m7	-827.9	2,565.1	2006m8	-3,512.9	3,796.3
16	FFS Non-Disabled Adults	1	2006m9	3,777.7	4,399.5	2008m7	-4,154.2	4,198.0	2006m8	-5,119.1	5,170.3
17	FFS Newborns	0	2006m8	4,354.4	4,488.5	2008m11	3,949.7	4,089.9	2006m8	4,518.5	4,653.1
18	Community Seniors	0	2006m8	-188.9	290.7	2008m11	2,144.1	2,422.8	2006m8	-329.9	436.1
19	Institutional Seniors	2	2006m10	638.0	699.3	2008m10	321.0	369.9	2006m8	813.4	882.9
20	Buy-in (Aged)	0	2006m8	1,064.6	1,270.2	2008m4	-465.8	542.8	2006m8	1,362.0	1,606.3
21	Buy-in (Disabled)	6	2007m2	484.0	491.4	2008m2	2,233.1	2,551.6	2006m8	431.6	493.3
22	HMO Basic	1	2006m9	-1,208.4	1,272.0	2008m11	-820.0	892.5	2006m8	-993.7	1,053.3
23	PCC Basic	0	2006m8	-633.6	716.1	2008m11	-717.7	784.7	2006m8	-413.9	585.4
24	Unenrolled Basic	0	2006m8	-3,588.8	3,662.8	2008m7	-3,733.6	3,808.1	2006m8	-3,759.1	3,833.9
25	EAEDC	0	2006m8	846.7	967.2	2008m3	921.5	1,052.7	2006m8	807.3	922.4
26	Basic Premium Assistance	0	2006m8	-6.2	6.7	2008m7	-8.8	9.6	2006m8	-5.2	5.6
27	CommonHealth Working Adults	0	2006m11	80.2	125.8	2008m7	296.1	374.2	2006m1	384.9	474.3
28	CommonHealth Non-Working Adults	1	2006m9	-1.8	30.8	2008m8	-130.3	156.3	2006m8	30.5	37.6
29	CommonHealth Children	0	2006m8	220.4	274.3	2008m5	207.2	259.5	2006m8	229.7	284.9
30	HMO Family Assistance Children	1	2006m10	-8,803.9	9,688.4	2008m8	-5,955.3	6,406.6	2006m9	-5,729.8	6,156.2
31	HMO Family Assistance Adults	6	2008m7	-5,613.3	13,776.8	2008m8	409.3	486.1	2008m1	382.1	455.2
32	PCC Family Assistance Children	1	2006m10	-2,042.8	2,194.0	2008m8	-846.2	933.8	2006m9	-1,193.6	1,283.4
33	PCC Family Assistance Adults	1	2006m9	-579.6	659.9	2008m8	68.9	82.8	2006m8	-17.8	91.0
34	Unenr Family Assistance Children	2	2006m10	254.7	439.1	2008m8	-1,425.6	1,628.5	2006m8	33.7	303.1
35	Unenr Family Assistance Adults	1	2006m9	387.1	391.5	2007m7	-294.8	295.6	2006m8	-318.0	319.4
36	FA IP Premium Assistance Children	0	2007m12	-1,285.4	1,469.0	2007m11	-1,160.7	1,320.3	2007m1	-1,059.8	1,205.5
37	FA IP Premium Assistance Adults	6	2008m10	-262.8	297.8	2008m11	-184.7	201.6	2008m4	-54.5	72.2
38	Limited Children	1	2006m11	893.9	1,045.8	2008m11	248.7	378.0	2006m1	1,240.9	1,385.7
39	Limited Adults	1	2006m11	-2,690.0	3,305.6	2008m07	1,648.8	1,894.6	2006m1	-991.4	1,644.5
40	Prenatal/Presumptive Eligibility	1	2006m9	-80.4	92.1	2008m07	-309.2	325.6	2006m8	-172.1	178.3
41	LTC <65	3	2006m11	-57.1	79.7	2008m11	-78.9	95.6	2006m8	-36.5	71.6
42	Kaleigh-Mulligan/A4E Adoption	1	2006m9	-8.4	13.0	2008m10	12.4	14.6	2006m8	-7.2	11.1
46	Standard Disabled Adult - Prem. Assist.	0	2006m8	-1.9	5.7	2008m9	-5.2	8.7	2006m8	1.0	4.3
47	Standard Non-Disabled Children - Prem.	2	2006m11	-1,659.9	1,927.0	2008m9	-1,571.3	1,806.8	2006m9	-1,102.0	1,271.8
48	Standard Non-Disabled Adult - Prem.	0	2006m8	-729.8	855.7	2008m8	-595.0	687.1	2006m8	-428.6	497.8
49	Commonhealth Premium Assistance	1	2006m12	-91.1	119.0	2008m10	75.0	84.0	2006m11	-90.8	111.3
50	PA Essential	1	2006m9	136.1	144.4	2008m10	107.9	114.6	2006m8	176.6	190.2
51	PCC Essential	1	2006m9	-2,590.4	10,325.8	2008m11	-5,230.0	12,142.1	2006m8	-91.6	8,545.0
52	SCO Community	0	2008m5	1,472.9	1,646.0	2008m8	1,814.9	2,053.2	2008m5	1,775.3	2,008.0
53	SCO Institutional	0	2007m5	-939.7	1,095.1	2008m11	-139.3	146.8	2007m5	-339.9	367.2
54	MCO CommonHealth Working Adult	0	2006m8	178.3	319.8	2008m10	121.3	269.8	2006m8	213.3	354.6
55	PCC CommonHealth Working Adult	2	2006m10	-120.4	302.3	2008m10	-324.6	482.4	2006m8	-89.7	265.8
56	MCO CommonHealth Non Working Adult	0	2006m8	8.2	18.3	2008m11	-5.0	12.3	2006m8	7.2	17.6
57	PCC CommonHealth Non Working Adult	0	2006m8	-9.4	19.9	2008m10	2.8	18.3	2006m8	80.8	95.8
58	MCO CommonHealth Children	0	2006m8	-64.1	70.8	2008m11	-64.6	71.4	2006m8	-63.9	70.7
59	PCC CommonHealth Children	0	2006m8	158.0	175.0	2008m10	164.6	182.6	2006m8	170.3	189.2
60	MCO Essential	0	2006m10	6,873.2	11,061.8	2008m11	9,620.8	14,835.1	2006m10	9,533.4	14,744.5

Table 2: RMSFEs of Individual Models and Total Caseload Models

	RMSFE of Individual Models*	RMSFE of Total Caseload Model**
Method A	19,679	4,015
Method B	7,601	13,157
Method C	14,975	8,167
*58 separate forecasts made, errors summed across forecasts to calculate one rmse		
**58 groups added together to make one total caseload forecast		

ATTACHMENT B

MATHEMATICA Policy Research

REPORT

FINAL REPORT

Medicaid Caseload Forecasting

April 30, 2014

Deborah Chollet

Purvi Sevak

Submitted to:

Commonwealth of Massachusetts
Executive Office for Administration and Finance
State House Room 373
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Reference Number: 40343

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I. INTRODUCTION AND SUMMARY

Historically, Massachusetts has operated 22 programs in Medicaid, each with different eligibility rules and some with different benefit designs. Most of these programs continue today. They include benefits for low-income children, adults, and seniors; for disabled and nondisabled children and adults; and for citizens and noncitizens. Eligibility for each program is limited by family income and by age; some programs also restrict eligibility by employment, firm size, or hours of employment; and some apply an asset test. With implementation of the Affordable Care Act (ACA), some of these programs (specifically, MassHealth Basic, Essential, Healthy Start, and Prenatal) were terminated as of January 2014, and some (CarePlus and Small Business Premium Assistance) were launched.

Massachusetts contracted with Mathematica Policy Research (Mathematica) to estimate the number of individuals in Massachusetts who were eligible for each program historically, from 2009 to 2011, and to identify the relative contribution to rising enrollment associated with two factors: (1) changes in the number of persons eligible for the programs; and (2) changes in the probability of enrollment when eligible. In addition, we were asked to project eligibility and enrollment in MassHealth programs from 2014 to 2020, and to develop confidence intervals around the 2014-2016 projections.

In this report, we present historical estimates and projections of future enrollment and eligibility based on analysis of the Massachusetts sample of the American Community Survey (ACS), which relies on a large population sample (approximately 1 percent). The analysis uses pooled annual samples benchmarked to a single year, thus relying on a still larger population sample for each annual estimate. However, even the pooled samples are insufficient to estimate each of the smaller programs individually; in addition, the ACS does not ask about circumstances (such as disability or immigration status) in the same way as MassHealth considers them. To address these problems, we consider programs in clusters, first defined by the populations served (children, adults, and seniors) and then parsed into programs clusters for each population group.

From analysis of enrollment changes from 2009 to 2011, we find that:

- The changes in enrollment from 2009 to 2011 reflect changes in the estimated number of persons eligible for these programs and in particular, changes in the percentage of persons in each population group with very low income – less than 133 percent of the federal poverty level (FPL).
- The proportion of eligible individuals enrolled in MassHealth grew steadily in each population group from 2009 to 2011, especially among children and seniors.
- Across all population groups and program clusters, greater take up among the eligible population accounted for 61 percent of net enrollment from 2009 to 2011, while an increase in the number of persons eligible accounted for 39 percent.

Based on the underlying analysis and projection of MassHealth enrollment from 2014 to 2020, we find that:

- Statistical (logit) models of enrollment among children, adults, and seniors (respectively) predict 94 percent of total enrollment, when tested against 2012 actual enrollment. The models perform equally well to predict 2012 enrollment in each population group and in most of the program clusters associated with children and seniors. For adults, the enrollment model performs less well overall and, in particular, when predicting enrollment in all but the largest program cluster (Standard and Common). Projections of 2014-2020 enrollment in CarePlus based on this modeling might be substantially low.
- Across all populations, the number of persons *eligible* for any MassHealth program is projected to decline 2.3 percent from 2014 to 2020. The changes in eligibility differ by population group, with projected eligibility among children and adults declining 2.7 percent and 3.8 percent, respectively, while projected eligibility among seniors increases 8.4 percent.
- Across all populations, the projected number of persons *enrolled* in MassHealth declines 5.8 percent from 2014 to 2020, with MassHealth serving 2.4 percent fewer children and 10.1 percent fewer adults in 2020 than in 2014. In contrast, the projected number of seniors enrolled in MassHealth grows more than 1 percent each year, cumulatively increasing 8.4 percent from 2014 to 2020.
- The changes in projected enrollment from 2014 to 2020 by population group are largely mirrored at the program level, when projected enrollment by population group is parsed into program clusters. Enrollment in every program cluster that serves children is projected to decline gradually each year. Among adults, the decline in projected enrollment is due largely to a relatively steep decline in Standard and Common and CarePlus enrollment, even as enrollment in Basic/Essential and Family Assistance is projected to rise. Enrollment among seniors is projected to grow in both program clusters that serve them, but more in the buy-in program than in Standard/Essential/Limited.

These projection results represent efficient estimates at the population level—that is, the 2014-2016 estimates for each population group are valid with 95 percent confidence within 1 percentage point above or below the mean projection, and often within 0.3 percent. However, the models themselves explained 23-56 percent of the variation in enrollment in 2011, and they predicted enrollment in 2012 that was 94 percent of actual enrollment. Thus, the unexplained heterogeneity in the models is embedded in the projections, even if it is not apparent in the calculation of confidence intervals.

Both phases of the analysis outlined above are presented in the following chapters. In Chapter II, we present the analysis decomposing the change in enrollment from 2009 to 2011 due to population change versus change in take up within each population group and by program cluster. In Chapter III, we present projections of eligibility and enrollment from 2014 to 2020, again by population group and program cluster. The data and methods used to support both analyses are described in Appendix A. The data elements and logic used to assign individuals to eligibility in each program cluster from 2009 to 2012 are reported in Appendix B. Modifications to that logic, for the purpose of projecting eligibility for each program cluster from 2014 to 2020, are reported in Appendix C.

II. DECOMPOSITION OF ENROLLMENT CHANGES

In this chapter, changes in MassHealth enrollment and estimated eligibility among children (age 0-18), adults (age 19-64), and seniors (age 65 and older) from 2009 to 2011 are presented, in total and by program cluster. Changes in enrollment are decomposed by year, population group, and program cluster into two component parts: (1) the change in enrollment due to a change in the take up rate among the eligible population; and (2) the change in enrollment due to a change in the number of people eligible for the program.

A. Changes in enrollment

From 2009 to 2011, enrollment in MassHealth programs grew 8.3 percent—an increase of approximately 103,000 enrollees over the 3-year period (Table II.1). Adults accounted for 57.8 percent of the total growth in MassHealth enrollment from 2009 to 2011; nearly 60,000 more adults were enrolled in 2011 than in 2009, about equally divided between the Standard and Common programs and Basic/Essential and Family Assistance programs.

Table II.1. Change in MassHealth enrollment by population group and program cluster, 2009-2011

Population and Program Cluster	2009	2010	2011	Change 2009-2011	Percent Change 2009-2011	Percent of Total Enrollment Change 2009-2011
Total, all populations and programs	1,242,341	1,295,797	1,345,539	103,197	8.3%	100.0%
Children	515,212	533,567	548,724	33,512	6.5%	32.5%
Standard and Common	439,336	459,815	473,179	33,843	7.7%	32.8%
Family Assistance	58,974	56,710	58,930	-45	-0.1%	0.0%
Limited, CMSP	16,901	17,043	16,615	-286	-1.7%	-0.3%
Adults	584,024	614,181	643,670	59,647	10.2%	57.8%
Standard and Common	434,620	447,828	460,790	26,170	6.0%	25.4%
Basic/Essential and Family Assistance	98,064	110,851	126,347	28,282	28.8%	27.4%
Limited, Prenatal	50,132	53,913	54,338	4,206	8.4%	4.1%
Buy-in	1,208	1,590	2,196	988	81.9%	1.0%
Seniors	143,106	148,049	153,144	10,038	7.0%	9.7%
Standard, Essential and Limited	124,823	128,881	132,510	7,687	6.2%	7.4%
Buy-in	18,283	19,168	20,634	2,351	12.9%	2.3%

Source: Mathematica Policy Research analysis of 2009-2011 MassHealth data.
Note: See Appendix A for definitions of population groups and program clusters.

Enrollment among children and seniors grew more slowly than among adults. Children's enrollment grew 6.5 percent, with larger growth in Standard and Common (7.7 percent) and declining enrollment in Family Assistance (-0.1 percent) and Limited/CMSP (-1.7 percent), Children accounted for 32.5 percent of enrollment growth across all MassHealth programs from 2009 to 2011.

MassHealth enrollment among seniors grew at about the same pace as among children, by 7 percent from 2009 to 2011, and about twice as fast (from a smaller base) in the Buy-in program as in the Standard, Essential, and Limited program cluster. Seniors accounted for 9.7 percent of the total increase in MassHealth enrollment from 2009 to 2011.

B. Changes in eligibility

The increase in total enrollment noted above corresponds to an increase in the total number of persons eligible for MassHealth programs. Estimated eligibility for one or more MassHealth programs increased 3.2 percent from 2009 to 2011, by more than 90,000 persons (Table II.2).

Table II.2. Change in the estimated eligible population by population group and program cluster, 2009-2011

Population and Program Cluster	2009	2010	2011	Percent Change 2009-2010	Percent Change 2010-2011	Summary: Percent Change 2009-2011	Change in Number of Estimated Eligibles 2009-2011	Percent of Total Change in Estimated Eligible Adults and Children 2009-2011
Total, all populations and programs	2,798,050	2,829,249	2,888,666	1.1%	2.1%	3.2%	90,616	n/a
Total, children and adults, all programs	2,479,991	2,515,072	2,577,480	1.4%	2.5%	3.9%	97,489	100.0%
Children	757,404	758,669	766,604	0.2%	1.0%	1.2%	9,200	9.4%
Standard and Common	594,961	598,193	607,520	0.5%	1.6%	2.1%	12,559	12.9%
Family Assistance	128,907	123,399	123,915	-4.3%	0.4%	-3.9%	-4,991	-5.1%
Limited, CMSP	37,855	41,076	38,629	8.5%	-6.0%	2.0%	775	0.8%
Adults	1,722,588	1,756,403	1,810,877	2.0%	3.1%	5.1%	88,289	90.6%
Standard and Common	612,823	642,103	655,309	4.8%	2.1%	6.9%	42,485	43.6%
Basic/Essential and Family Assistance	1,005,196	1,012,071	1,047,326	0.7%	3.5%	4.2%	42,130	43.2%
Limited, Prenatal	88,916	87,530	87,693	-1.6%	0.2%	-1.4%	-1,223	-1.3%
Buy-in	35,503	31,883	36,975	-10.2%	16.0%	4.1%	1,472	1.5%
Seniors	318,058	314,177	311,186	-1.2%	-1.0%	-2.2%	-6,873	n/a
Standard, Essential and Limited	253,551	246,070	251,850	-3.0%	2.3%	-0.7%	-1,701	n/a
Buy-in	64,508	68,106	59,336	5.6%	-12.9%	-8.0%	-5,172	n/a

Source: Mathematica Policy Research analysis of 2009-2011 American Community Survey data, Massachusetts population sample.

Notes: See Appendix A for definitions of population groups and program clusters. Persons eligible for programs in more than one cluster are counted in each cluster. As a result, the number of persons in the program clusters may not sum to the population group totals.

All of the increase in the eligible population was due to growth in the number of eligible adults and children. The number of adults eligible for MassHealth grew 5.1 percent from 2009 to

2011, with the increase about evenly divided between Standard and Common (where the number of eligible adults grew 6.9 percent, by approximately 42,000 adults) and Basic/Essential and Family Assistance (where the number of eligible adults grew 4.2 percent, also approximately 42,000 persons). Adults accounted for 90.6 percent of the increase in the number of persons eligible for MassHealth from 2009 to 2011, net of the small decline in the estimated number of eligible seniors.

The number of children eligible for MassHealth grew more slowly, by 1.2 percent from 2009 to 2011. Nearly all of the increase was due to growth in eligibility for Standard and Common (where the number of eligible children grew 2.1 percent). Children eligible for Limited/CMSP also grew (by 2.0 percent), but from a very small base.

In contrast, the number of seniors eligible for any MassHealth program declined 2.2 percent, mostly due to fewer seniors eligible for the buy-in programs. However, the number of seniors eligible for other MassHealth programs (Standard, Essential, and Limited) also declined slightly, by 0.7 percent.

The change in the number of persons eligible for specific MassHealth programs is reflected in the changing income distribution among the population eligible for any MassHealth program from 2009 to 2011 (Table II.3). The number of eligible children in families with income below 133 percent FPL grew 7.0 percent from 2009 to 2011, while the number of eligible adults with family income below 133 percent FPL grew 11.5 percent. The number of seniors eligible for any MassHealth program fell overall, but much faster among those with income above 133 percent FPL (- 4.6 percent) than among seniors with lower incomes (-0.2 percent).

Table II.3. Estimated number of persons eligible for MassHealth by federal poverty level, 2009-2011

Population and Program Cluster	2009	2010	2011	Percent Change 2009-2010	Percent Change 2010-2011	Percent Change 2009-2011
Total	2,798,050	2,829,249	2,888,666	1.1%	2.1%	3.2%
Children	757,404	758,669	766,604	0.2%	1.0%	1.2%
0-133% FPL	323,421	339,960	346,156	5.1%	1.8%	7.0%
Above 133% FPL	433,983	418,709	420,448	-3.5%	0.4%	-3.1%
Adults	1,722,588	1,756,403	1,810,877	2.0%	3.1%	5.1%
0-133% FPL	560,404	613,713	624,858	9.5%	1.8%	11.5%
Above 133% FPL	1,162,184	1,142,691	1,186,019	-1.7%	3.8%	2.1%
Seniors	318,058	314,177	311,186	-1.2%	-1.0%	-2.2%
0-133% FPL	183,436	179,953	183,158	-1.9%	1.8%	-0.2%
Above 133% FPL	134,622	134,224	128,028	-0.3%	-4.6%	-4.9%

Source: Mathematica Policy Research analysis of 2009-2011 American Community Survey data, Massachusetts population sample.

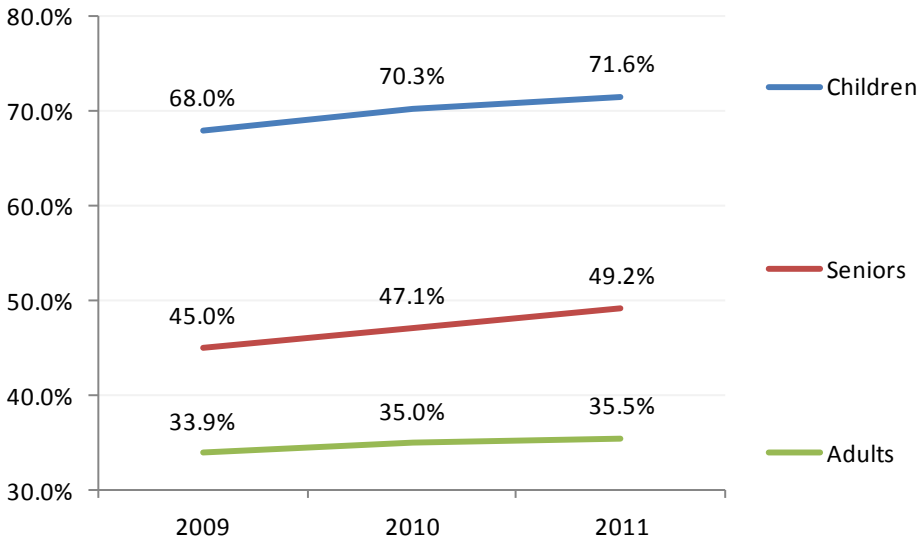
Notes: See Appendix A for definitions of population groups. For comparison with projections of eligibility and enrollment in 2014 through 2020, federal poverty levels are estimated as Modified Adjusted Gross Income (MAGI) divided by HHS-determined poverty income. The 5-percent FPL income disregard that the ACA requires as of 2014 is not applied.

C. Changes in take up

The proportion of eligible individuals enrolled in MassHealth (take up) grew steadily in each population group from 2009 to 2011. Take up among children grew from 68.0 percent in 2009 to 71.6 percent in 2011, while take up among seniors grew from 45.0 percent to 49.2 percent (Figure 1). Take up among adults grew more slowly, from 33.9 percent to 35.5 percent.

Among eligible children, take up in the largest program cluster for children, Standard and Common, grew more than in other program clusters, rising from 73.8 percent of eligible children in 2009 to 77.9 percent in 2011 (Table II.4). Among adults, take up of Standard and Common (also the largest program cluster for adults) was about the same in 2009 (70.9 percent) as in 2011 (70.3 percent), but take up in the smaller Basic/Essential program cluster increased from 9.8 percent in 2009 to 12.1 percent in 2011. Among eligible seniors, take up in both program clusters increased, but faster in the relatively small buy-in programs, from 28.3 percent in 2009 to 34.8 percent in 2011.

Figure II.1. MassHealth enrollment as a percent of eligible children, adults, and seniors, 2009-2011



Source: Mathematica Policy Research analysis of 2009-2011 American Community Survey data, Massachusetts population sample.

Note: See Appendix A for definitions of population groups and represented programs.

Table II.4. Estimated take up rates by population group and program cluster, 2009-2011

Population and Program Cluster	2009		2010		2011	
	Enrollment	Estimated Take up	Enrollment	Estimated Take up	Enrollment	Estimated Take up
Total	1,242,341	44.4%	1,295,797	45.8%	1,345,539	46.6%
Children	515,212	68.0%	533,567	70.3%	548,724	71.6%
Standard and Common	439,336	73.8%	459,815	76.9%	473,179	77.9%
Family Assistance	58,974	45.7%	56,710	46.0%	58,930	47.6%
Limited, CMSP	16,901	44.6%	17,043	41.5%	16,615	43.0%
Adults	584,024	33.9%	614,181	35.0%	643,670	35.5%
Standard and Common	434,620	70.9%	447,828	69.7%	460,790	70.3%
Basic/Essential and Family Assistance	98,064	9.8%	110,851	11.0%	126,347	12.1%
Limited, Prenatal	50,132	56.4%	53,913	61.6%	54,338	62.0%
Buy-in	1,208	3.4%	1,590	5.0%	2,196	5.9%
Seniors	143,106	45.0%	148,049	47.1%	153,144	49.2%
Standard, Essential and Limited	124,823	49.2%	128,881	52.4%	132,510	52.6%
Buy-in	18,283	28.3%	19,168	28.1%	20,634	34.8%

Source: Mathematica Policy Research analysis of 2009-2011 program and American Community Survey data, Massachusetts population sample.
Note: See Appendix A for definitions of population groups and program clusters.

D. Decomposition of enrollment changes

In this section, we present estimates of enrolment from 2009-2010 decomposed as (1) the change in enrollment due to a change in take up; and (2) the change in enrollment due to a change in the number of eligible persons. The change in enrollment from the base year due to a change in the rate of take up is calculated as the difference between enrollment in year *t* and the enrollment that would have occurred had the take up rate not changed from the base year *b*. That is, where E_t and L_t are the number of persons respectively enrolled and eligible in year *t*, the change in enrollment due to a change in the rate of take up *r* is:

$$\Delta_r = E_t - (L_t * r_b)$$

The change in enrollment due to a change in the number of people eligible is calculated as the residual, that is:

$$\Delta_L = E_t - E_b - \Delta_r = (L_t - L_b) * r_b$$

The eligibility and take up components of the annual and 2-year change in MassHealth enrollment from 2009 to 2011 are shown by population group in Figure 2. Two aspects of these changes are noteworthy: First, the factors that drove change in each population group are different. Among children, increased take up accounted for most of the change each year, and for 78 percent of the change in enrollment over two years. Among seniors, increased take up accounted for all of the increase in enrollment from 2009-2010 (as the estimated number of

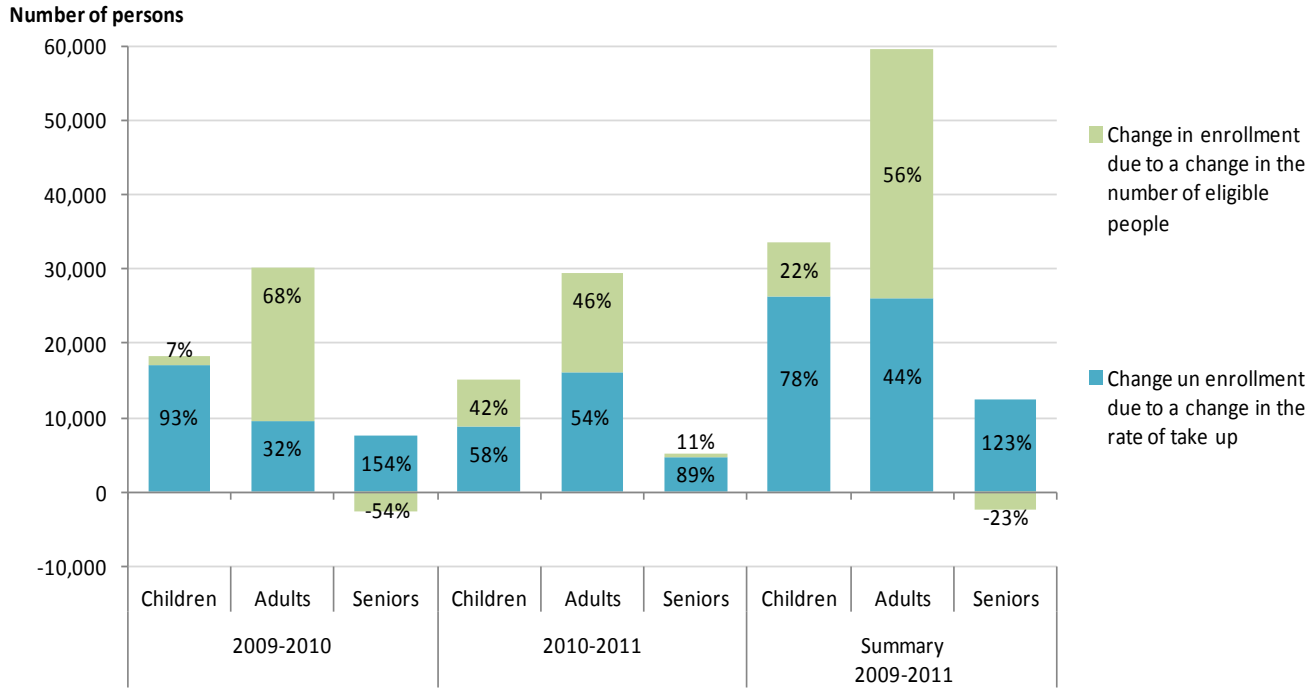
eligible seniors declined) and 89 percent of increase in enrollment from 2010 to 2011. As shown in Table II.5, across all population groups and program clusters, greater take up accounted for 61 percent of net enrollment from 2009 to 2011, and an increase in the eligible population accounted for 39 percent.

Second, the changes in enrollment associated, respectively, with changes in take up and changes in the number of eligible people vary widely by program cluster. For example, the relatively large increase in children's enrollment in Standard and Common from 2009 to 2010 was predominantly due to an increase in take up (88.3 percent); while the smaller increase in enrollment from 2010 to 2011, was due to both to higher take up (46.4 percent) and larger numbers of eligible children (53.6 percent).

Among adults, growth in the number of eligible adults accounted for all of the increase in enrollment in Standard and Common from 2009 to 2010, and 71.1 percent of the increase from 2010 to 2011. Conversely, in Basic/Essential and Family Assistance, most of the increase in enrollment both 2010 and 2011 was due to increased take up. Over both years, greater take up accounted for 85.5 percent of the increase in the number of adults enrolled in Basic/Essential and Family Assistance.

Similarly, greater take up accounted for all of the increase in MassHealth enrollment among seniors in both Standard/Essential/Limited and the buy-in program over the two-year period from 2009-2011, as eligibility declined. However, from 2010 to 2011, both higher take up and growth in the size of the eligible population accounted for the one-year increase seniors' enrollment in the larger Standard/Essential/Limited program cluster.

Figure II.2: Decomposition of the change in MassHealth enrollment by population group, 2009-2011



Source: Mathematica Policy Research analysis of 2009-2011 American Community Survey data, Massachusetts population sample.

Note: See Appendix A for definitions of population groups and represented programs.

Table II.5. Decomposition of MassHealth enrollment change by program cluster and population group, 2009-2011

Population and Program Cluster	2009-2010			2010-2011			Summary: 2009-2011		
		Percent of Enrollment Change Due to:			Percent of Enrollment Change Due to:			Percent of Enrollment Change Due to:	
	Change in Enrollment	Change in Take Up	Change in Number Eligible	Change in Enrollment	Change in Take Up	Change in Number Eligible	Change in Enrollment	Change in Take Up	Change in Number Eligible
Total	53,456	74.1%	25.9%	49,741	45.3%	54.7%	103,197	61.0%	39.0%
Children	18,355	92.9%	7.1%	15,157	57.8%	42.2%	33,512	78.1%	21.9%
Standard and Common	20,478	88.3%	11.7%	13,365	46.4%	53.6%	33,843	72.6%	27.4%
Family Assistance	-2,265	-11.3%	111.3%	2,220	89.3%	10.7%	-45	-5023.6%	5123.6%
Limited, CMSP	141	-917.2%	1017.2%	-428	-137.4%	237.4%	-286	220.9%	-120.9%
Adults	30,158	31.9%	68.1%	29,489	54.5%	45.5%	59,647	43.7%	56.3%
Standard and Common	13,208	-57.2%	157.2%	12,962	28.9%	71.1%	26,170	-15.1%	115.1%
Basic/ Essential and Family Assistance	12,787	94.8%	5.2%	15,495	75.1%	24.9%	28,282	85.5%	14.5%
Limited, Prenatal	3,781	120.7%	-20.7%	425	76.5%	23.5%	4,206	116.4%	-16.4%
Buy-in	382	132.2%	-32.2%	607	58.2%	41.8%	988	94.9%	5.1%
Seniors	4,943	153.9%	-53.9%	5,095	89.0%	11.0%	10,038	122.9%	-22.9%
Standard, Essential and Limited	4,058	190.7%	-90.7%	3,629	16.6%	83.4%	7,687	110.9%	-10.9%
Buy-in	885	-15.3%	115.3%	1,466	268.4%	-168.4%	2,351	162.3%	-62.3%

Source: Mathematica Policy Research analysis of 2009-2011 program and American Community Survey data, Massachusetts population sample.

Note: See Appendix A for definitions of population groups and program clusters.

III. MassHealth Enrollment Projections

In this chapter, we report MassHealth enrollment projections from 2014 to 2020. In Section A, we summarize our projection methods; in Section B, estimates of enrollment in 2012 using those methods are presented and compared to actual 2012 enrollment. In Section C, projected enrollment from 2014 to 2020 is presented, inclusive of ACA effects on enrollment in current programs as well as in the new CarePlus program for low-income adults. Confidence intervals around the mean 2014-2016 enrollment projections for each population group are reported in Section D.

A. Projection methods

Our projection methods allow two sources of change in eligibility for MassHealth: (1) population changes (specifically, changes in the size and age of the population, as well as the occupational and industry mix of employment); and (2) changes in program eligibility. As described in Appendix A, we benchmarked the baseline population to reflect the population and employment projections in each forecast year, 2014-2020.

To predict enrollment among the eligible population, we estimated three logit regression models on the 2011 ACS predicting enrollment among (respectively) children, adults, and seniors as a function of various personal and family characteristics. To support prediction of enrollment in CarePlus, we included adults eligible for Commonwealth Care in the model estimated for adults. The estimated coefficients for each model, when applied to individuals in the projected population data, generate a predicted probability of enrollment for each individual in each projected year, consistent with 2011 enrollment behavior.

Once the ACA changes in program eligibility that occur in 2014 are assigned, only changes in the distribution of characteristics within the population groups—including their age and employment characteristics as well as changes in characteristics that correlate with age and employment, such as income—drive changes in projected enrollment. The rules used to assign eligibility in all years from 2014 to 2020 are listed in Appendix C.

B. Comparing 2012 projected to actual enrollment

To gauge the models' ability to predict enrollment accurately, we projected 2012 enrollment and compared the results to administrative enrollment counts. Comparisons for each population group and program cluster are presented in Table III.1.

On average, the models predict 94 percent of total enrollment, and they perform about equally well for each population group. They also perform about equally well—within 6 percentage points—for most of the program clusters associated with children and seniors. For some program clusters (Family Assistance for children and the buy-in program for seniors), the models predicted within 3 percentage points.

Table III.1. Actual and projected enrollment by population group and program cluster, 2012

Population and program cluster	Actual Enrollment	Predicted Enrollment	Ratio of Predicted to Actual Enrollment
Total, all populations and programs	1,636,304	1,536,665	0.94
Children	562,064	535,022	0.95
Standard and common	486,148	456,781	0.94
Family assistance	59,649	60,013	1.01
Limited, CMSP	16,267	18,228	1.12
Adults	913,742	849,083	0.93
Standard and common	476,080	447,340	0.94
Basic/essential, family assistance	136,379	174,639	1.28
Limited, prenatal	55,840	49,978	0.90
Buy-in	2,639	7,236	2.74
Commonwealth care[a]	242,804	169,890	0.70
Seniors	160,498	152,559	0.95
Standard, essential, and limited	138,998	130,389	0.94
Buy-in	21,500	22,170	1.03

[a] Enrollment in Commonwealth Care, which was not a MassHealth program and is discontinued as of 2014, was projected as an indicator of potential enrollment in HealthPlus.

However, the take up model for adults performs less well overall (predicting 93 percent of actual enrollment, versus 95 percent for children and seniors), and it performs substantially less well when parsed into all but the largest program cluster (Standard and Common). The model predicts enrollment in the smallest program cluster (adult buy-in, with fewer than 3,000 actual enrollees in 2012) with the greatest error, predicting 2.74 times actual enrollment. Conversely, it underestimates enrollment in Commonwealth Care by 30 percent—suggesting that our projections of enrollment in CarePlus are substantially less than might actually occur.

C. Projected eligibility and enrollment

We projected eligibility within each population group from 2014 to 2020. Changes in the projected number of persons eligible are driven only by changes in the demographic and employment characteristics of the projected population. Consequently, they do not reflect a number of economic changes that are not measured by employment status—including, for example, potential changes in productivity due to technological change or projected changes in retirement income among seniors.

Table III.2 presents projections by year and population group. We project that across all populations, the number of persons eligible for any MassHealth program will decline 2.3 percent between 2014 and 2020. However, the changes in eligibility differ by population group, with eligibility among seniors increasing 8.4 percent, eligibility among children declining 2.7 percent, and adult eligibility declining 3.8 percent. Approximately half of the change in eligibility among children (-1.4 percentage points) is projected to occur from 2014 to 2015.

Table III.2. Projected number of persons eligible for MassHealth by population group, 2014-2020

Year	Total	Children	Adults	Seniors
Average monthly eligible				
2014	3,280,562	725,176	2,214,183	341,204
2015	3,277,668	714,826	2,216,470	346,372
2016	3,260,178	712,835	2,196,755	350,588
2017	3,244,290	710,902	2,178,351	355,037
2018	3,230,013	709,029	2,161,248	359,737
2019	3,217,362	707,219	2,145,435	364,708
2020	3,206,350	705,473	2,130,903	369,974
Annual change				
2014-2015	-0.1%	-1.4%	0.1%	1.5%
2015-2016	-0.5%	-0.3%	-0.9%	1.2%
2016-2017	-0.5%	-0.3%	-0.8%	1.3%
2017-2018	-0.4%	-0.3%	-0.8%	1.3%
2018-2019	-0.4%	-0.3%	-0.7%	1.4%
2019-2020	-0.3%	-0.2%	-0.7%	1.4%
Total change, 2014-2020	-2.3%	-2.7%	-3.8%	8.4%

As described above, projected enrollment by population group is based on the enrollment models estimated for children, adults, and seniors, applied to the projected population in each year. Consistent with declining eligibility for MassHealth overall, total enrollment in MassHealth is projected to decline (-5.8 percent, from 2014 to 2020), due to fewer children and adults projected to enroll (Table III.3). The number of children and adults enrolled in MassHealth is projected to decline each year, with MassHealth serving 2.4 percent fewer children and 10.1 percent fewer adults in 2020 than in 2014. In contrast, the number of seniors projected to enroll in MassHealth increases by more than 1 percent each year, and cumulatively by 8.4 percent from 2014 to 2020.

Table III.3. Projected MassHealth enrollment by population group, 2014-2020

Year	Total	Children	Adults	Seniors
Average monthly enrollment				
2014	1,614,304	520,615	932,603	161,086
2015	1,600,612	513,640	923,175	163,798
2016	1,582,086	512,410	903,942	165,735
2017	1,564,820	511,224	885,821	167,775
2018	1,548,816	510,083	868,804	169,928
2019	1,534,075	508,990	852,880	172,205
2020	1,520,599	507,945	838,038	174,616
Annual change				
2014-2015	-0.8%	-1.3%	-1.0%	1.7%
2015-2016	-1.2%	-0.2%	-2.1%	1.2%
2016-2017	-1.1%	-0.2%	-2.0%	1.2%
2017-2018	-1.0%	-0.2%	-1.9%	1.3%
2018-2019	-1.0%	-0.2%	-1.8%	1.3%
2019-2020	-0.9%	-0.2%	-1.7%	1.4%
Summary: 2014-2020	-5.8%	-2.4%	-10.1%	8.4%

The changes in projected enrollment by population group are largely mirrored at the program level, when projected enrollment is parsed into program clusters. Enrollment in nearly every program cluster that serves children or adults is projected to fall each year from 2014 to 2020. The largest decline in children's enrollment is projected to occur in 2014-2015 (-1.3 percent in Standard and Common, and -1.5 percent in Family Assistance and Limited/CMSP) (Table III.4). In all other years, from 2015 to 2020, children's enrollment is projected to decline 0.2 percent per year.

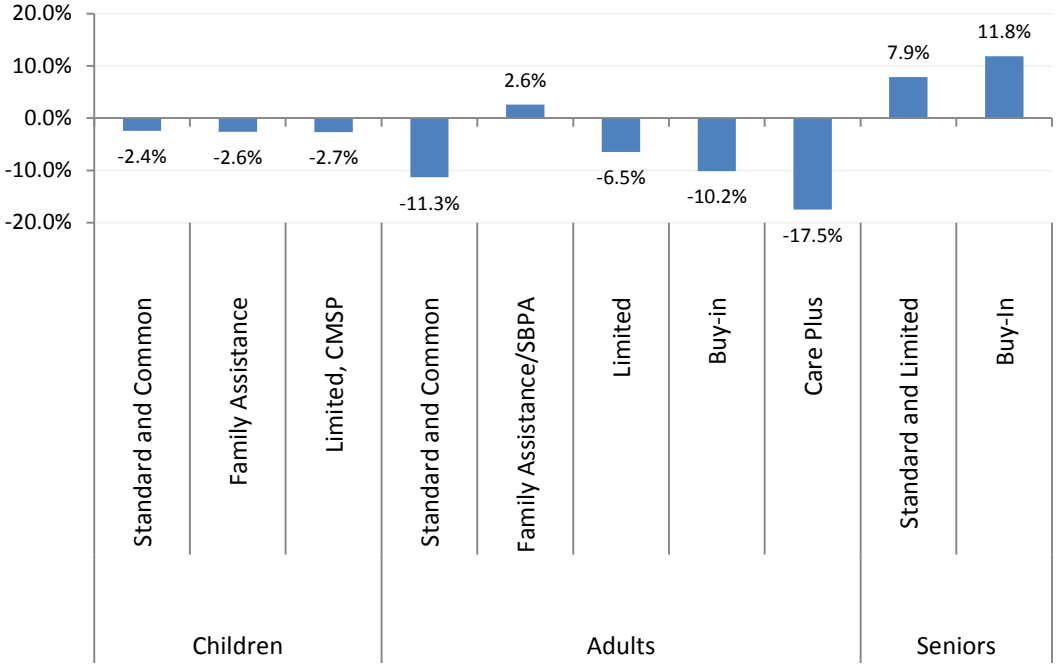
Among adults, total enrollment is projected to decline faster from 2015 to 2020 than from 2014 to 2015, driven by declining enrollment in two of the three largest program clusters that serve adults—Standard and Common, and CarePlus. From 2015 to 2020, adult enrollment in Standard and Common is projected to decline more than 2 percent per year, while enrollment in CarePlus is projected to decline more than 3 percent per year. Cumulatively, from 2014 to 2020, adult enrollment in Standard and Common is projected to decline 11.3 percent, while enrollment in CarePlus is projected to decline 17.5 percent (Figure III.1). That said, as noted in Section B, the enrollment model estimated for adults under-predicts enrollment in both programs, and especially in CarePlus; whether the model increasingly under-predicts over time (so as to predict steadily declining enrollment in these programs) might warrant further investigation. In contrast to all other MassHealth programs that serve adults, enrollment in Family Assistance or Small Business Premium Assistance (SBPA) program cluster is projected to maintain enrollment, increasing 1 percent from 2014 to 2015 and 0.3 percent each year from 2015 to 2020.

Table III.4. Projected MassHealth enrollment by population group and program cluster, 2014-2020

	2014	2015	2016	2017	2018	2019	2020
Projected average monthly enrollment							
Total, all populations and programs	1,614,304	1,600,612	1,582,086	1,564,820	1,548,816	1,534,075	1,520,599
Children	520,615	513,640	512,410	511,224	510,083	508,990	507,945
Standard and Common	448,155	442,274	441,216	440,196	439,217	438,281	437,387
Family Assistance	54,790	53,967	53,839	53,715	53,594	53,478	53,365
Limited, CMSP	17,670	17,398	17,355	17,313	17,272	17,232	17,193
Adults	932,603	923,175	903,942	885,821	868,804	852,880	838,038
Standard and Common	477,239	470,635	459,959	449,881	440,395	431,495	423,175
Family Assistance/SBPA	166,459	168,195	168,668	169,166	169,689	170,235	170,804
Limited	46,650	46,114	45,534	44,995	44,499	44,045	43,633
Buy-in	7,130	7,089	6,934	6,788	6,651	6,524	6,405
Care Plus	235,124	231,142	222,848	214,991	207,570	200,581	194,021
Seniors	161,086	163,798	165,735	167,775	169,928	172,205	174,616
Standard and Limited	139,406	141,702	143,258	144,894	146,619	148,441	150,370
Buy-In	21,680	22,096	22,477	22,881	23,310	23,764	24,247
Annual percentage change in projected average monthly enrollment							
Total, all populations and programs	--	-0.8%	-1.2%	-1.1%	-1.0%	-1.0%	-0.9%
Children	--	-1.3%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
Standard and Common	--	-1.3%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
Family Assistance	--	-1.5%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
Limited, CMSP	--	-1.5%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
Adults	--	-1.0%	-2.1%	-2.0%	-1.9%	-1.8%	-1.7%
Standard and Common	--	-1.4%	-2.3%	-2.2%	-2.1%	-2.0%	-1.9%
Family Assistance/SBPA	--	1.0%	0.3%	0.3%	0.3%	0.3%	0.3%
Limited	--	-1.1%	-1.3%	-1.2%	-1.1%	-1.0%	-0.9%
Buy-in	--	-0.6%	-2.2%	-2.1%	-2.0%	-1.9%	-1.8%
Care Plus	--	-1.7%	-3.6%	-3.5%	-3.5%	-3.4%	-3.3%
Seniors	--	1.7%	1.2%	1.2%	1.3%	1.3%	1.4%
Standard and Limited	--	1.6%	1.1%	1.1%	1.2%	1.2%	1.3%
Buy-In	--	1.9%	1.7%	1.8%	1.9%	1.9%	2.0%

In contrast to declining MassHealth enrollment among children and adults in nearly all program clusters, the number of seniors enrolled in MassHealth is projected to rise in both program clusters that serve them, and to rise faster in the buy-in program than in the Standard/Essential/Limited programs. The number of seniors enrolled in the buy-in programs is projected to increase 11.8 percent, compared with a 7.9 percent increase in seniors projected to enroll in the Standard/Essential/Limited programs (Figure III.1).

Figure III.1. Cumulative change in projected enrollment by population group and program cluster, 2014-2020



D. Confidence intervals for 2014-2016 projected enrollment

We estimated confidence intervals around projected enrollment for each population subgroup in 2014, 2015, and 2016. In general, the confidence intervals for the estimates are narrow, reflecting specification of the enrollment models to include only highly predictive independent variables. The estimates for children are the most efficient: with 95 percent confidence, the estimates are within 0.2 percent of mean projected enrollment (Table III.5). The confidence intervals for adults are similarly narrow: within 0.3 percent of projected enrollment. The projections for seniors are the least efficient, but the enrollment projections for seniors are nevertheless within 0.9 percent of mean projected enrollment with 95 percent confidence.

Table III.5. Confidence intervals for projected enrollment by population group, 2014-2016

	2014		2015		2016	
	Projected Mean	95 Percent Confidence Interval	Projected Mean	95 Percent Confidence Interval	Projected Mean	95 Percent Confidence Interval
Children	520,570	+/- 0.2%	513,588	+/- 0.2%	512,355	+/- 0.2%
Adults	931,888	+/- 0.3%	922,463	+/- 0.3%	903,204	+/- 0.3%
Seniors	161,795	+/- 0.9%	164,511	+/- 0.9%	166,451	+/- 0.9%

The narrow confidence intervals around the projections reflect our effort to specify the underlying enrollment models (as documented in Appendix A) parsimoniously—rejecting potential explanatory variables that were marginally significant or insignificant, and that did not add appreciably to the overall goodness of fit. That said, the models explained just 23 to 56 percent of variation in enrollment among the eligible populations in 2011 and, as described in Section B, they projected just 94 percent of actual 2012 enrollment. Thus, substantial unexplained heterogeneity is embedded in the projections and with it, the potential for larger error in the projections than may be apparent from the narrowness of the confidence intervals around the projected means.

APPENDIX A

METHODS

APPENDIX A. METHODS

In the sections below, we describe the data sources, preparation of the database to support the Phase 1 estimates, and development of the Phase 2 projections.

A. Data sources

The reported eligibility estimates and enrollment projections are derived from analysis of the American Community Survey (ACS), an annual survey of U.S. households conducted by the U.S. Census Bureau. The ACS obtains information about the demographic and socio-economic characteristics of individuals and households. The ACS household sample includes approximately 3.1 million individuals (1 percent of the U.S. population), more than any other survey conducted by the Census Bureau; it is representative at the state level and also representative for many metropolitan areas and counties.

The analysis is based on respondents to the 2009, 2010, 2011, and 2012 ACS living in Massachusetts,[1] as well as administrative data measuring monthly enrollment in MassHealth. In each year, the ACS had about 65,000 Massachusetts respondents. To increase the precision of our estimates, we pooled each ACS year with the next adjacent year and reweighted the data (as described in Section C below) to provide annual estimates.

B. Preparation of the phase 1 database

1. Assigning MassHealth eligibility

During the 2009-2012period, MassHealth administered more than ten programs for low income residents. Eligibility for each program depended on personal characteristics (age, employment and hours of work, pregnancy and parental status, disability, Medicare or private health insurance coverage, and citizenship or immigration status) as well as family characteristics (income, family size, and spousal employment and hours of work). We abstracted the eligibility criteria for each program from the member booklets for each year, with consultation from MassHealth.

a. Measurement of personal characteristics

Some of the personal characteristics that define eligibility for the various MassHealth programs are not observable in the ACS or are reported differently than might be observed in an administrative process of eligibility determination. The eligibility algorithms developed for the analysis ultimately did not include criteria based on characteristics (e.g., breast cancer, HIV/AIDS status, or financial assets) that are not reported in the ACS. However, most of the MassHealth eligibility criteria for the various programs are reported in some manner in the ACS

[1] These data were extracted from the integrated public-use microdata files made available through the University of Minnesota. See: Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. *Integrated Public Use Microdata Series: Version 5.0* [Machine-readable database], 2014.

and were included in the eligibility algorithms—although some are less specific than the criteria MassHealth uses for eligibility determination. For example:

- The ACS asks respondents about their citizenship status and differentiates among immigrants by the year they entered the U.S. In contrast, MassHealth defines "qualified immigrants" as documented immigrants or "special status aliens." To define eligibility for MassHealth, we included as qualified immigrants all immigrants living in Massachusetts who had been in the U.S. at least five years.
- The ACS does not identify current pregnancy status, but does identify whether a woman gave birth to a child in the past year. We used this variable as a proxy for pregnancy in the prior year, which is the same time frame over which income is reported in the ACS.
- The ACS does not measure disability in the same way as MassHealth does. The ACS includes a six-question sequence on functional limitations. While many studies have used this sequence of questions to identify the population with disabilities, it likely misidentifies many individuals with respect to determination of MassHealth eligibility. We coded individuals that report income from a Social Security disability program (SSI if younger than age 65, or SSDI if younger than age 62) as disabled. Because ACS does not separately report income for children under age 15, we used an affirmative response to one or more of the six functional limitation questions to identify disability among children younger than age 15.

b. Measurement of family characteristics

We constructed family units as they are defined for the purpose of determining MassHealth eligibility. For seniors (age 65 or older), a family unit is composed of the respondent and a spouse, if present. For adults under age 65 (age 19 to 64), the family unit is composed of the respondent and (if present in the household), a spouse and related children age 0-18. For children, the family unit is composed of the child and (if present in the household) a parent, foster parent, or caregiver (defined below); the spouse of the parent, foster parent, or caregiver; and other children age 0-18 related to the parent, foster parent, caregiver, or spouse.

For children that live with neither parent, we defined the caregiver as a related adult in the household. Because only one adult in a household can be deemed a caregiver for purposes of determining program eligibility, we imposed a hierarchy to identify the caregiver in households with more than one adult. If there was a related adult man and woman, we selected the woman. If there were multiple women related to the child, we selected the woman whose age was nearest to the child's age plus 20 years.

We calculated family income as income from selected sources, summed across all adult family members. To approximate "current" income relevant to eligibility determination, we recoded the annual earnings reported in the ACS to zero for all adults who reported not working at the time of the survey. Children residing with a foster parent or caregiver are deemed eligible for MassHealth and were coded as having no family income.

For seniors, MassHealth disregards some earned and unearned income when determining eligibility.[2] We followed the programs' "countable income" rules when calculating income for seniors. In addition, we presumed that seniors who reported difficulty in at least two of four areas (mobility, cognition, self-care, or independent living) would qualify for an additional income disregard for personal care attendant services to live at home.[3]

Family size was measured as the number of family members (as defined earlier), and used to compare family income (considering sources of income as appropriate to each MassHealth program) with poverty thresholds set by the U.S. Department of Health and Human Services to calculate family income as a percent of poverty.[4]

c. Eligibility assignment

In light of the individual and family level characteristics that are observable in the ACS and the size of the population sample, we made a preliminary determination that it might be feasible to identify eligibility for any of nine MassHealth programs:[5]

1. Standard
2. Common
3. Family Assistance
4. Basic and Essential (taken together)
5. Buy-in
6. Limited
7. CMSP
8. Health Start Program
9. Prenatal

We developed eligibility algorithms reflecting the eligibility rules for each program and flagged whether the individual was eligible for each – allowing eligibility for more than one program. The program eligibility rules as reflected in these algorithms are described in Appendix A.

[2] Countable income of seniors is the sum of 50 percent of monthly earned income after a $65 earnings disregard (or up to 85 dollars if unearned income is less than twenty dollars), and unearned income after a twenty dollar unearned income disregard.

[3] For an individual who is in need of PCA services (indicated by completion of a PCA supplement through the application process), instead of the $20 unearned income disregard, MassHealth subtracts the "increased unearned income disregard" as described at 130 CMR 520.013(B). This increased unearned income disregard is equivalent to the difference between the MassHealth Income Standard and 133% FPL for the applicable family size.

[4] U.S. Department of Health and Human Services, Assistant Secretary for Planning and Evaluation. Prior HHS Poverty Guidelines and Federal Register References. Accessed April 18, 2014.

[5] For the purpose of benchmarking the ACS to administrative data, we also estimated eligibility for Commonwealth Care, although it is not administered by MassHealth.

2. Coding program enrollment

An individual was coded as enrolled in a particular MassHealth program if the individual was eligible for the program and reported being enrolled in Medicaid. Unlike eligibility, enrollment was coded hierarchically—so that individuals were flagged as enrolled only in the most generous program for which they were eligible. After examining the unweighted counts of individuals flagged eligible and enrolled in each MassHealth program, we grouped the populations and programs into nine clusters as shown in table A.1, aggregating programs for which it was apparent that either the variables we could observe inadequately discriminated or the ACS sample size (even when combining survey years, as described below) was inadequate to measure low levels of enrollment.

Table A.1. Population groups and program clusters defined for analysis

Cluster	Definition	Program Composition
1	Full benefits, children	Standard and Common, children
2	Full benefits, adults	Standard and Common, adults
3	Moderate benefits, children	Family Assistance, Children
4	Moderate benefits, adults	Family Assistance and Basic/Essential, Adults
5	Limited benefits, children	Limited, CMSP, Children
6	Limited benefits, adults	Limited, Prenatal, Adults
7	Seniors – all non-buy-in programs	Standard, Essential, and Limited, Seniors
8	Buy in, non-seniors	Buy-in
9	Buy in, seniors	Buy-in

After organizing the monthly enrollment data provided by MassHealth into the nine population/program clusters, we discovered that our eligibility algorithms identified too few children and adults eligible for full benefits, and too many eligible for moderate benefits.[6] To account for the monthly income volatility that MassHealth observed, but that is unobserved in the ACS (even after adjusting annual income for periods of not working), we randomly selected 50 percent of children and 10 percent of adults that we had flagged as eligible for moderate benefits and re-flagged them as eligible for full benefits.

3. Creating benchmarked annual files

To conduct the Phase 1 analysis of take-up, we combine two adjacent years of ACS data in order to produce larger sample sizes (and, therefore, potentially more variation in population characteristics) for each year. We combined the 2009 and 2010 ACS to produce 2009 estimates, the 2010 and 2011 ACS to produce 2010 estimates, and the 2011 and 2012 to produce 2011

[6] This result is consistent with the substantial income volatility known to occur among the low-income nonelderly population. See, for example: Shore-Sheppard, Lara. Income Dynamics and Coverage Transitions of Health Reform Expansion Populations. 2012 and Sommers et al., Medicaid And Marketplace Eligibility Changes Will Occur Often In All States, 2014.

estimates. Using a conventional raking[7] process, we generated new population weights for each pooled sample benchmarked to key socio-demographic characteristics that determine Medicaid eligibility. These benchmarking characteristics and their sources are documented in Table A.2.

Table A.2. Benchmarks used to reweight the pooled 2009-2011 ACS population samples

Benchmark	Values	Source
Population age	Number of individuals in 5-year age intervals from 0-4 through 75-79. Individuals age 80 or older are top coded.	Census reports of MA population for each target year[a]
Family income as a percent of poverty	Number of individuals with estimated MAGI less than 100%, 100%-200%, 200%-300%, or more than 300% of the HHS poverty threshold	Benchmark distribution calculated from the ACS in the target year
Race and ethnicity	Number of individuals who report being of Hispanic descent (any race), White only (non-Hispanic), Black only (non-Hispanic), and other non-Hispanic (including mixed race).	Benchmark distribution calculated from the ACS in the target year
Medicaid eligibility	Number of individuals flagged as eligibility for each of the 9 program clusters or Commonwealth Care.	Benchmark distribution calculated from the ACS in the target year
Medicaid enrollment	Number of individuals enrolled in each of the nine clusters or Commonwealth Care.	MassHealth

[a] U.S. Census Bureau, Population Division. Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties, and Puerto Rico Commonwealth and Municipios: April 1, 2010 to July 1, 2012, June 2013.

C. Phase 2 projections

1. Preparation of the forecasting data

To generate the Phase 2 enrollment forecasts, we "aged" the 2011 database derived from the ACS and developed in Phase 1. This process involved reweighting the data to be representative of the Massachusetts population in sequential years 2014 to 2020. As in Phase 1, raking was used to generate new population weights for pooled 2-year samples benchmarked to demographic and employment forecasts.[7]

The raking used population forecasts for 2015 and 2020 that were generated by the University of Massachusetts Donohue Institute.[8] We linearly interpolated between 2012 and 2015 to obtain a forecast for 2014, and between 2015 and 2020 to obtain forecasts for 2016-2019. Employment forecasts were generated by the Massachusetts Executive Office of Labor and Workforce Development. These forecasts include estimates of the number of workers by

[7] See: Izrael, David, David C. Hoaglin, and Michael P. Battaglia. A SAS Macro for Balancing a Weighted Sample, 2000.

[8] UMass Donahue Institute. Population Projections, December 2013.

industry and occupation through 2020;[9] taken together with the projected population, they also provide forecasts of the number of non-workers. The detailed benchmarking groups used to rake the data to each projection year are shown in Table A.3. Adjusting the population weights to approximate the future distribution of employment has the effect of adjusting the distribution of family income and poverty measures that correlate with employment measures. For children, we benchmarked the industry and occupation of the parent with higher earnings in order to, in effect, adjust their family income in step with projected employment changes.

Table A.3. Benchmarks used to reweight the ACS population samples to 2020

Benchmark	Values	Source
Population age by sex	Number of individuals in 5-year age intervals from 0-4 through 75-79. Individuals age 80 or older are top coded.	University of Massachusetts Donohue Institute
Number of workers by occupation	Occupational groups: Management Business and Financial Operations Computer and Mathematical Operations Architecture and Engineer Life, Physical, and Social Science Community and Social Services Legal Education, Training, and Library Art, Design, Entertainment, Sports, and Media Healthcare Practitioners and Technical Healthcare Support Protective Services Food Preparations and Serving Related Building and Grounds Cleaning and Maintenance Personal Care and Service Sales and Related Office and Administrative Farming, Fishing, and Forestry Support Construction and Extraction Installation, Maintenance, and Repair Production Transportation and Materials Moving Military Non Workers	Massachusetts Executive Office of Labor and Workforce Development
Number of workers by industry	Industry groups: Agriculture, Forestry, Fishing, Hunting and Mining Construction, Utilities, and Manufacturing Wholesale Retail Transportation, Information, Real Estate, Accommodations and Food Finance, Professional, Administration and Remediation Management of Companies and Education Health Care, Arts, Other Services Government Non Workers	Massachusetts Executive Office of Labor and Workforce Development

[9] Massachusetts Industry-Occupation Employment Matrix, 2010-2020. Massachusetts Executive Office of Labor and Workforce Development (http://lmi2.detma.org/lmi/projections.asp)

The resulting population projections strictly reflect the external population and employment forecasts used to age the 2011 ACS; in effect, these forecasts drive the projected changes in eligibility and enrollment from 2014 to 2020. The projections do not reflect any factors that might vary the rate of workers per population, nor do they reflect factors that might vary the level or distribution of real income other than workers' industry/occupational mix. For example, if the rate of employment does not improve according to forecasts, the ratio of workers to nonworkers will be less than projected; in turn, more adults and children would likely be eligible for MassHealth, and enrollment might be greater than projected. Alternatively, if productivity rises due to technological change, earnings might increase; in turn, fewer adults and children in working families might be eligible for MassHealth, and enrollment might be less than projected. Among seniors, the projections assume the same levels of real income (by age cohort and gender) that were observed among seniors in 2011, although many fewer seniors might have defined pension income or substantial retirement savings in 2020. These alternative scenarios, while feasible, are not reflected in current economic forecasts.

2. Coding 2014 eligibility

We coded additional eligibility variables to reflect the changes in eligibility in January 2014. These changes are listed in detail in Appendix C. Most importantly with respect to re-coding eligibility, we created a new income variable to approximate modified adjusted gross income (MAGI) that all states must use as of January 2014 to determine Medicaid eligibility for nondisabled children and adults. MAGI excludes income from SSI or TANF. In addition, we created CarePlus eligibility rules for childless adults. Adults eligible for CarePlus were included in a new Cluster 10, in addition to the 9 clusters described in Table A.1.

3. Take up analysis

Using the 2011 file prepared for the Phase 1 analysis, we estimated three models predicting take-up among (respectively) children, adults, and seniors using Logit regression. The model specifications were selected to maximize the predictive power of the models as measured by the pseudo R-square[10] and the Hosmer-Lemeshow Test.[11] The final specifications and logistic regression results are reported in Tables A.4 through A.6.

[10] Institute for Digital Research and Education, University of California at Los Angeles. FAQ: What are pseudo R-squareds? Accessed April 18, 2014.

[11] SAS Institute. The Hosmer-Lemeshow Goodness of Fit Test. SAS/STAT(R) 12.1 User's Guide. Accessed April 18, 2014.

Table A.4. Logit regression estimates for children: dependent variable = enrolled in Medicaid, 2011

Independent Variable (Dependent: Enrolled =1)	Coefficient Estimate	Level of Significance
Eligible only for limited benefit	-3.4792	<.0001
Medicare coverage	-3.615	<.0001
Private or military insurance	-4.4238	<.0001
Private or military insurance interacted with FPL[a]	0.00236	<.0001
Residence in institution or group quarters	1.3279	0.0189
Has disability	1.1119	0.0006
Has disability interacted with continuous age[a]	0.1211	<.0001
SNAP receipt	0.6939	<.0001
SSI receipt	-1.4561	<.0001
TANF receipt	2.9753	0.022
Unmarried parents	0.5381	<.0001
No parents in household	0.7978	<.0001
FPL less than 100	1.6214	<.0001
FPL 100 to 132	2.339	<.0001
FPL 133-149	2.0409	<.0001
FPL 150-199	1.6702	<.0001
FPL 200-299	1.4491	<.0001
Mother's (or father's when mother not present) race/ethnicity is Hispanic	0.702	<.0001
Mother's (or father's when mother not present) race/ethnicity is Other Race (not White or Black)	0.3719	0.0006
Highest educational attainment of parent is less than high school graduate	0.2426	0.1007
Parent has Medicaid	6.6788	<.0001
N = 14,573		
Model Fit Statistics:		
Pseudo r-square =0.5922		
Hosmer-Lemeshow: Chi-Square =741.38 (DF 8, Pr>ChiSq < 0.0001)		

[a]Variable is continuous; all other variables are categorical (0-1).

Table A.5. Logit regression estimates for adults: dependent variable = enrolled in Medicaid, 2011

Independent Variable (Dependent: Enrolled =1)	Coefficient Estimate	Level of Significance
Eligible only for limited benefit	3.0122	<.0001
Eligibility only for programs with premiums	-0.1932	0.0048
Eligible for Standard/Common	2.095	<.0001
Eligible for Standard/Common without premiums	-0.4922	<.0001
Private or military insurance	-3.0859	<.0001
Age 19 to 26	-0.4007	<.0001
Female	0.1773	<.0001
Gave birth in past year	1.5044	<.0001
Married	-0.1558	0.0015
Children in household	0.1278	0.0107
FPL less than 100	0.9884	<.0001
FPL 100 to 132	1.3729	<.0001
FPL 133-149	1.248	<.0001
FPL 150-199	1.0452	<.0001
FPL 200-299	0.6018	<.0001
Education is college graduate	-0.2726	<.0001
Number of disabilities [a]	0.0893	0.0046
Number of disabilities interacted with age>50 [a]	-0.2009	<.0001
Self employed	0.3761	<.0001
Unemployed	0.3279	<.0001
Employed full time	-1.4884	<.0001
Employed part time[b]	-1.1176	<.0001
SNAP receipt	0.8893	<.0001
SSI receipt	-0.1966	0.0029
TANF receipt	1.6289	<.0001
N = 39,795		
Model Fit Statistics:		
Pseudo r-square = 0.5387		
Hosmer-Lemeshow: Chi-Square = 1904.14 (DF 8, Pr>ChiSq < 0.0001)		

[a]Variable is ordinal, ranging from 0 to 6; all other variables are categorical (0-1).
[b]Missing = not in labor force

Table A.6. Logit regression estimates for seniors: dependent variable = enrolled in Medicaid, 2011

Independent Variable[a] (Dependent: Enrolled =1)	Coefficient Estimate	Level of Significance
Private or military insurance	-0.8026	<.0001
Age 65-69	0.4477	<.0001
Age 70-74	0.176	0.0308
Age 75-79	0.2915	0.0002
Female	-0.0135	0.8491
Hispanic	0.6418	<.0001
Black	0.4237	0.0002
Other race (not White)	0.3604	0.0007
Residence in institution or group quarters	1.1413	<.0001
Married	-0.2088	0.0392
Married and female	0.1008	0.4562
FPL less than 100	0.1285	0.1103
FPL 100 to 200	0.2179	0.0027
Education is less than high school graduate	0.214	0.0003
Employed	-0.5797	<.0001
Self-employed	-0.3353	0.0952
Age 70+ interacted with cognitive limitation	0.133	0.0894
Age 70+ interacted with physical limitation	0.00391	0.9612
Age 70+ interacted with mobility limitation	0.0993	0.2539
Age 70+ interacted with vision limitation	0.0595	0.5087
Age 70+ interacted with hearing limitation	-0.0121	0.8692
Age 70+ interacted with self care limitation	0.2246	0.0126
SNAP receipt	1.2633	<.0001
SSI receipt	-0.5672	<.0001
TANF receipt	0.0456	0.7708
Homeowner	-0.4846	<.0001
Nonparent caregiver	0.5599	0.1772
N = 7,620		
Model Fit Statistics:		
Pseudo r-square = 0.2318		
Hosmer-Lemeshow: Chi-Square = 122.55 (DF 8, Pr>ChiSq < 0.0001)		

[a]All variables are categorical (0-1).

4. Projecting enrollment from 2014 to 2020

These estimates reported in Tables A.4 through A.6 were used to stochastically assign Medicaid enrollment among MassHealth-eligible children, adults, and seniors in each forecasting year. Specifically, we developed a stochastic model that calculated the predicted probability of enrollment for each individual as $e^{(a + \sum bx)}/(1+e^{(a + \sum bx)})$ where e is the exponential function and, for each population group, a is the estimated intercept term, b is the vector of estimated coefficients, and x is the vector of values of the independent variables. The predicted probability input was then compared with a random number between 0 and 1 generated for each individual. Individuals were assumed to enroll if their predicted probability of enrollment exceeded their random number—allowing for forecasts that included individuals likely to enroll as well as some individuals who were not likely to enroll. Using the adjusted population weights for each forecast years 2014-2020, we tabulated enrollment among each population group in each year, and then parsed forecasted enrollment into the 10 program clusters.

To generate confidence intervals around the enrollment forecast for each population group in years 2014 to 2016, we re-ran the stochastic model described above, using values for b drawn from the 95 percent confidence intervals around each estimated coefficient to predict the probability of enrollment for each individual. We replicated this process 1,000 times to generate a distribution of predicted enrollment within a 95 percent confidence interval around the mean estimate.

APPENDIX B

RULES FOR CODING PROGRAM 2009-2012 PROGRAM ELIGIBILITY

APPENDIX B. RULES FOR CODING PROGRAM ELIGIBILITY

A. Eligibility rules: under age 65

1. Standard

- Eligible if a citizen or qualified immigrant (U.S. born or immigrated at least 5 years prior to year of survey) and is
  - Pregnant in prior 12 months AND family income less than or equal to 200% FPL; or
  - Under one year of age with family income less than or equal to 200% FPL; or
  - Aged 1-18 with family income less than or equal to 150% of FPL; or
  - A parent or adult caregiver of a child age 18 or younger with family income less than or equal to 133% FPL; or
  - Identified to have a disability with family income less than or equal to 133% FPL.

2. Buy-in

- Eligible if not eligible for Standard, identified to have a disability, reports Medicare coverage, and is
  - Not married and has monthly "countable income" less than or equal to $1,277 in 2013, $1,277 in 2012, $1,246 in 2011, $1,239 in 2010, or $1,240 in 2009; or
  - Married and has monthly "countable income" less than or equal to $1,675 in 2013, $1,675 in 2012, $1,675 in 2011, $1,660 in 2010, or $1,661in 2009.

3. CommonHealth

- Eligible if not eligible for Standard or Buy-in, identified to have a disability, is a citizen or qualified immigrant (U.S. born or immigrated at least 5 years prior to year of survey), and is
  - aged 18 or younger; or
  - aged 19 or older with reported weekly hours worked of 10 or more; or
  - aged 19 to 64 and not working

4. Family assistance

- Eligible if not eligible for Standard or Common Health, is a citizen or qualified immigrant (U.S. born or immigrated at least 5 years prior to year of survey), and is
  - aged 18 and younger with family income less than or equal to 300% FPL; or
  - aged 19-64, working (or has a spouse who is working) and has family income less than or equal to 300% FPL

5. Basic & essential

- Eligible if not eligible for Standard, Common Health, or Family Assistance, is a citizen or qualified immigrant (U.S. born or immigrated at least 5 years prior to year of survey), and is not working, has not worked in the past year, does not have a spouse that works more than 25 hours per week, and has family income less than or equal to 100% FPL.

6. MassHealth limited

- Eligible if not eligible for Standard, Common Health, Family Assistance, Basic/Essential and is
  - Pregnant in prior 12 months, and has family income less than or equal to 200% FPL; or
  - Under one year of age with family income less than or equal to 200% FPL; or
  - Aged 1-18 and has family income less than or equal to 150% FPL; or
  - A parent or adult caregiver of a child age 0-18 and has family income less than or equal to 133% FPL; or
  - Identified as having a disability and has family income less than or equal to 133% FPL.

7. Children's medical security plan

- Eligible if not eligible for Standard, Common Health, Family Assistance, or Basic/Essential; is aged 0-18; and has no source of coverage other than Medicaid

8. MassHealth prenatal

- Eligible if pregnant in the prior 12 months.

9. Commonwealth care

- Eligible if not eligible for Standard, Common Health, Family Assistance, Basic/Essential, Limited, or Prenatal, is a citizen or qualified immigrant (U.S. born or immigrated at least 5 years prior to year of survey), is aged 19-64, and has family income less than or equal to 300% FPL

B. Eligibility Rules: Age 65 and Older.

1. Standard/Essential

- Eligible if a citizen or qualified immigrant (U.S. born or immigrated at least 5 years prior to year of survey) and is
- Not married and has monthly countable income was less than or equal to $951in 2013, $951 in 2012, $928 in 2011, $923 in 2010, or $923 in 2009; or
- Married and has monthly countable income was less than or equal to $1,281 in 2013, $1,281 in 2012, $1,246 in 2011, $1,235 in 2010, or $1,235 in 2009; or

- Not married and has a positive response to two or more of the ACS six disability questions, and countable income adjusted for personal care is less than or equal to $951 in 2013, $951 in 2012, $928 in 2011, $923 in 2010, or $923 in 2009; or
- Married and has a positive response to two or more of the ACS six disability questions, and countable income adjusted for personal care is less than or equal to $1,281 in 2013, $1,281 in 2012, $1,246 in 2011, $1,235 in 2010, or $1,235 in 2009.

2. Limited

- Eligible if not eligible for Standard/Essential and
  - Not married and monthly countable income is less than or equal to $951 in 2013, $951 in 2012, $928 in 2011, $923 in 2010, or $923 in 2009; or
  - Married and monthly countable income is less than or equal to $1,281 in 2013, $1,281 in 2012, $1,246 in 2011, $1,235 in 2010, or $1,235 in 2009.

3. Buy In

- Eligible if not eligible for Standard/Essential, has Medicare, is a citizen or qualified immigrant (U.S. born or immigrated at least 5 years prior to year of survey) and is
  - Not married and monthly countable income is less than or equal to $1,277 in 2013, $1,277 in 2012, $1,246 in 2011, $1,239 in 2010, or $1,240 in 2009; or
  - Married and monthly countable income is less than or equal to $1,675 in 2013, $1,675 in 2012, $1,675 in 2011, $1,660 in 2010, or $1,661 in 2009.

APPENDIX C

RULES FOR CHANGING PROGRAM ELIGIBILITY IN 2014

APPENDIX C. RULES FOR CHANGING PROGRAM ELIGIBILITY IN 2014

A. Changes in eligibility rules: under age 65

- Replace FPL with MAGI FPL (adjusted for the 5 percent FPL income disregard), other than for eligibility based on disability

1. Standard

- Age range for child eligibility changed from ages 1 to 18 to ages 1 to 20

2. Buy-in

- Income threshold changed to $1313 for non-married eligibility, and $1765 for married eligibility

3. CommonHealth

- Age range for child eligibility changed from ages 1 to 18 to 1 to 20.

4. Family Assistance

- An additional eligibility group added for ages 19 and 20, with MAGI FPL less than 150 percent of poverty.

5. Basic, Essential, Healthy Start Program, Prenatal, and Commonwealth Care

- Removed, as the programs were eliminated

6. CarePlus added as a new program

- Eligible if not eligible for Standard
- Are a citizen or immigrated prior to five years
- MAGI FPL less than 133

7. Small Business Premium Assistance added as a new program

- Eligible if not eligible for Standard, CommonHealth, Family Assistance, or CarePlus
- Age is between 19 and 64
- FPL is greater than 133 but no more than 300
- Employed
- Are a citizen or immigrated prior to five years

8. Limited

- Replace FPL with MAGI FPL in all eligibility rules, other than for eligibility based on disability.
- Age range for child eligibility changed from ages 1 to 18 to ages 1 to 20

B. Changes in Eligibility Rules: Age 65 and Over

1. Standard and Limited

- Income threshold changed to $978 for non-married eligibility and $1313 for married eligibility

2. Buy-in

- Income threshold changed to $1313 for non-married eligibility, and $1765 for married eligibility

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Table of Contents

Stepwise Methodology for Creating the MassHealth Caseload Member Month Forecast

Introduction

The following narrative outlines the step by step process of caseload forecasting presented to MassHealth on March 15th 2004 and is a supplement to the "*MassHealth Caseload and Expenditure Analysis: Final Caseload Analysis Deliverable*," to be presented to MassHealth budget personnel on August 2, 2004. This methodology is dependent on a number of factors as outlined below. There are four primary steps in the proposed forecast methodology. The narrative will follow these incremental steps and each will be explained in detail. Examples will be provided so as to provide further understanding as to the complex assumptions analysts must employ.[1] This is a draft for policy discussion only.

Step 1: "Completing" the Most Recent Eligibility (member) Months

> ***Rationale:*** Step 1 explains the process by which "completion" factors are calculated for the most recent five months of eligibility data assuming that the sixth month is complete.
> ***Required Data:*** Eligibility days per month going back at least 12 months as seen in 12 consecutive months for each of the budget groups
> ***Tool:*** Completion Factors Worksheet
> ***Example:*** "Caseload Narrative Examples" Ex1

The first step in the forecasting process is confirming the accuracy of the most recent data. This process, generally called "completion," addresses the issue of variance in eligibility data based on the effects of redeterminations, retroactive eligibility, application verification, eligibility appeals and the movement among aid categories. The process utilizes past eligibility figures as seen in up to 12 months to create multipliers that act to increase or decrease eligibility in each budget group based on the historical "completion" percentages.

When creating trend-based eligibility projections, one of the most crucial issues is where to start the trend. As with any projection, the further into the future the forecast moves, the less reliable it becomes. This is magnified by inaccuracies in the starting point of the trend. If started in the wrong place, the forecast will only prove to be less and less accurate. Completion factors allow for a more accurate starting place to begin the forecast. By "completing" the most recent months of data (rather than simply disregarding them, as was previously done), this current/ relevant data becomes accessible and will result in more accurate projections into the future.

[1] This narrative has been updated from the last version distributed to MassHealth on March 15, 2004, to included the creation of completion factors.

A. Calculating Completion Factors

The analyst must begin by organizing the eligibility days collected for each budget group going back 12 months, as seen in each of the twelve months, by group code, month, and "as of" date. This can be accomplished by employing the Excel "sort" function. An example of the organization of the data and the calculation of the completion factors can be found in *Caseload Narrative Examples: Ex1.* This organization provides the analyst with a list of eligibility days by month, and seen in up to 12 months.

From this list there will be seven months from which there have been six "as of date" observations, as seen in Table 1.

Table 1: Example of Data Required to Calculate Completion Factors

As of Date	Group Code	Month	Eligibility Days	Multiplier (month 6/ month 'n')
Nov 2003 (month1)	40	Nov 2003	13246	.846
Dec 2003 (month 2)	40	Nov 2003	12248	.915
Jan 2004 (month 3)	40	Nov 2003	11340	.988
Feb 2004 (month 4)	40	Nov 2003	11090	1.01
Mar 2004 (month 5)	40	Nov 2003	11270	.995
Apr 2004 (month 6)	40	Nov 2003	11210	1.0

The calculation of completion factor multipliers requires the assumption that the 6th "as of date" observation is complete.[2] The multipliers are developed by dividing the eligibility days of the sixth month by the eligibility days of each month previous to it (5th, 4th, 3rd, 2nd, and 1st). The resultant figures represent the factor by which each previous month differs from the 6th month observation (see Table 1). CHPR recommends that seven months (including 6 "as of dates" each) of data for each budget group (going back a total of 12 months from the current date) be used to calculate the completion factors.[3]

[2] CHPR found in its analysis that a 6 month completion time frame (event horizon) provided the sufficient level of completion for a quarterly forecasting period without over burdening the analysis. The average % completion of the 6 month completion factors for all budget groups was 98%. There are some budget groups that continue to complete up to 18 months. For these budget groups, (FFS, TPL, and Other) the analyst needs to utilize historical knowledge of budget group behavior to assess the value of the completion factor.

[3] Utilizing more than 12 months of historical data may skew the completion factors based on policy and environmental conditions that predominated historically. As completion factors are calculated on a regular basis and data is conserved, MassHealth will have the ability to assess the consistency of the calculations over time and adjust the current factors accordingly.

The seven sets of factors developed for “month 1” through “month 5” (“month 6” will always equal one and therefore does not need to be included), need to be averaged. In addition the standard deviation and confidence interval need to be calculated. The formulas for these calculations are available in M.S. Excel. Once the confidence interval has been developed, the analyst can calculate the range (Low and High) by adding the confidence interval to the average for that month, respectively, see Table 2.

Table 2: Completion Factor Calculation

6 Month Completion Analysis								Average (“COMPLETION FACTOR”	Std Dev.	Confidence Interval	Range of Confidence	
	Monthly Multipliers										Low	High
Month1	0.801	0.771	0.788	0.837	0.853	0.855	0.846	0.822	0.034	0.025	0.796	0.847
Month2	0.860	0.886	0.888	0.928	0.923	0.940	0.915	0.906	0.028	0.021	0.885	0.927
Month3	0.975	0.975	0.990	1.003	1.002	1.001	0.989	0.991	0.012	0.009	0.982	1.000
Month4	1.002	0.993	0.998	1.008	1.007	1.008	1.011	1.004	0.006	0.005	0.999	1.009
Month5	1.000	0.996	1.002	1.008	0.999	1.017	0.995	1.002	0.008	0.006	0.997	1.008
Month6	1	1	1	1	1	1	1	1.000	0			

Once the range of confidence is developed the analyst can then make the judgment as to which multipliers to include. If the value “1” is included in the range of confidence, then the difference between that month and the 6th month is not significant and therefore does not need to be “completed”.

The analyst can utilize the range of confidence to make judgments on the level at which the most recent months of a particular budget group, are to be “completed”. The range of confidence represents the statistical range that the multiplier is expected to reside within. This provides the analyst the opportunity to adjust the multiplier, based on institutional knowledge of the budget group behavior. In the absence of this level of institutional knowledge, CHPR recommends that the “average” value of the seven month multipliers, be employed as the completion factor for that month of the budget group.

To implement the “completion factors” the analyst must multiply the most recent months of eligibility data in the “Member Month” data set by the factors developed above. The resultant figures will represent “completed” member months that can then be utilized in the development of the eligibility forecast.

Step 2: The Establishment of the Historical Months to Forecast in each Budget Group

Rationale: Step 2 outlines the methodology through which historical member month eligibility data is used to develop future forecast eligibility. This methodology presents the analyst a number of tools that expose the essential features of past eligibility patterns that will have an effect on future eligibility.
Required Data: Most Recent "Member Month FY##Q#" Dataset
Tool: Triangle Analysis Worksheet
Example: "Caseload Narrative Examples" Ex2 and Ex3

The second and most complex step in forecasting requires the establishment of the number of historical months to include in the forecast. The forecast is based on variations upon a historical trend, therefore the number of member months included within the forecast, both recent and past, can yield extremely different results. Therefore, the analyst must use caution and where available any internal information (such as past and present policy decisions, future policy changes, and the effects of similar changes on caseload numbers in the past) to augment the methodology presented within this narrative, and to make informed decisions upon the member months to be included within the current forecast.

Based on CHPR analysis, it has been found that the calculation of Compounded Monthly Growth Rates (CMGRs) within each budget group is an excellent means, both mathematically and visually, by which to gain insight as to the behavior of caseload elligibility over time. CMGRs represent the weighted month-to-month growth percentage of a particular budget group as a function of the most recent member month included in the calculation. The usefulness of the calculation is in its ability to expose a linear extrapolation and visual representation of the growth of the particular budget group for particular months of analysis. From the comparison and analysis of the CMGR linear extrapolation of up to four of the most recent months, the analyst can identify specific historic points to be included within the forecast.

The CMGRs are calculated for each month in every budget group according to the methodology presented below. These CMGRs are then graphed and utilized to choose a historical date at which to begin the trend function of the forecast.

A. The Calculation and Utilization of CMGRs

Utilizing data from the most recent "Mem Months ____" worksheet in the most recent "Member Month FY##Q#" dataset, calculate the sequential Compound Monthly Growth Rates (CMGR) for up to 32 months in each budget group (this number is based on the number of months available; as of FY04Q1 32 months were available). No less than 18 months should be calculated. The calculations are easily made in Microsoft Excel and the attached ***Triangle Analysis Worksheet*** (both text and electronic) have

been designed to assist in the development of this methodology. The formula for the CMGR calculation is as follows:

- **CMGR = $[[X_t/X_{t-n}]^{(1/n)}]-1$** where X=member month, n=1…32 (number of time increments), and t=initial month

This formula will be applied sequentially to the most recent member month eligibility data and all member months previous to it resulting in up to 32 columns (equal to the number of months used in the data set) of growth rates.[4] The most recent consisting of up to 32 growth rates, the next most recent consisting of up to 31 growth rates. See Table 1.

Table 1. Example of Consecutive CMGR Calculation

Month	Mem-Months	CMGRs March	CMGRs April	CMGRs May	CMGRs June
Jan 03	ff				
Feb 03	ee				=[(aa/ff)^(1/5)]-1
Mar 03	dd			=[(bb/ff)^(1/4)]-1	=[(aa/ee)^(1/4)]-1
Apr 03	cc		=[(cc/ff)^(1/3)]-1	=[(bb/ee)^(1/3)]-1	=[(aa/dd)^(1/3)]-1
May 03	bb	=[(dd/ff)^(1/2)]-1	=[(cc/ee)^(1/2)]-1	=[(bb/dd)^(1/2)]-1	=[(aa/cc)^(1/2)]-1
Jun 03	aa	=[(dd/ee)^(1/1)]-1	=[(cc/dd)^(1/1)]-1	=[(bb/cc)^(1/1)]-1	=[(aa/bb)^(1/1)]-1

These calculations will result in month to month growth percentages representing the compounded growth expected from the month analyzed to the most recent month data is available. Comparison of these growth rates allows for an understanding of the minute growth changes reflected by the month to month eligibility figures.

The *Triangle Analysis Worksheet* includes all the formulas necessary to calculate 32 consecutive month CMGR columns. The data analyst must paste the date (Column A) and member month eligibility (Column B) into the worksheet making sure that the data is ordered top down from past to present with the most recent/current month data residing at the bottom of the Column (Row 36). If copied correctly, the table to the right will display the month-to-month sequential CMGR percentages for each of the dates analyzed in a separate column.

The primary reason for making these calculations sequentially in columns is that it is the comparison of the sequential rates which allows for the choice of historical months to be included in the forecast.[5]

[4] In the absence of completion factors, the three most recent member months must be dropped from (not included in) the forecast due to a lack of completeness caused by retro-active eligibility and redetermination effects. There may be a need to drop/not include additional months based on the CMGR analysis. Further discussion on this topic is presented below.

[5] A methodology for assessing the completeness of the most recent member months based on CMGR analysis was included in the March 15th version of this document. As it is the CHPR recommendation that completion factor analysis be conducted (as it is more accurate), this section has been removed from this version of the document.

B. Choosing the Historical Period to Forecast

From the sequential CMGR calculations, the most recent four months (entire columns) should be charted together with the date acting as the X axis, the growth percentage as the Y axis, and each of the Sequential CMGR columns acting as individual series. An example of this can be seen in *Caseload Narrative Examples Ex2, Chart 1: Group 09 Consecutive CMGRs*.[6]

Utilizing the charted sequential CMGRs for four of the most recent consecutive months allows the analyst to view a linear extrapolation of each budget group in terms of its month-to-month growth. From this linear extrapolation the analyst must make a choice as to the extent to which historical months are included in the forecast. There are points in the past at which no drastic policy change was occurring, yet the behavior of the budget group changed substantially. This change will result in an obvious disruption in all four of the CMGR lines. This point is called a node of inflection.

In a single CMGR chart there may be multiple nodes of inflection. In order to choose the most relevant point, CHPR recommends that analysts only consider nodes of inflection that go back six "completed" months or more. Due to the lack of reliability of the most recent data juxtaposed with its relevance for the trend start point, it was found that six months (in the absence of significant policy changes) was the minimum number of the most recent months to include within the trend function.[7] Caution is suggested when using a time period of eighteen months or more, because the distant eligibility figures will be weighted more heavily.[8] Charts 1 through 3 demonstrate nodes of inflection identified in previous forecasts and utilized as the historical date at which the forecast trend was started.

Nodes of inflection offer a point at which a change occurred in the growth behavior of the budget group. Based upon this, if chosen correctly, the eligibility data more recent (to the right) of the node is a better predictor of the future than the data previous to it. The node represents the change point, however analysts can choose a point before or after the node to reflect their awareness of policies that may have been affecting the budget group, without changing the slope of the forecast trend substantially.

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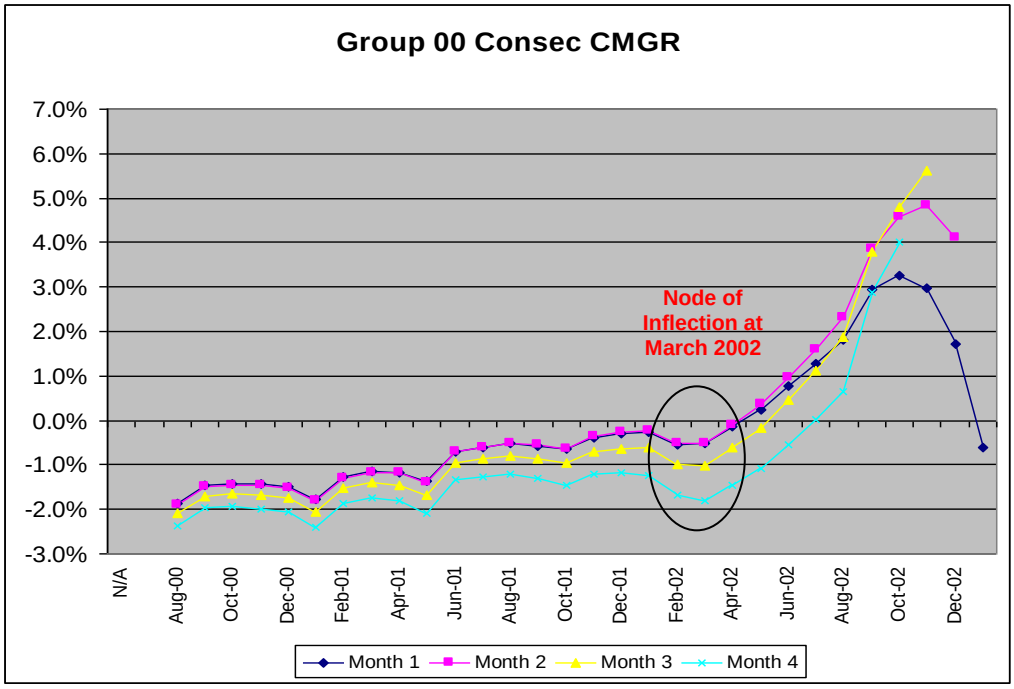
[6] If the most recent month(s) is considered "incomplete" and dropped from the forecast period, it should not be charted in as part of the historical period choice, as it will cause a drastic change in CMGR values and not allow for accurate historical period choice. See ***Caseload Narrative Examples Ex3.***

[7] Often, in the case of recent policy changes, the analyst is forced to use less historical information. This will be discussed in more detail in Section D.

[8] When more than 18 previous months are used, actual eligibility for the forecast period should be charted and carefully scrutinized to assure consistency of the trend.

Mathematical models are available that can statistically determine the "change point" based on complex quangle analyses.[9] Due to significant amount of time and effort required to produce such analyses, the relative accuracy of the procedure outlined above, and the request by MassHealth for operational tools that can easily be implemented into the forecast methodology, these models were not implemented during this analysis.

Chart 1: Example of a Node of Inflection in a Sequential CMGR Chart [10]



[9] Quangle analysis plots a range of data along a 360 degree axis. Although complex in calculation, this process is often used to determine change points.

[10] All data from Member Month FY03Q3 and FY04Q1Data Sets, provided by Miguel Vargas-Ramirez and applied to CHPR methodology presented 3-15-04 in "Forecasting MassHealth Caseload – Comparative Analysis of Methodologies".

Chart 2: Example of a Node of Inflection in a Sequential CMGR Chart

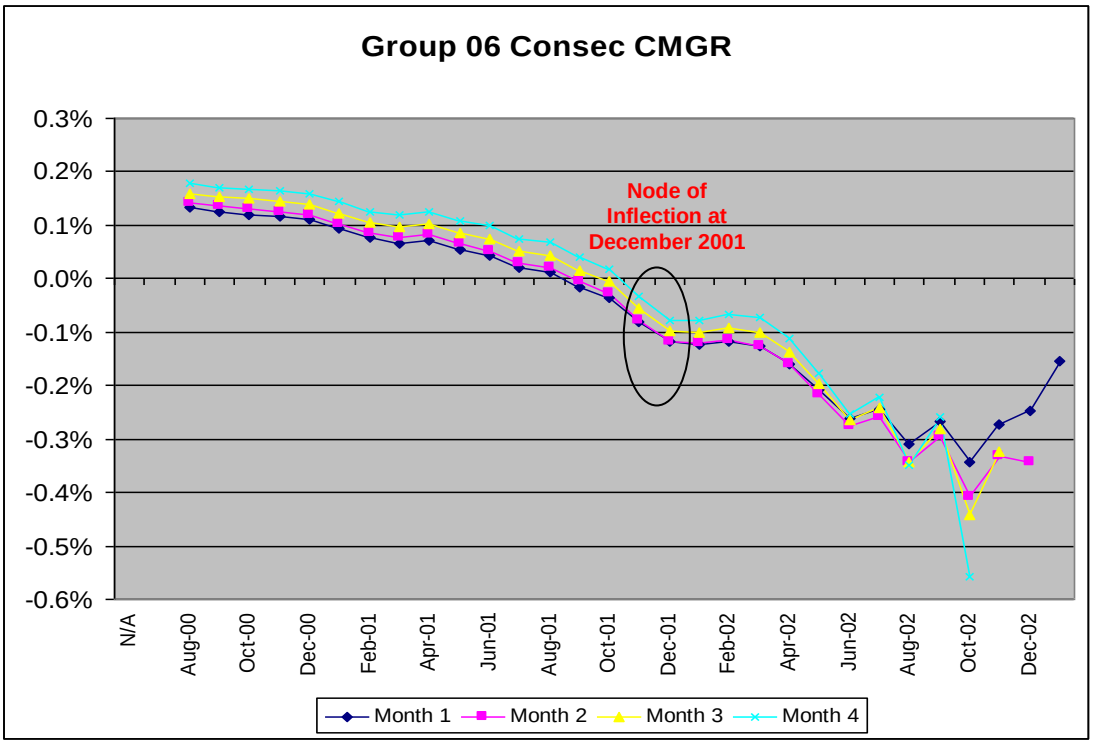
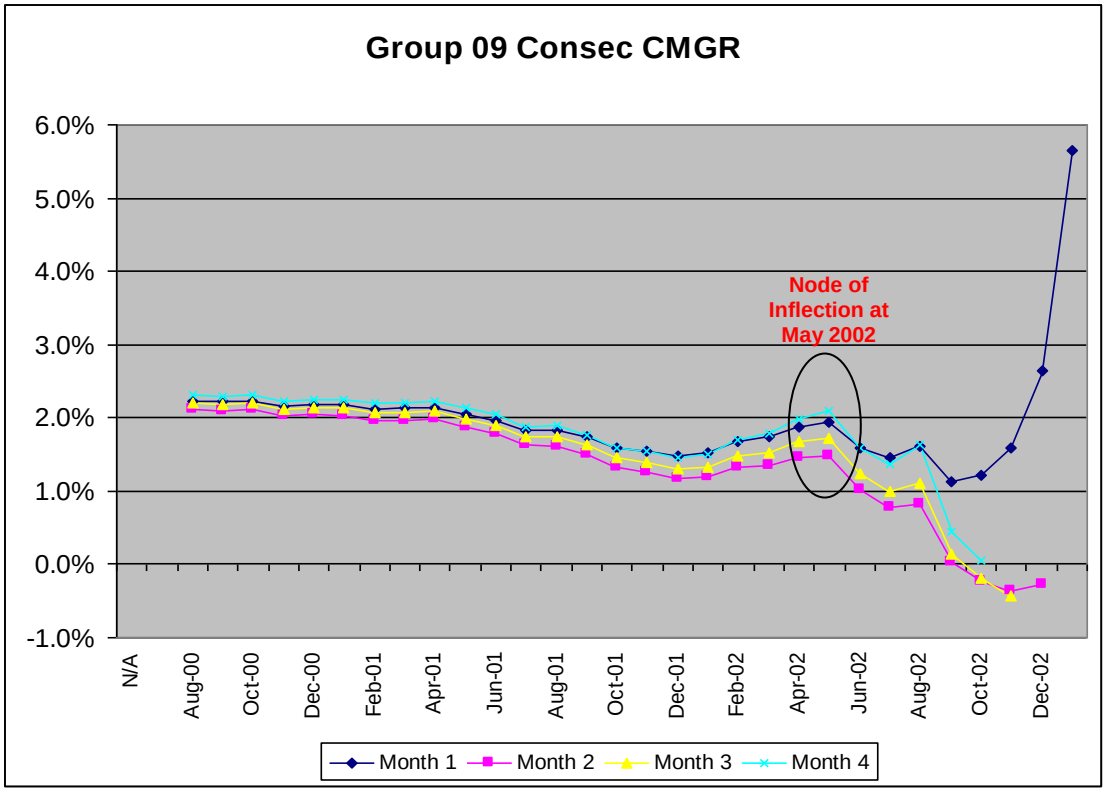


Chart 3: Example of a Node of Inflection in a Sequential CMGR Chart



The three examples above demonstrate the choice of a node of inflection based upon an apparent change in growth pattern. There are instances where there are ambiguous changes in the pattern of growth over time, therefore the analyst must make a subjective decision as to the most relevant historical date to begin the forecast. This subjective choice demonstrates the difficulty of the forecasting process and exemplifies the need for checks and balances

Logical Consistency Check of Historical Month Choice

Due to the fact that CMGRs are weighted month-to-month growth rates, they do not directly reflect the observed trend when the actual caseload member month eligibility is charted. Due to this fact, it is suggested that for all budget groups, the sequential CMGR chart be directly compared to a chart of actual member month eligibility for the same monthly period. From this comparison the logical consistency of the historical month choice can be assessed against both the weighted growth and raw caseload. An example of this comparison can be found in Charts 4 and 5. In this example there are a clear node of inflection and from the raw member month eligibility chart it can be seen that previous to this point the eligibility trend had a very different slope associated with it.

Chart 4: Example of Consistency Check

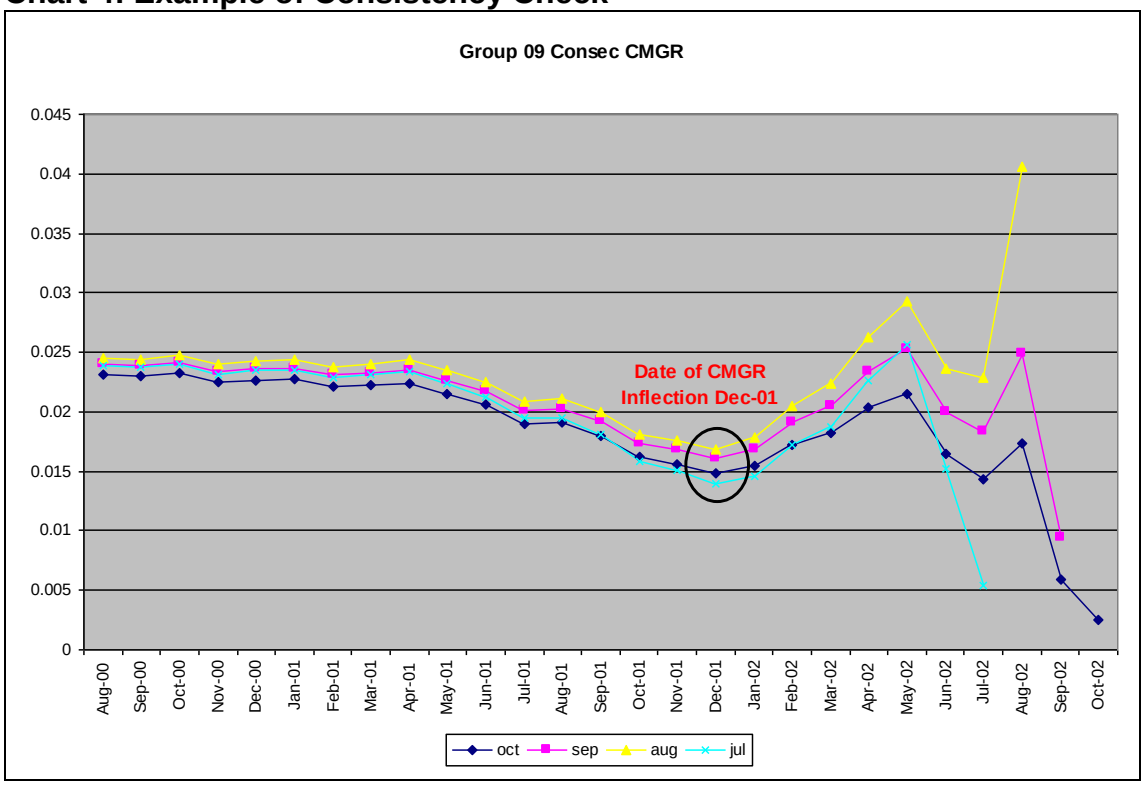
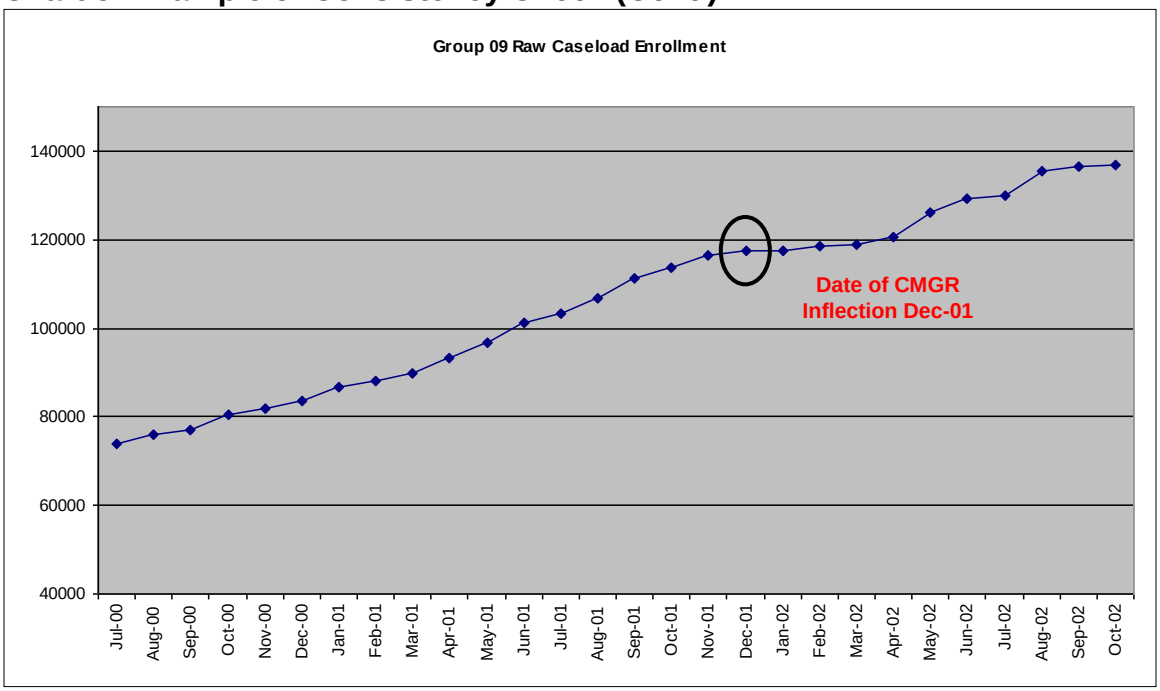
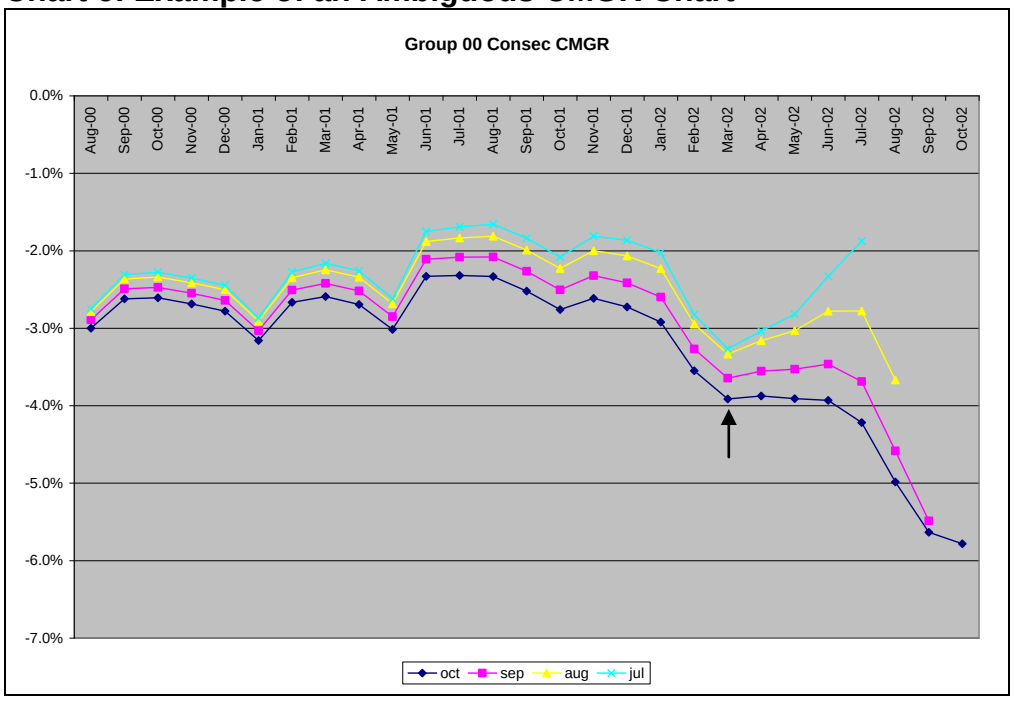


Chart 5: Example of Consistency Check (Cont.)



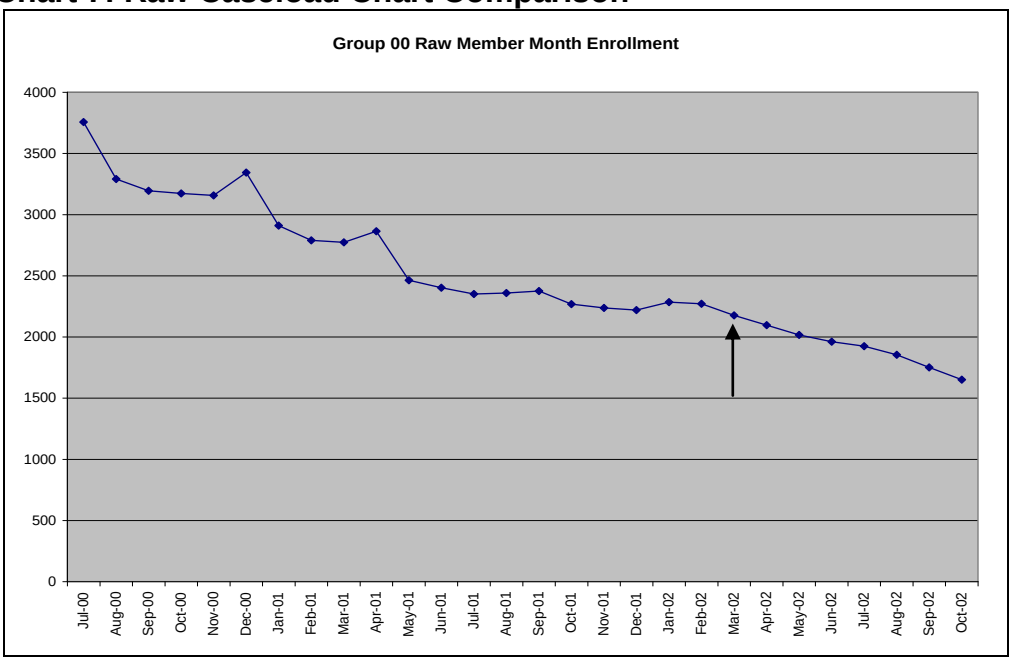
Ambiguous growth is often seen in fee for service (FFS) and other groups not clearly defined by age, disability, or provider status. The chart below (Chart 6) demonstrates an ambiguous growth situation for Group 00 (Other), a catch-all group for MassHealth members not easily categorized into an age or disability grouping.

Chart 6: Example of an Ambiguous CMGR Chart



It is clear from this chart that although there is some seasonal variation in the growth rates, choosing an inflection point is rather difficult. The arrow represents a possible inflection point. Charting the actual eligibility data can help to determine the historical period (see Chart 7).

Chart 7: Raw Caseload Chart Comparison



From Chart 7 it is clear that the growth rate is relatively stable going back to June of 2001. With the most recent data "completed", the point of March of 2002 seems to be the logical choice as it includes at least six months of eligibility data and reflects more accurately the current trend in budget group behavior, than if more historical data were to be included.

This example demonstrates that when data supporting policy change is lacking, and there is ambiguity in the CMGR growth, that the historical behavior of the budget group becomes the most reliable predictor in the forecast. The tools presented here for the choice of historical dates to begin the forecasting period are meant to assist the analyst, yet they are all based upon historical eligibility figures. In cases where the value of these tools is decreased, the analyst is forced to make a subjective decision that requires that institutional knowledge bridge the gap.

C. Historical Period Choice in light of Policy Changes

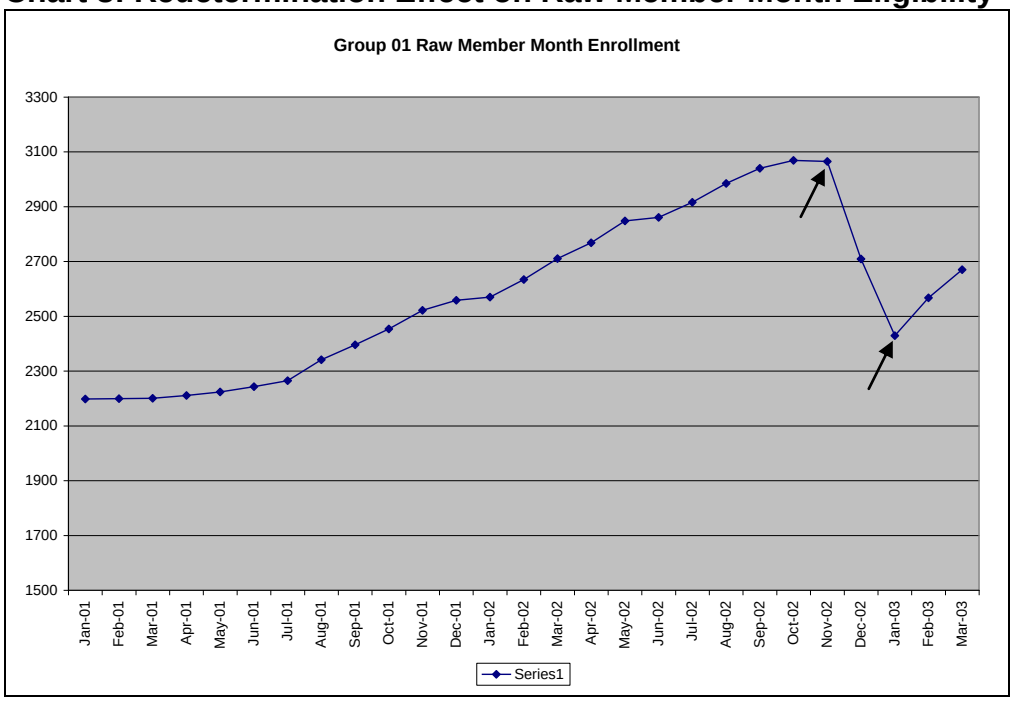
Often, policy changes are made that have significant effects on caseload eligibility. However, many of these effects are short term, as in the case of redeterminations. Based on the analyst's familiarity with the policy change and the particular group being analyzed, different methodologies can be employed. Whenever possible, historical data should be included within the forecast function. For example, when making the FY04Q1 forecast, it was

found that between November 2002 and January 2003 a new redetermination policy was substantially decreasing member month eligibility in some budget groups. Yet from January 2002 through March of 2003, eligibility was increasing at a faster rate than before the policy change (Chart 7).

In this instance the analyst expected (based upon similar results for this policy change in the past) that eligibility would increase to levels seen before the policy change. Therefore, when choosing historical months to forecast, the four sequential CMGRs occurring before the policy effects were charted (Jul, Aug, Sep, Oct; 2002), and utilized to determine a historical starting point. From this, the forecasted trend function was adjusted to allow the recent increase as well as the historical trend to have an affect. The methodology for creating forecast trends will be discussed in Step 2: Developing the Forecast.

At times policy changes will occur, and the analyst has little information as to the potential effects on caseload eligibility. In this situation, it is suggested that a forum of key stakeholders discuss potential outcomes. Even in the event of policy changes, the forecast should utilize the tools available to assess past eligibility, and establish the relevant historical period. The benefits of generating the forecast in the absence of policy change lie in the forecast's ability to capture the historical behavior of the budget group, and therefore preserve that historical behavior in the policy-adjusted forecast.

Chart 8: Redetermination Effect on Raw Member Month Eligibility



Step 3: Developing the Forecast for Each Budget Group

> ***Rationale:*** Step 2 outlines the methodology for developing the individual budget group forecasts. Outlined are simple tools through which the analyst can utilize the historical information developed in Step 1 to create the expected eligibility for each budget group.
> ***Required Data:*** Most Recent "Member Month FY##Q#" Dataset, Historical Months Chosen in Step 1
> ***Tool:*** MS Excel: Trend Function

MassHealth has traditionally utilized simple tools available in most spreadsheet programs to develop its short-term caseload forecast. These tools included least squared trending, fixed averages, and weighted averages. Often times these tools were augmented with growth factors calculated from past eligibility data or external environmental factors such as industry trends and unemployment. Based upon CHPR analysis it was found that the use of multiple mathematical formulas did not provide the benefits of additional accuracy between forecasted eligibility and actual eligibility figures. As past eligibility is the best predictor of future eligibility, CHPR has recommended that least squared trending and variations thereof, be the primary tools used to generate future caseload eligibility forecasts.

The MassHealth forecast has traditionally been conducted within an MS Excel spreadsheet, and all the necessary sheets are currently designed to import caseload eligibility information (Member Month Data Sets). Utilizing these sheets with the historical dates chosen in Step 2, the analyst must then create the forecast function that generates the expected eligibility for the upcoming fiscal year.[11] As stated above the primary tool through which the forecast is generated is the MS. Excel Trend function. This function fits a straight line to the known eligibility values (the member months chosen in Step 2), and returns the linear values for the selected future timeframe resulting in forecasted member month eligibility figures.

MassHealth has made a policy decision of not allowing for downward trends in the future forecasts, in order to prevent under budgeting. Therefore where a downward trend was exhibited by actual eligibility figures, analysts have utilized averages to stabilize the trend and prevent it from continuing on its downward slope. Based upon this policy decision, CHPR has recommended steps in the forecasting process to streamline mathematical formulas and increase the accuracy of the forecast by allowing for downward trending where applicable. These steps are outlined below.

[11] Note: CHPR recommends caution when forecasting for more than 12 full months. As the extent of time forecasted increases the accuracy of the forecast decreases substantially.

A. Applying the Trend Forecast

Once the historical period for the forecast is chosen, the MS Excel trend function should be applied to the member month eligibility for that period, for each budget group. The forecast projection period should be for 12 months, but may increase to 24 based upon the needs of MassHealth. Caution must be observed recommending budgetary requirements for distant future periods. The inaccuracy of the forecast projection increases as the length of time incorporated increases.

In the Member Month Data Sheet, the analyst should apply the trend function directly below the actual eligibility figures for each budget group.[12] By designing the sheet in this manner, individual budget group forecasts can be charted and analyzed for consistency. In addition, the analyst should document the historical period used in the forecast along with the particular trend function used.

Once the trend function is applied to each budget group for the specific time periods required (past and future), the forecasted figures must be analyzed for consistency. The manner in which this consistency is assessed is up to the analyst. The consistency should be assessed against institutional knowledge as to the policy changes affecting budget groups, stability/instability of eligibility per budget group, expected eligibility, and policy decisions on downward trending. The trend functions can be adjusted accordingly, based upon this consistency check.

B. Modifying Trends for Policy Changes

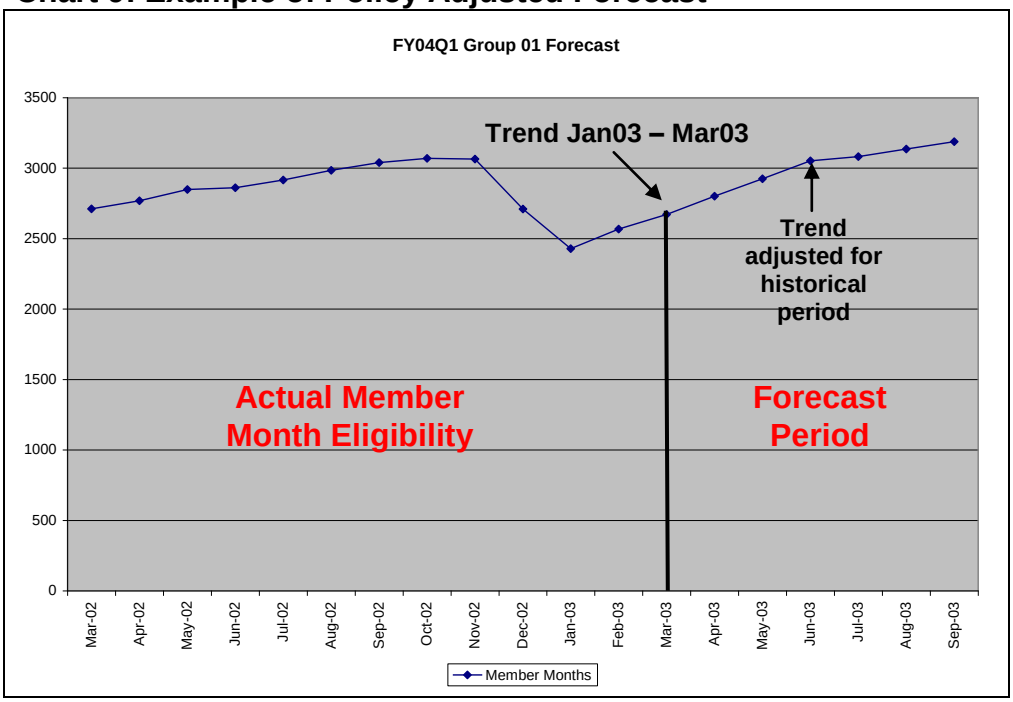
Often times a policy change will significantly affect caseload member month eligibility as demonstrated above in Step 2C. At this point the analyst must utilize all institutional information available to adjust the forecast for the upcoming period. A methodology for historical month choice was demonstrated above. Based upon the policy change and the information available to the analyst, utilizing historical member month eligibility data may or may not be advantageous.

In the example presented above, redetermination had drastically decreased eligibility in particular budget groups during the months of November 2002 and January 2003 (See Chart 8). The institutional knowledge available at the time of the FY04Q1 forecast presented the expectation that eligibility in the budget group would continue to increase to levels seen previous to the policy change and that eligibility behavior would be relatively similar to that observed in the past. From this information, the analyst was able to utilize the historical period chosen in Step 2C along with the current eligibility pattern to develop a modified trend function for the future forecast. Chart 8

[12] Electronic versions of the data sets will be provided with this document.

demonstrates an increase in member month eligibility from December 2002 through the most recent month data was available; March 2003. Utilizing these figures, a trend function was developed and applied (Jan03-Mar03) until eligibility was equal to that observed before the policy change (October 2002). At this point, the trend developed from the historical period chosen in Step 2C was applied to the subsequent dates in the forecast. See Chart 9.

Chart 9: Example of Policy Adjusted Forecast



The above example demonstrates the use of both recent and historical information in the forecast. In this circumstance the analyst had information available to make an educated estimate of future eligibility and utilized all information available to adjust the resultant forecast. The amount of policy related information available to analysts for this forecast may not be available for all policy changes and therefore subjective adjustments will need to be made.

Step 4: Cluster Level Forecasting

Rationale: Step 3 addresses the movement within, between, and among budget groups. Through the use of specific grouping tools, the analyst is provided the ability to gain insight into the populations MassHealth serves as well as achieve greater forecast accuracy.
Required Data: Most Recent "Member Month FY##Q#" Dataset and Individual Budget Group Forecasts
Tool: MS Excel: Sum and Trend Functions

CHPR recommends forecasting the MassHealth caseload eligibility in groups of age and disability related clusters. These will include disabled children, non-

disabled children, disabled adults, non-disabled adults, seniors, and other. The recommended clusters and budget groups therein are shown in Table 2. By grouping specific related budget groups into clusters, the analyst gains insight into system-wide eligibility patterns, and how individual budget group eligibility compares to the population of related individuals.

Table 2: Budget Group Clusters

Non-Disabled	CHILDREN	Disabled
09 HMO		01 HMO
11 PCC		03 PCC
13 TPL		05 TPL
15 FFS		07 FFS
17 FFS Newborn		29 Common Health
30 HMO Family Assistance		
32 PCC Family Assistance		
34 Unenrolled Family Assistance		
36 Premium Assistance		
38 Limited Children		
42 Adoption		
Non-Disabled	**ADULTS**	**Disabled**
10 HMO		02 HMO
12 PCC		04 PCC
14 TPL		06 TPL
16 FFS		08 FFS
22 HMO Basic		27 CH Working Adults
23 PCC Basic		28 CH Non-Working Adults
24 Unenrolled		41 LTC < 65
31 HMO Family Assistance		
33 PCC Family Assistance		
35 Unenrolled Family Assistance		
37 Premium Assistance		
39 Limited		
40 Prenatal		
SENIORS		
18 Community Senior		
19 Institutional Senior		
OTHER		
00 Other		
44 DMH Clients		
20 Buy-In		
21 Buy-In		
26 Basic Buy-In		

In addition to offering a system-wide check and balance system, clustering allows the analyst to assess movements between budget groups and adjust the forecast accordingly. Therefore, CHPR has recommended allowing for trending down at the budget group level followed by an overall trend assessment and adjustment at the cluster level.

To forecast at the cluster level the analyst must arrange the budget groups and their associated forecasted trends as developed in Step 3A, into the clusters designated in Table 2. **Caseload Narrative Examples Ex8** provides an example of the FY03Q3 Cluster forecast worksheet developed in Microsoft Excel. After all the budget groups are arranged by cluster, the cluster forecast is developed by summing the member month eligibility for each budget group of the cluster in a new column within the worksheet entitled “Cluster Forecast”. Once the “Cluster Forecast” is developed for all clusters, the analyst must then assess the slope of the associated forecasts. If the trend of the forecast is increasing then that is the forecast member month eligibility that should be budgeted for. If the trend of the forecast is decreasing, then the forecast must be adjusted to prevent member month eligibility at the cluster level from decreasing.

The budget groups with downward trends should be analyzed. It is at this point that the analyst must bring into the analysis any additional institutional knowledge that may allow for the understanding of the cluster level behavior. From this knowledge, the analyst must make the subjective judgment as to which budget group(s) needs to be adjusted to facilitate an increasing trend at the cluster level. For example, if the analyst were aware of specific budget groups from which a significant decrease in eligibility was trended for in Step 2 based upon a redetermination policy. The analyst may reassess which months are included in the historical trend for these particular budget groups or they may choose to employ the “Trend/pull” function developed in Step 2. The use of either of these methods is a subjective judgment and is based upon the specific knowledge the analyst has available at that time, and the projected impact of the change on the cluster level forecast.

Concluding Remarks

The forecasting process is complex and has subjective components. It requires a substantial level of institutional knowledge and skill in the assessment of the behavior of individual budget group populations from a mathematical and a policy perspective. This narrative is designed to assist the analyst in the forecasting process and to add to the rationale developed in the "*MassHealth Caseload and Expenditure Analysis: Final Caseload Analysis Deliverable*," presented to MassHealth on August 2, 2004.

The methodologies outlined above were developed by the Center for Health Policy and Research (CHPR) to augment the current procedures for forecasting MassHealth caseload eligibility. Therefore the complex assumptions and caveats discussed above are also subject to the assumptions currently employed in the existing forecasting process. These recommendations for improvement are meant to add to the toolbox of the informed analyst and should not be used in a vacuum. Forecasting is a process of informed decision making and educated guessing. The mathematical process is a mechanism from which the analyst can gain the insight needed to make these decisions. Finally, these tools are meant to be fluid and adjusted as necessary as policy changes require or knowledge levels increase.