



**Rutgers** Center for  
State Health Policy

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# Discussion Paper

## Community Living Exchange

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### **Data Presentation:**

Managing and Using Home and  
Community-Based Services Data for  
Quality Improvement

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## Managing and Using Data for Quality Improvement

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The Data Management and Use Series represents the third in a group of papers synthesizing the ideas and practices of states as they improve the quality of home and community based services (HCBS) and supports for older persons and persons with disabilities.

In 2003, the Centers for Medicare & Medicaid Services (CMS) awarded grants to 19 states to enhance their quality management (QM) programs for HCBS programs.<sup>1</sup> CMS contracted with the Community Living Exchange Collaborative<sup>2</sup> to assist states in their grant activities by promoting information exchange and facilitating discussions on topics of common interest. As part of its work with the Community Living Exchange Collaborative, the Muskie School of Public Service, together with grantee states, identified three initial priority topics for working papers:

1. Quality Management (QM) Roles and Responsibilities
2. Discovery Methods for Remediation and Quality Improvement
3. **Managing and Using Data for Quality Improvement**

The Data Management and Use Series builds upon the concepts and techniques discussed in the two previous papers and provides additional resources for states as they seek to organize, analyze and report data in a way that informs decision making and supports quality management and improvement.

### Focus and Purpose of Data Use and Management Series

As 2003 Quality Grantees move into the third year of their projects, their methods for collecting and automating HCBS waiver data are continuously improving, and program and outcome data are becoming more readily available. One challenge that is frequently articulated by grantees is how to organize, analyze and report this data in a way that is timely, accurate and cost-effective. States are challenged to integrate information from a variety of separate systems and present data in a format that is meaningful, purpose-driven and often dependent on the audience or stakeholder. CMS's requirement that states report data in a way that directly addresses HCBS waiver assurances gives each of these challenges additional weight.

A number of specific issues and questions were identified through monthly conference calls and one-on-one discussions with grantees. These include the following:

- **Performance Measurement:** How do states construct and use performance measures to evaluate HCBS programs?
- **Data Analysis:** How do states validate, clean and analyze waiver data in a way that supports project management and informs decision-making?
- **Data Presentation:** What types of tables, charts and graphics are used to present data, and how does the effectiveness of these formats vary depending on the type of information and/or pattern being conveyed?
- **Reporting:** What types of reports are generated from HCBS waiver data and how do these reports vary depending on the audience and purpose?

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<sup>1</sup> QA/QI grantee states include: California, Colorado, Connecticut, Delaware, Georgia, Indiana, Maine, Minnesota, Missouri, North Carolina, New York, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Wisconsin, and West Virginia.

<sup>2</sup>The Community Living Exchange Collaborative is a partnership of the Rutgers Center for Health Policy, the National Academy for State Health Policy and Independent Living Research Utilization. Under contract with the Technical Exchange Collaborative, the Muskie School of Public Service is the lead for providing technical assistance in the area of quality assurance/quality improvement.

- **Data Integration:** How is data from different sources blended and linked to create a larger and more comprehensive data environment?

This paper is an attempt to address the challenges of data presentation from a program manager's perspective. It is not meant to be an exhaustive research document, nor is it intended to single out any one correct approach. The paper is meant to facilitate communication between program units and analytic staff and serve as one reference for states as they continue to improve upon data collection techniques and use this information for ongoing quality management and improvement.

## Data Presentation

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Presenting numbers and patterns is a critical component of data analysis. Once analyses have been completed, the next step involves sharing key findings with program staff and stakeholders and using these findings as a basis for decision-making. As this section details, there are a number of ways to present the results of quantitative data analysis. Tables organize and display detailed numeric information, while various charts and graphs are used to demonstrate general patterns, make comparisons and show relationships. The challenge in constructing an effective visual is to select the most appropriate format for the information or pattern being conveyed. This section provides an overview of the most frequently used formats and includes tips on how to select among these types for different topics and variables.

### Tables

Effective tables present numeric information in a clear and well-organized fashion. They are coordinated with the text, but can also stand alone to provide a concise summary of the analytical question under discussion and occasionally serve as a data source. Effective tables include the following:

- a title that (1) specifies the topics or research questions addressed within the table; (2) conveys the general categories for which numeric information will be shown; and (3) includes pertinent details on where and when the data was collected, as well as what was measured.
- clearly labeled rows and columns.
- data units that state the system of measurement for every variable in the table (*e.g.*, percent of sample; cost per capita, etc.).
- numbers that speak specifically to the research questions and inform readers of the table's main points. (Keep all other data out of the table where it does not get in the way of the important stuff.)
- a list of the data source or sources.
- definitions of terms and abbreviations used throughout the table.
- any notes that are needed to explain the calculations, assumptions and/or methods used in preparing the data.

Two types of tables commonly found in reports are univariate and bivariate tables. Univariate tables are the simplest kind of table and show information on each variable alone rather than in association with other variables. Common types of univariate tables include those that present the composition of a sample (Table 1) or provide descriptive statistics on a series of related outcomes, such as categories of perceived health status (see Table 2). Note that numeric information is often shown in more than one format, such as frequency and percentage, or mean and standard deviation.

**Table 1. Demographic Characteristics of Children in Maine’s Medicaid/SCHIP Survey Sample, FY 2003 (N=1840)**

	Percent	Frequency
<i>Age</i>		
0-5	25	464
6-12	39	721
13-20	36	655
<i>Gender</i>		
Male	50	916
Female	50	924
<i>Program</i>		
Medicaid	54	986
Medicaid Expansion	23	423
CubCare	23	431

*Source: Families’ Evaluation of Maine Medicaid and State Children’s Health Insurance Program, FY 200*

**Table 2. National Core Indicator Adult Family Survey: Health Status of Respondents in 12 States, 2003-2004**

	Percent	Frequency
Excellent	19	917
Good	52	2447
Fair	25	1176
Poor	4	180
Total	100	4720

*Note: 12 states included AZ, CA, CT, ME, NC, OK, PA, SC, WA, WV, WY.*

*Source: NCI Adult Family Survey, 2003-2004 data*

Bivariate, or two-way, tables show the relationship between two variables and are used to present correlations and cross-tabulations, as well as the differences in means or compositions of two or more populations. Table 3 compares consumer satisfaction survey results for three geographic regions within a sample state.

**Table 3. Comparison of Consumer Satisfaction Survey Results by Region and by Service Domain**

Question	Percent of Consumers Who Were Satisfied		
	Region I (N=131)	Region II (N=128)	Region III (N=135)
Service options explained in assessment process	72	83	76
Participated as much as wanted to in developing care plan	86	89	83
Respectful worker	80	85	82
Satisfied with amount of privacy	68	75	75

*Source: Hypothetical data for sample state*

In Table 4, health insurance coverage of American children is examined by type of coverage and area of residency.

**Table 4. Health Insurance Coverage of U.S. Children by Residence, 1998 (N=75.5 million)**

	Percent Distribution by Coverage Type		
	Private	Public	Uninsured
Rural, Non-Adjacent	52.1	27.3	20.6
Rural, Adjacent	67.4	16.8	15.8
Urban	66.9	18.6	14.5
Total	65.5	19.3	15.2

*Source: Medical Expenditure Panel Survey (MEPS), 1998*

Things to remember when constructing a table:

- Use a table to display detailed numeric information that might otherwise get lost in a chart or graphic.
- Make tables self-explanatory. Include a title, labeled units, source or sources of the data and definitions of abbreviations when appropriate.
- Create tables that are structured around a key point or research question. Do not include unnecessary raw data (*e.g.*, cumulative frequencies, row percentages, column percentages, etc.) that is not directly relevant to the message you are trying to convey.

## Charts and Graphs

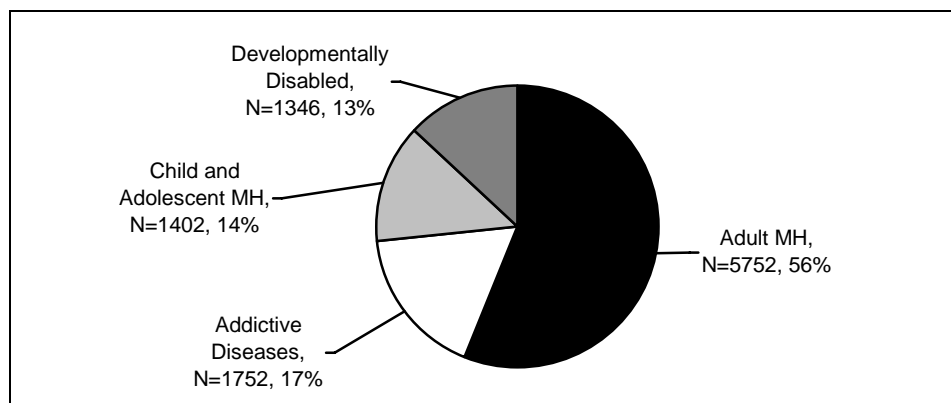
Charts and graphs are used to emphasize important comparisons, patterns and relationships which might not be readily apparent in text or tables. Effective charts provide a clear and simple picture of the general pattern and complement a text description by illustrating the shape and size of differences between numbers.

One important step in charting and graphing effectively is to choose the appropriate chart or graph for the specific message you are trying to convey. A few types of charts/graphs commonly used in statistical presentation are the pie chart, bar chart, histogram and line graph. In this section, we will discuss each of these layouts and provide tips and examples of when each is appropriate.

### *Pie Charts*

A pie chart is appropriate when depicting the distribution or composition of a single variable, such as age, gender or program expenditures. A pie chart is shaped as a circle and divided into two or more slices, with each slice representing the relative size or frequency of the corresponding category. In the example provided below, survey respondents are broken down by consumer group. The primary message of the chart is to convey the relative size of each category in relation to the others.

**Figure 1. Georgia's Consumer Survey Respondents by Consumer Group, FY 2003**



*Source: Georgia's Performance Measurement and Evaluation System, FY2003 Performance Profile and MHDDAD Statewide Summary*

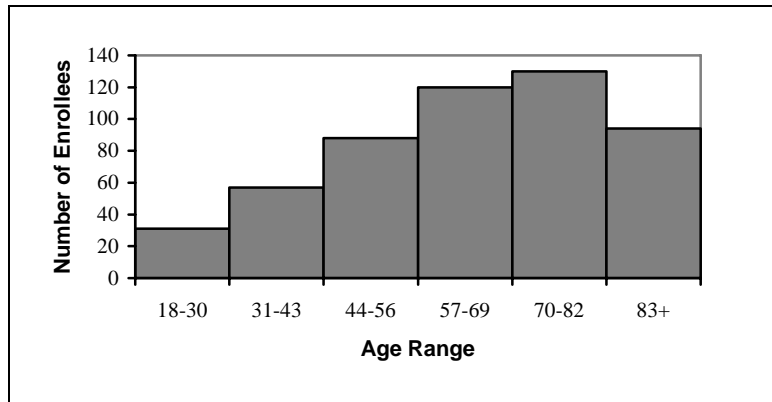
### Things to Remember:

- Use pie charts to illustrate distribution or composition of a single variable.
- Display only one variable per pie chart: either ethnicity or gender distribution – not both.
- Only use pie charts for variables whose values are mutually exclusive, *i.e.*, where no cases fall into more than one category.
- Avoid using pie charts for variables that have more than five categories.

### ***Histograms***

Histograms are a form of bar chart used to show distribution of a variable with values that can be ranked along the x-axis. You may have seen histograms used to illustrate the distribution of letter grades within a classroom, or income groups within a specific population. To create a histogram, array the values of the variable across the x-axis and plot frequency, either as the number of cases or percentage of the total, on the y-axis. As demonstrated in Figure 2 below, bars in a histogram should touch one another except if there are intervals on the x-axis for which there are no cases.

**Figure 2. Age Distribution of Aged and Disabled Waiver Enrollees in Sample State, 2004**



*Source: Hypothetical data for Sample state*

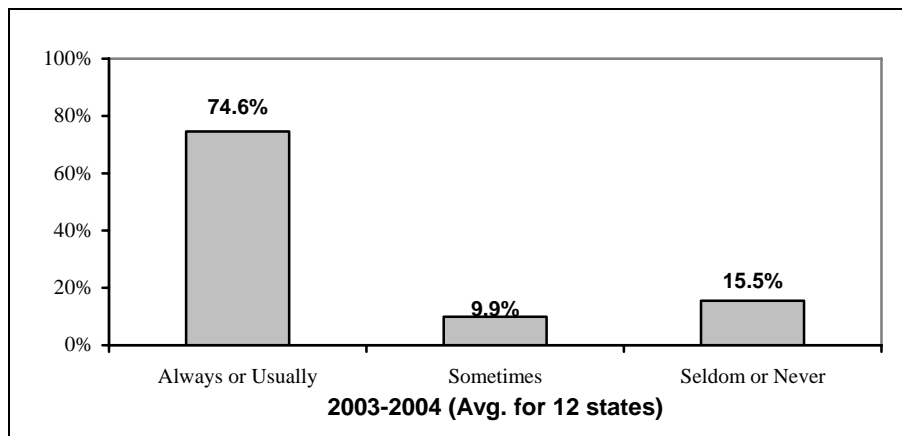
### Things to Remember:

- Use a histogram to display distribution of a variable that can be rank ordered, such as months of a year, quality indicator values or scores, age ranges or income categories.

### **Bar Charts**

Bar charts can be horizontal or vertical. A simple bar chart presents the relationship between two variables - a categorical variable and a continuous outcome variable, usually number or percent. Bar length or height is varied to represent quantities of a variable, such that the greater the length or height of the bar the larger the value of the variable. An example of a simple bar chart is shown below in Figure 3. Responses to a survey question are arrayed based on the answer options selected by respondents. Each bar is the same color because the categories being compared are part of the same variable (*i.e.*, access to dental services). In addition, a legend is not required because the two variables in question (*i.e.*, access to dental services and percent of total respondents) are already defined by the axis titles and labels.

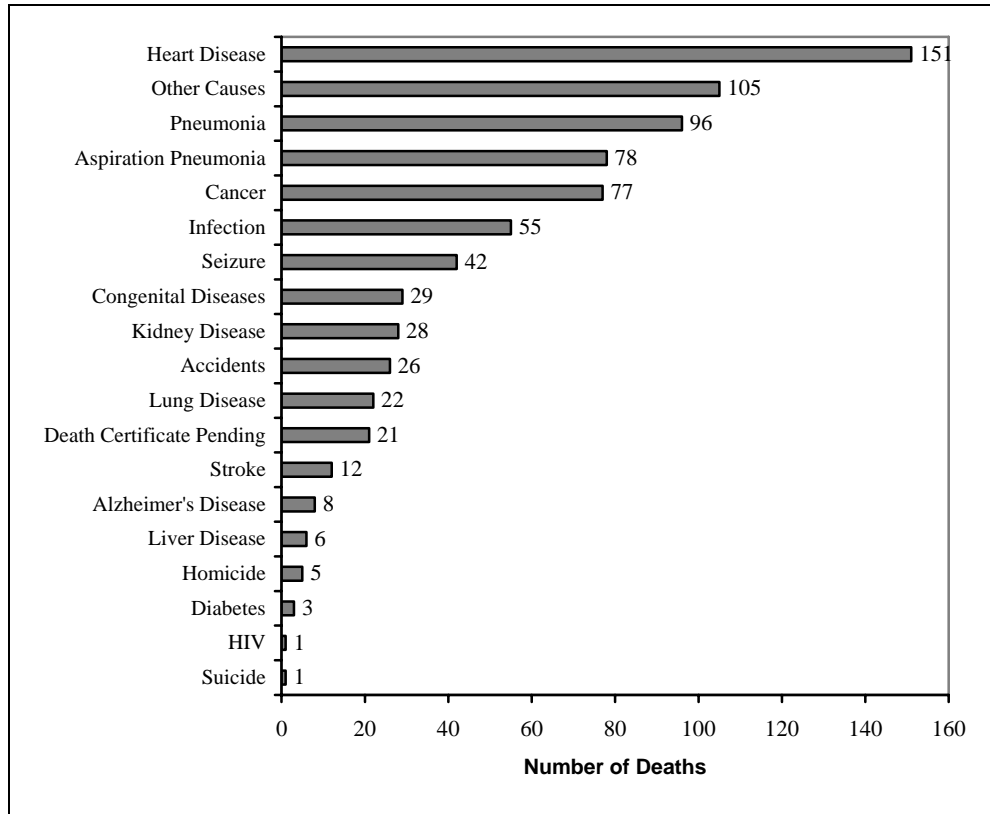
**Figure 3. Do you have access to dental services for your family member?**



*Source: NCI Adult Family Survey, Final Report – February 2005*

Bar charts can also be presented horizontally. One advantage of horizontal bar charts is that they have more room on the vertical axis for labels, especially if the number of bars to be portrayed is relatively large (e.g., 50 states). In Figure 4, a horizontal bar chart is used to depict causes of death during a single year. Bars are arranged in order of length so that it is easy to differentiate the most prevalent causes of mortality from the less common ones.

**Figure 4. Causes of Death of MR/DD Clients in Ohio, 2004**

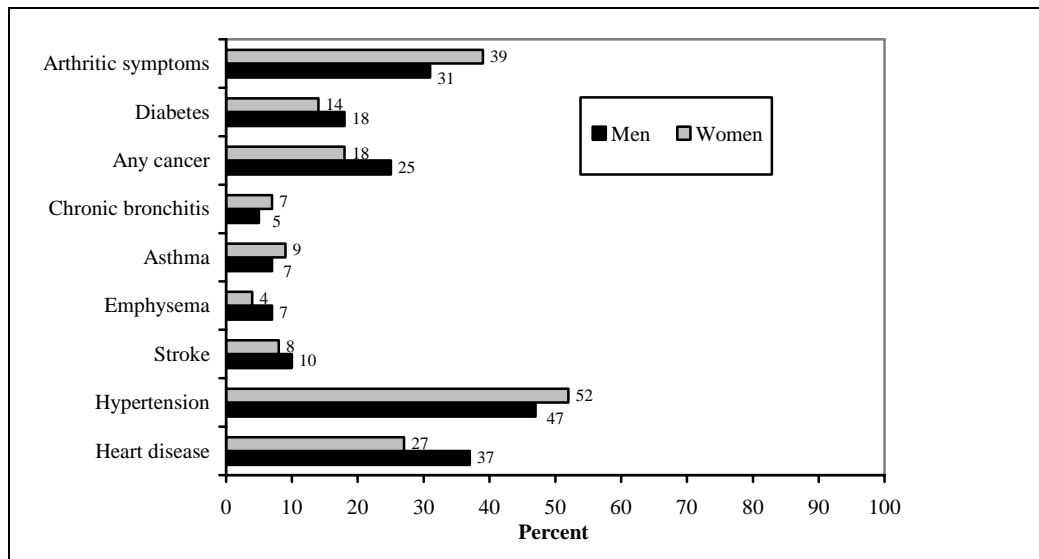


Source: Ohio Department of MR/DD Major and Unusual Incident Report – Cause of Death Annual 2004



A clustered bar chart is used to show the relationship between three variables - a continuous outcome variable, such as number or percent, and two categorical variables. In the chart below, one categorical variable (chronic conditions) is arranged on the y-axis, while the other, gender, is shown in the legend and determines the color or shading of the bar. The continuous outcome variable (percent of people age 65 and over) is arranged on the x-axis.

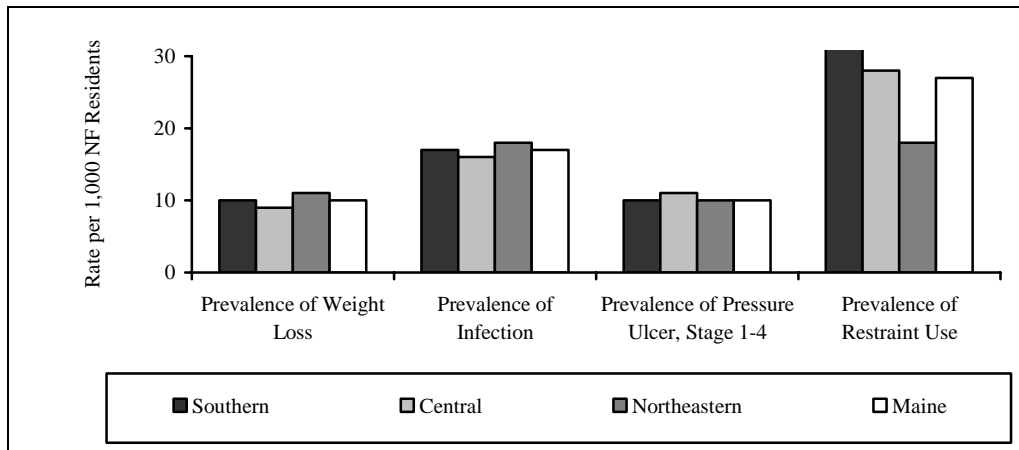
**Figure 5. Percentage of People Age 65 and Over Who Reported Having Select Chronic Conditions, By Sex, 2001-2002**



Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Survey

Figure 6 is another example of a clustered bar chart. In this chart, the prevalence rates of four different nursing home quality indicators are presented by region and compared to the state of Maine average.

**Figure 6. Selected Quality Indicators, Nursing Home Care**

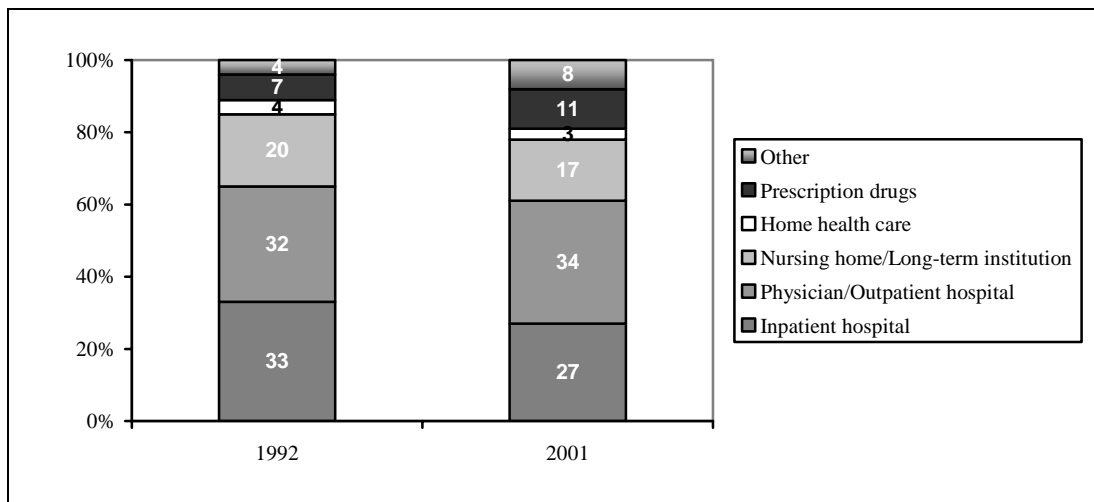


Source: US Department of Health & Human Services, Centers for Medicare & Medicaid Services, Minimum Data Set, 2002-2003

A final type of bar chart is the stacked bar chart. A stacked bar chart consists of one or more segmented bars and is used to show the distribution of a variable, either by itself or according to another characteristic. As with pie charts, which also show distribution, all cases of the variable must be mutually exclusive. The continuous variable is arranged on the y-axis and the variables on the x-axis and in the segments must be categorical.

In Figure 7, the distribution of health care costs for Medicare enrollees is compared for two years: 1992 and 2001. The slices represent major components of cost, such as prescription drugs and home health care, and vary in height according to the size of the total that each component contributes. Year is shown on the x-axis, and percent of Medicare enrollees is displayed on the y-axis. Note that this type of stacked bar chart is used to highlight distribution. To highlight both the distribution and level of the variable shown on the x-axis, create a stacked bar chart in which the height of the bar reflects the value of the outcome level (e.g., dollars, number of people, etc.).

**Figure 7. Major components of health care costs among Medicare enrollees age 65 and over, 1992 and 2001**



*Source: Centers for Medicare & Medicaid Services, Medicare Current Beneficiary Survey*

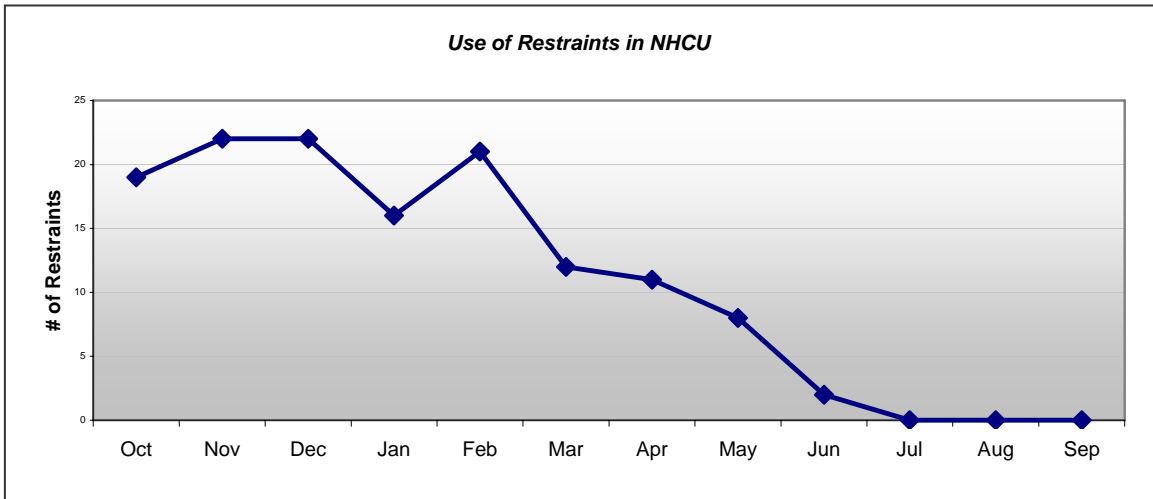
Things to Remember:

- Use a bar chart to show comparisons among categories.
- A horizontal bar chart is often used when the x-axis labels are too long to fit under vertical columns.

**Line Graphs**

A line graph is best used to show change over time. A line graph can help depict fluctuations or variations in a process, and/or document trends. A single line graph illustrates the relationship between two continuous variables, such as age and mortality rate, or program cost and year. Typically, the predictor variable is shown on the x-axis, and the outcome variable is shown on the y-axis. In Figure 8, use of restraints is plotted by month to demonstrate the reduction in restraints over a 12-month period. In Figure 9, home and community-based service waiver expenditures are plotted by year to demonstrate growth in spending over a decade.

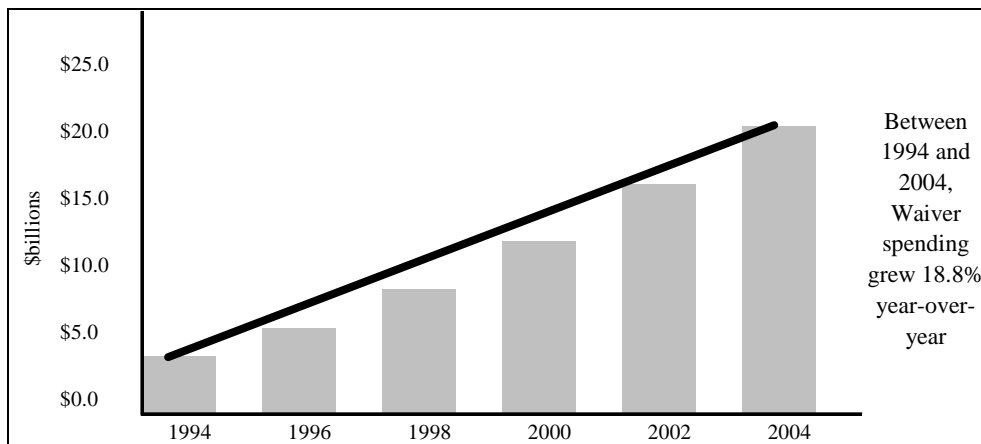
**Figure 8. Use of Restraints in Nursing Home Care Unit Over a 12-Month Period**



Source:

[http://www.patientsafety.gov/SafetyTopics/fallstoolkit/resources/collaborative/Implementing\\_a\\_Falls\\_Assessment\\_Program.doc](http://www.patientsafety.gov/SafetyTopics/fallstoolkit/resources/collaborative/Implementing_a_Falls_Assessment_Program.doc)

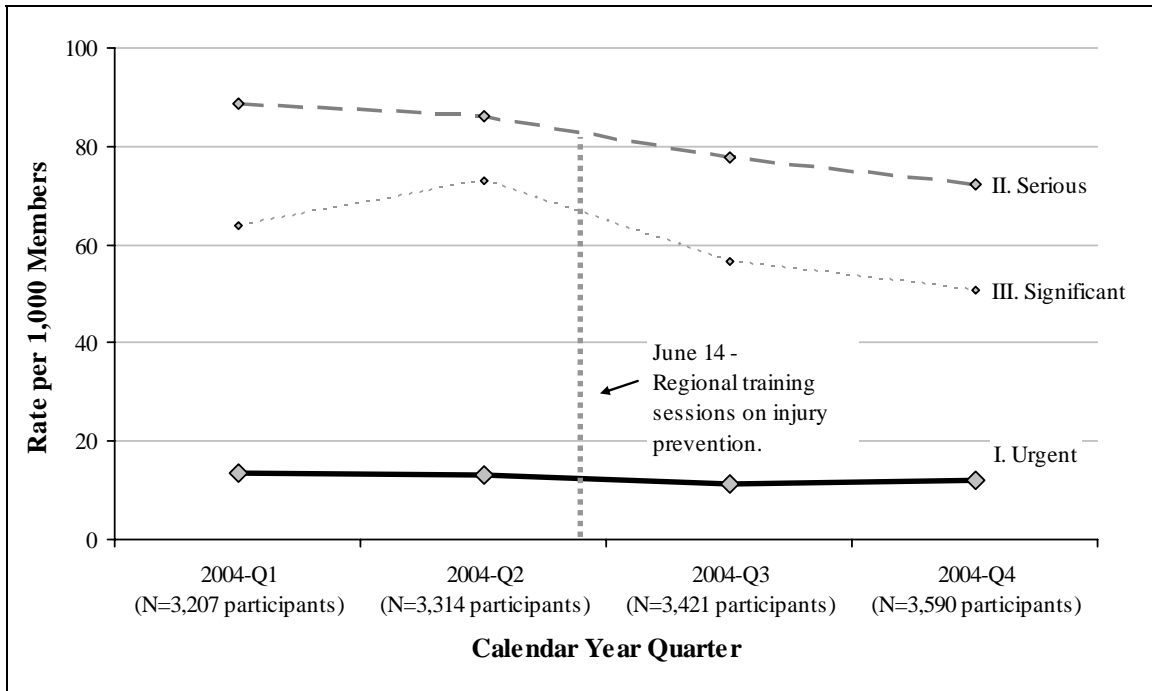
**Figure 9. HCBS Waiver Expenditures: 1994-2004**



Source: CMS Presentation on The Revised 1915(c) Waiver Application

A multiple line graph adds a third dimension to the chart and, in addition to showing the relationship between two continuous variables, tracks change for at least two categorical variables. In the multiple line graph shown in Figure 10, critical incident rates are tracked over time and by incident level. Incident level is the categorical variable and is identified in the legend. A different line style is used to demarcate trends for each level of incident. Additionally, a vertical line at a single point in time indicates a regional training on injury prevention and enables readers to track critical incident rates over time in light of a specific intervention.

**Figure 10. Statewide Confirmed Critical Incident Rate by Incident Level (2004)**



Source: Hypothetical data for Sample state

Things to Remember:

- Use a line graph to show change over time or to depict the relationship between two continuous variables.
- A double or multiple line graph can elaborate on how trends or relationships vary according to an additional category, such as region or gender.

## **Additional References for Displaying Data**

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