

PowerPoint Poster Making Guide

Instructional and Brand Guidelines
for Stony Brook Medicine



Stony Brook
Medicine



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Poster Considerations

The following guide was designed to assist you with formatting and printing your poster presentation while using the system-wide brand guidelines of Stony Brook Children's Hospital.

PowerPoint templates referenced in this guide are available on Stony Brook University's Communication Toolkit

http://www.stonybrook.edu/commcms/toolkit/telling_story/presentations

Note: Most instructions are for Mac users, and can be adapted for PC users. In some instances, specific instructions for both Mac and PC users are included.

Word Count: under 500 words

A poster is *not* a paper.

- A paper is constructed for independent learning.
- A poster by contrast has YOU standing next to it as its guide.
- Your entire poster should have **under 500 words total**.
- If your poster is clear and concise, an individual should be able to read it in under 10 minutes.
- PowerPoint was designed to project large images in a dark room. The amount of copy, images and colors that work well for slides don't necessarily work for a poster.

Always remember your target audience!



Visual Components

Every image is important.

Images should be legible from a distance. Clean and precise images are easy to see and understand.

- **Use charts, graphs and tables**

Excel imports are common. If import problems occur, save the image in a pdf format, then import to PowerPoint.

- **Use clear photographs and/or illustrations**

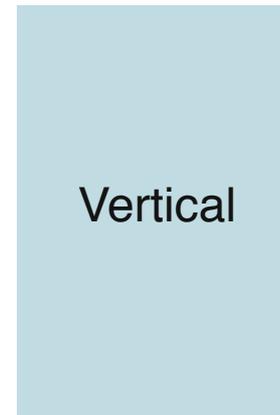
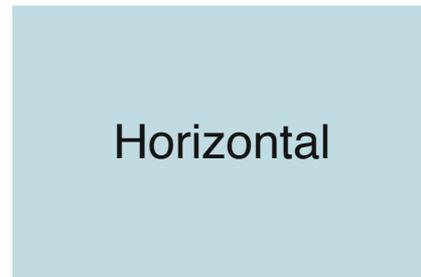
Save these images in a jpg, png or pdf format (300 dpi is recommended).

For best printing results, the original photograph or illustration should be 12” wide at 300 dpi. It is not recommended to enlarge these images or to download low resolution images (72 dpi) from the Internet. Visual quality will be compromised. If the image looks blurred when imported to your poster, it will print this way as well.



Poster Dimensions

PowerPoint templates provided are both horizontal 42" x 36" and vertical 36" x 42" orientations.



The paper available for printing is 42 inches.

Note: Posters more than 42 inches are considerably more expensive to print.

Important Information about Paper Resizing

This template was designed to be 42” wide x 36” high.

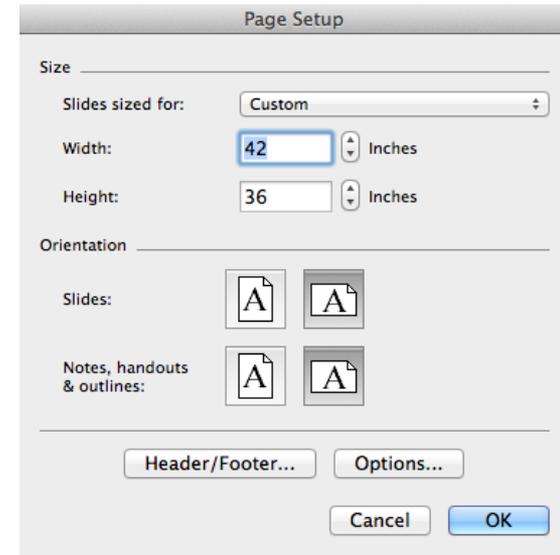
Although not recommended, if you must increase the poster size, follow these steps:

1. Go to **File, Page Setup, Width and Height.**
2. Check with your printer for paper size availability and cost increase.
3. Change both the **Width** and **Height** to increase the paper by 5%, 10% or 15% using the specific dimensions here:

5% - 44.1” w x 37.8” h

10% - 46.2” w x 39.6” h

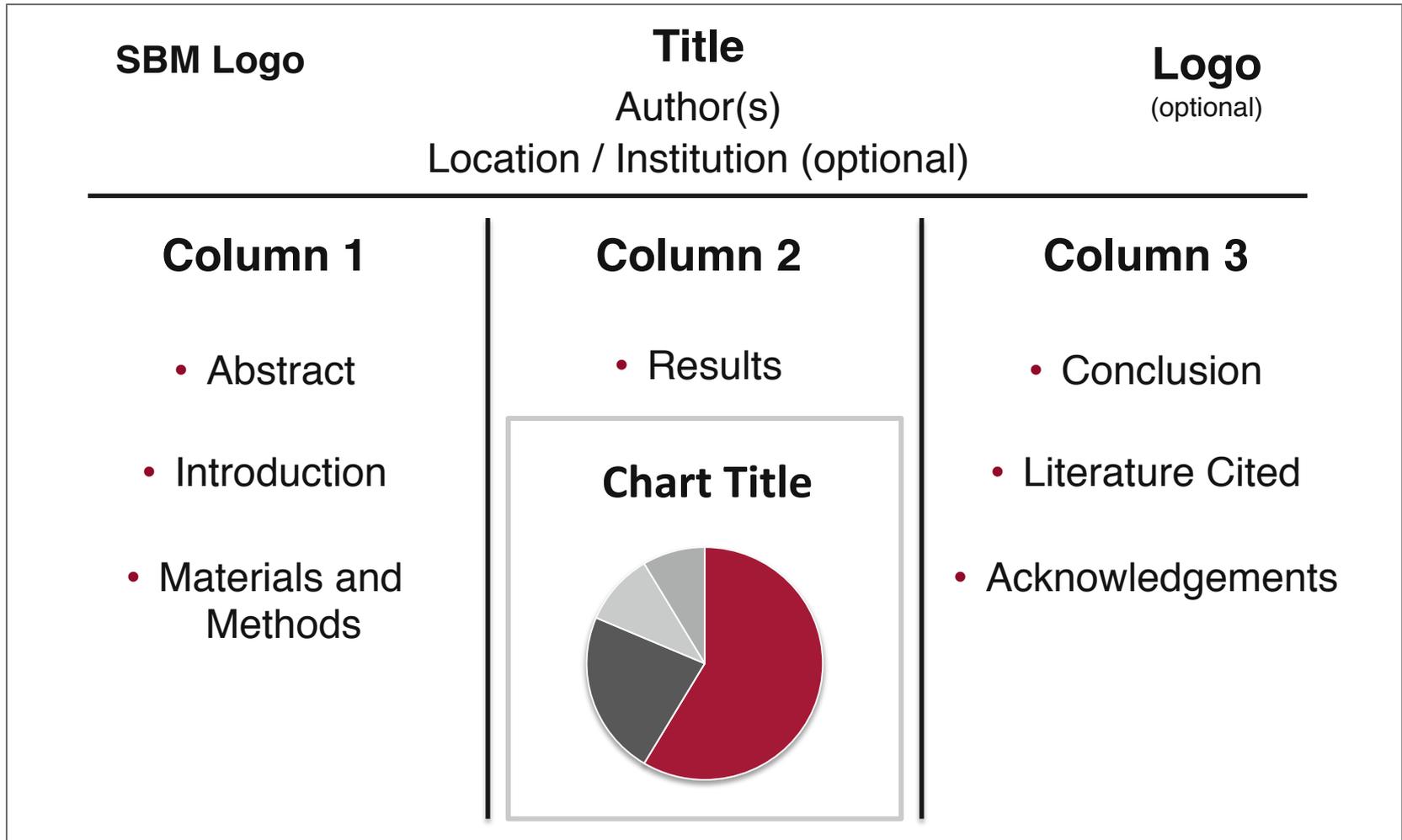
15% - 48.3” w x 41.4” h



Note: DO NOT simply change the paper size of the template, as all linked logo(s) and images will be distorted, resulting in poor branding practices.



Layout of Poster





Poster Components

Title: Convey the issue under study and draw passersby to your poster.

- Derive it from your hypothesis.
- Should not be greater than two lines.

Introduction: Use the absolute minimum amount of background information.

- Set the context of your study and draw your audience in.
- State your hypothesis clearly.
- Remember, less is more.

Materials and Methods: Briefly describe experimental procedures, patient population, statistical analysis, etc.

- Section may be omitted if sufficient detail is included in figure/table legends.



Poster Components

Results: Use tables and figures to present your findings.

- Clinical research usually begins with a flow chart describing patient recruitment and a table of demographics for subjects included in the analysis.

Conclusions: Restate the significant findings of your study and the relevance of the results.

- Affirm or reject your original hypothesis. Discuss future directions.

Literature cited: Stick to one bibliography format for all listed references.

- Limit the bibliography to a maximum of 10 references.

+/- Acknowledgments: Include the names of all people who helped with the work but were not included as authors.

- List sources of funding.
- Include a conflict of interest statement.



Getting Ready...

Draw a rough draft of your poster's components.



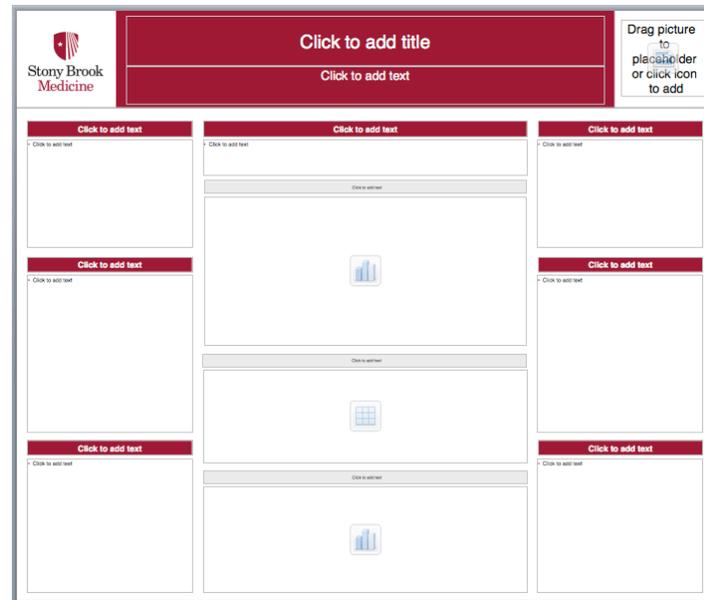
Download a Poster Template

The poster template choices for Stony Brook Medicine are:

SBM 2015_HorizontalPosterTemplates.potx

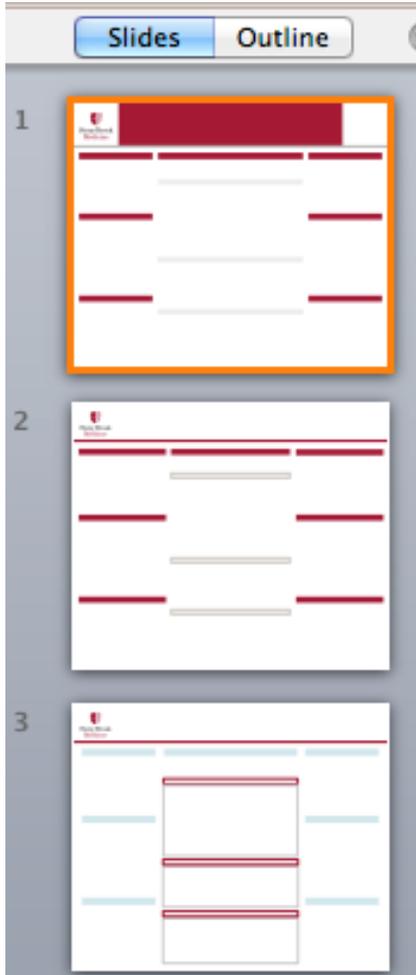
and

SBM 2015_VerticalPosterTemplates.potx





Choose a Poster Template

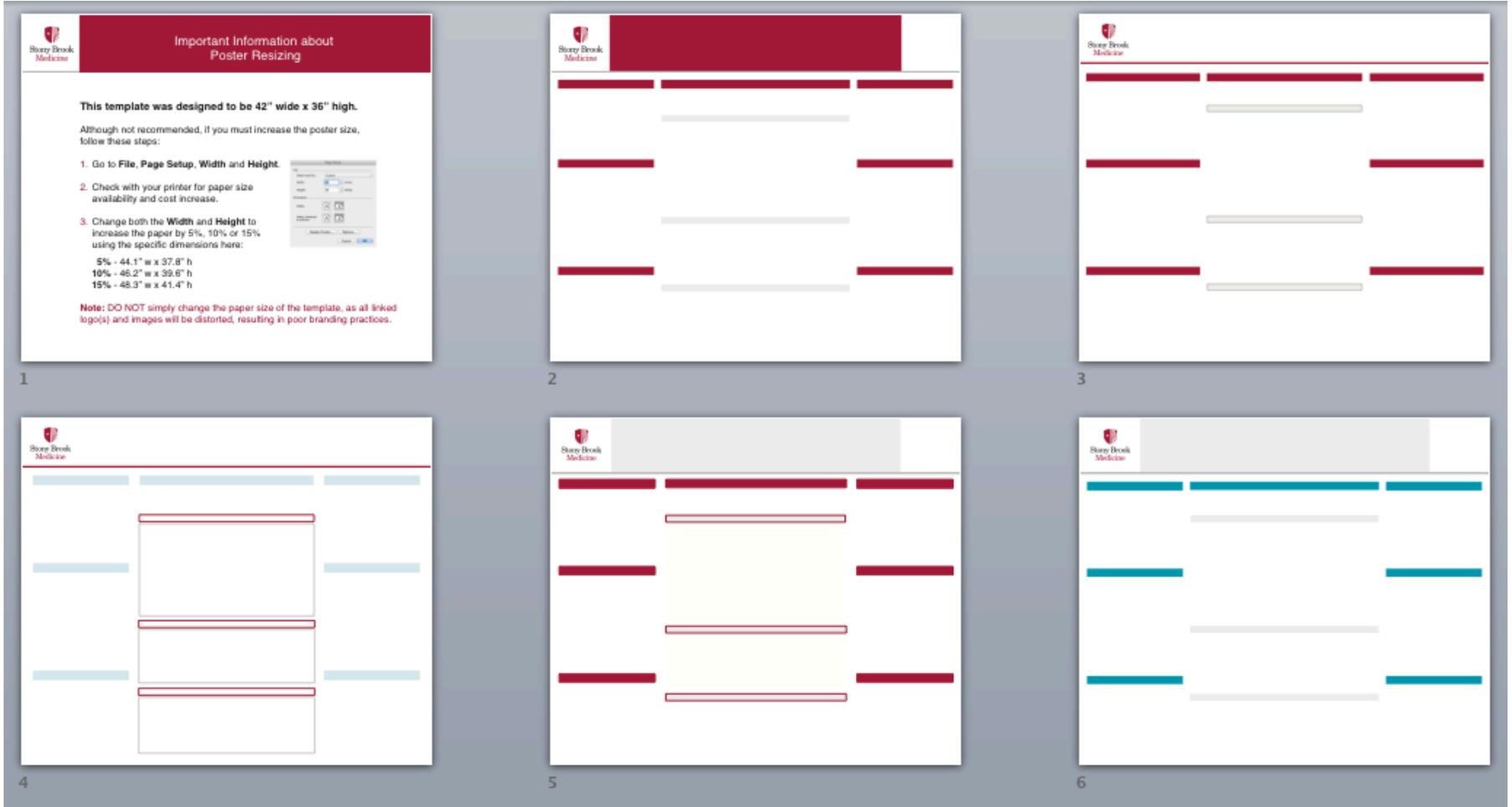


Choose one layout template

- Delete all remaining pages when ready.
- If you need to add a slide, in the upper left corner of the document ribbon, Go to **Home**, **New Slide**, **click** and **hold the drop-down arrow** to the right of the (New Slide) icon.

Note: If you do not see the icon, click on the Home tab in the ribbon.

Horizontal Poster Options



Important Information about Poster Resizing

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2. Check with your printer for paper size availability and cost increase.
3. Change both the **Width and Height** to increase the paper by 5%, 10% or 15% using the specific dimensions here:
 - 5% - 44.1" w x 37.8" h
 - 10% - 46.2" w x 39.6" h
 - 15% - 48.3" w x 41.4" h

Note: DO NOT simply change the paper size of the template, as all linked logo(s) and images will be distorted, resulting in poor branding practices.

1

2

3

4

5

6

Vertical Poster Options

Important Information about Poster Resizing

This template was designed to be 42" wide x 36" high.

Although not recommended, if you must increase the poster size, follow these steps:

1. Go to **File, Page Setup, Width and Height**.
2. Check with your printer for paper size availability and cost increase.
3. Change both the **Width and Height** to increase the paper by 5%, 10% or 15% using the specific dimensions here:
 5% - 44.1" w x 37.8" h
 10% - 46.2" w x 39.6" h
 15% - 48.3" w x 41.4" h

Note: DO NOT simply change the paper size of the template, as all linked logo(s) and images will be distorted, resulting in poor branding practices.

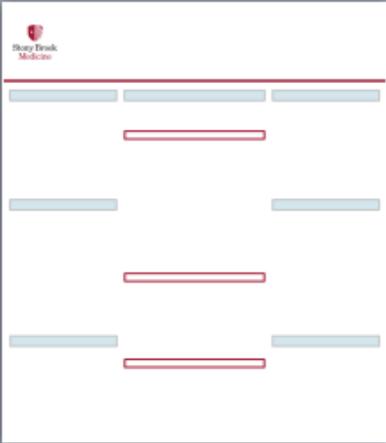




2



3



4



5

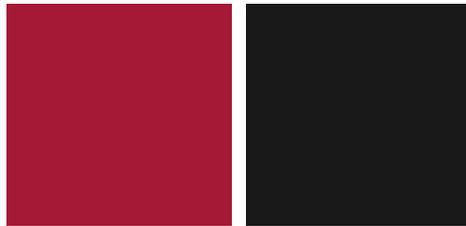


6

SBM Color Palette

Correct usage of the
Stony Brook Medicine Graphic Standards Color Palette
is vital for brand consistency.

Primary Colors



Pantone
187

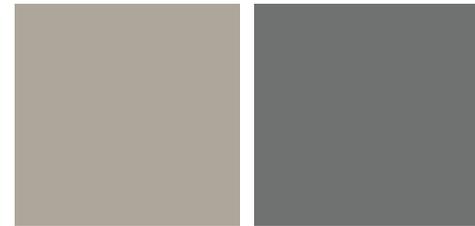
Black

Secondary Color



Pantone
632

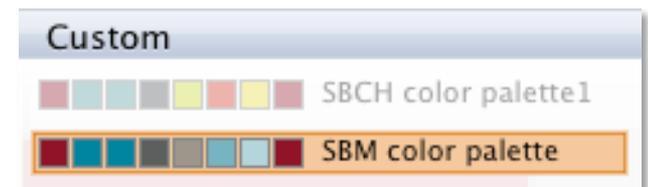
Neutral Colors



Pantone
Warm Gray 4

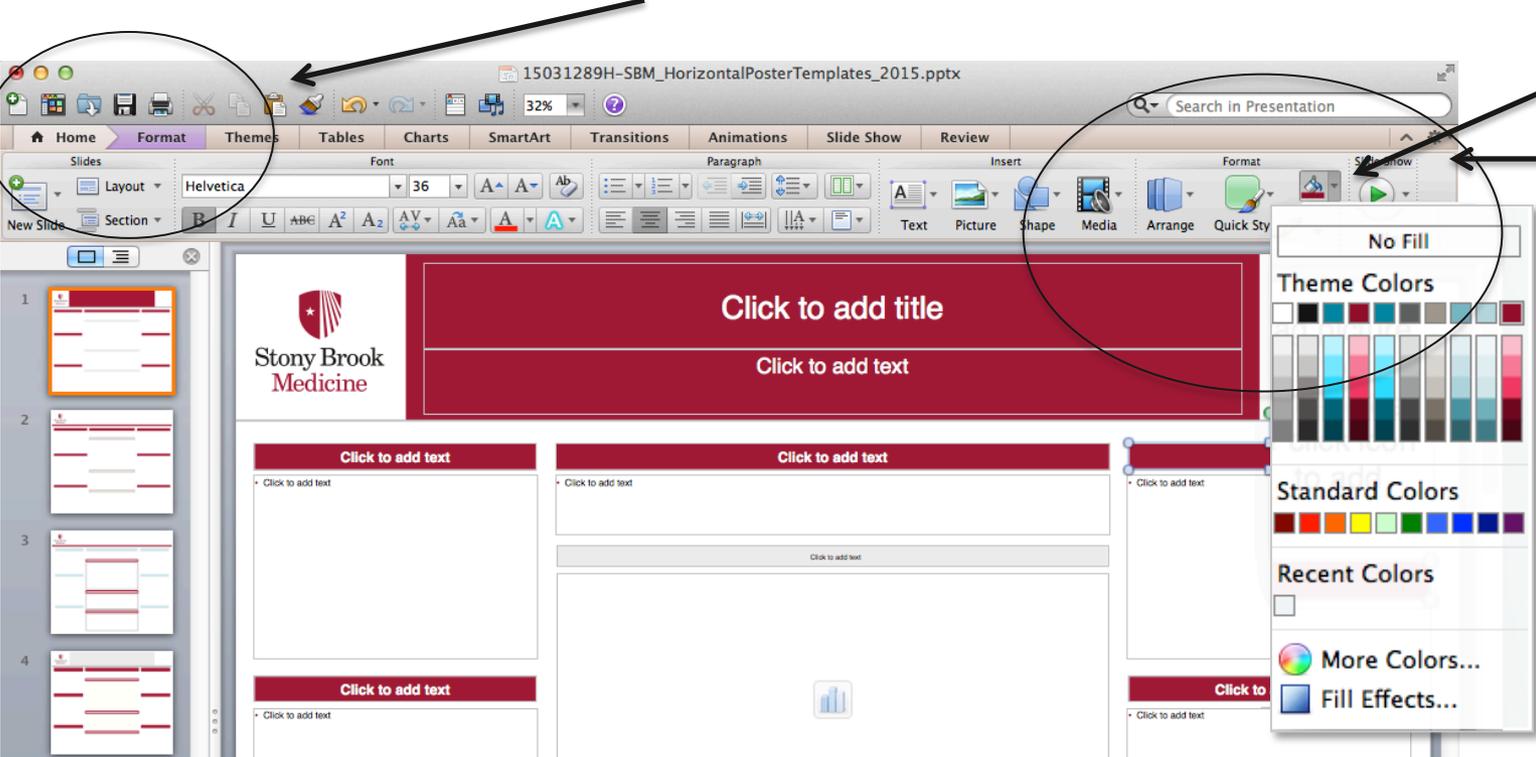
Pantone
Cool Gray 9

Do not recreate or add to the Theme Color Palette.



SBM Theme Colors

Theme Colors have been set-up for you to use within PowerPoint and Excel. Go to the Ribbon's **Home Tab, Format** and click on the **paint bucket icon**. (PC users go to **Home Tab, Shape Fill** and click on the **paint bucket icon**.)



The screenshot shows the Microsoft PowerPoint interface. The **Format** ribbon is selected, and the **Shape Fill** group is active. The **Theme Colors** palette is open, displaying various color options. A black circle highlights the **Theme Colors** palette, and an arrow points to it from the label "Theme Color Palette". Another arrow points to the **Format** ribbon from the label "Ribbon". A third arrow points to the **Shape Fill** group from the label "Ribbon". The main slide area shows a template with a red header and footer, and a central text box. The slide thumbnail pane on the left shows four slides.

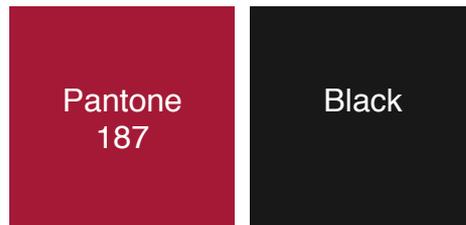
Ribbon

Theme Color Palette

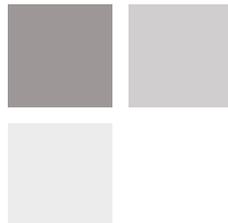
Theme Color Palette Percentages

You are encouraged to use the Theme Color Palette with **color percentages** for charts, graphs and tables – ***not text***.

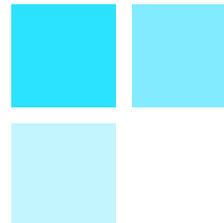
Primary Colors



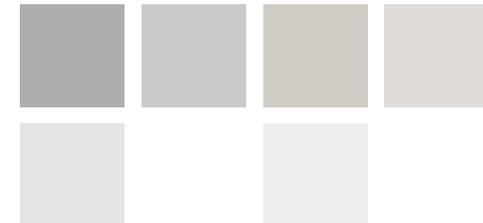
Avoid using color percentages for Pantone 187 (Red) when possible.



Secondary Color



Neutral Colors

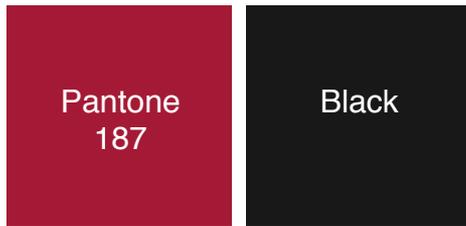


Do not recreate or add to the Theme Color Palette.

RGB Color Palette

The RGB Color Palette breakdowns listed below are for those using statistical software programs other than Excel.

Primary Colors



RGB
184-18-55

Secondary Color



RGB
46-191-202

Neutral Colors



RGB
120-122-124

RGB
182-175-165

Please note:

Use the SBM color palette in this guide for all other software programs (Excel, PowerPoint, Word, etc.)



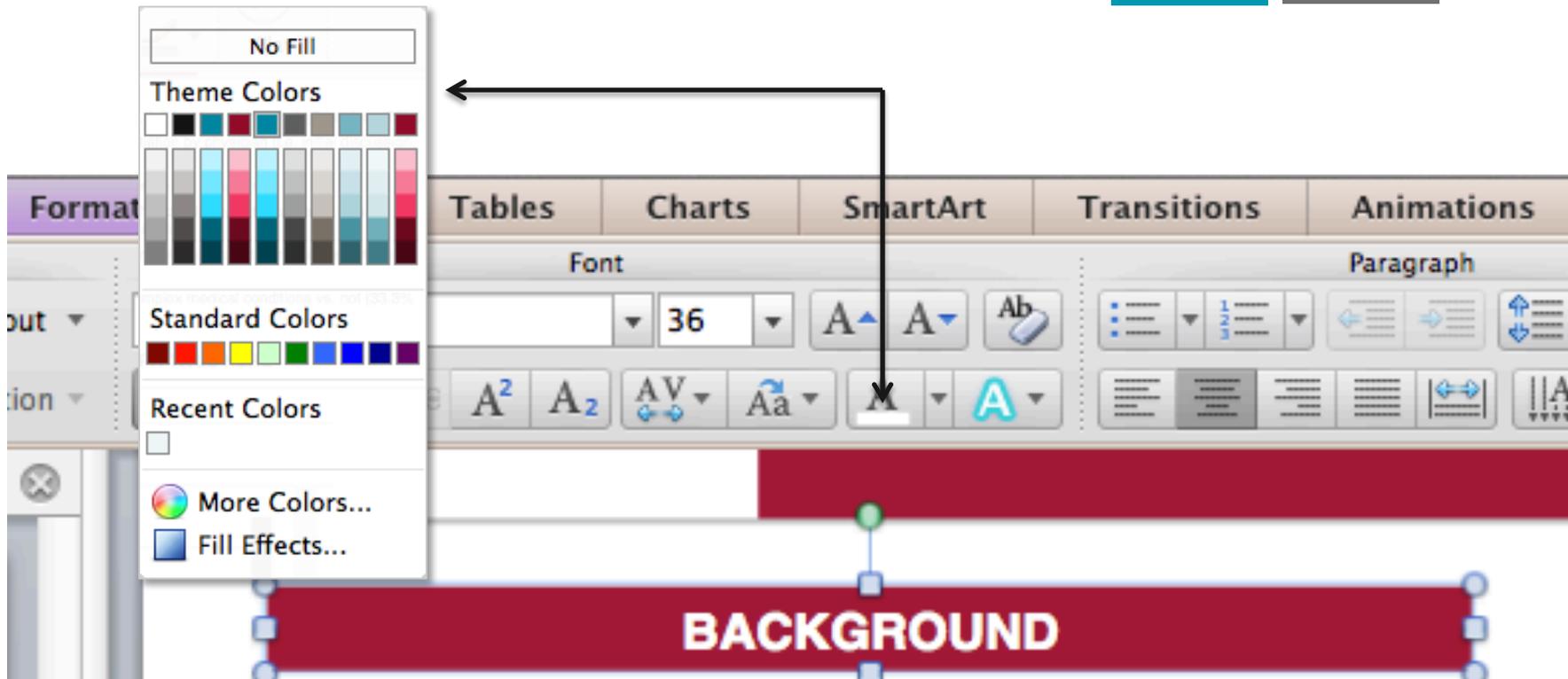
Font Recommendation

Helvetica

(Only Helvetica)

Font Color Options

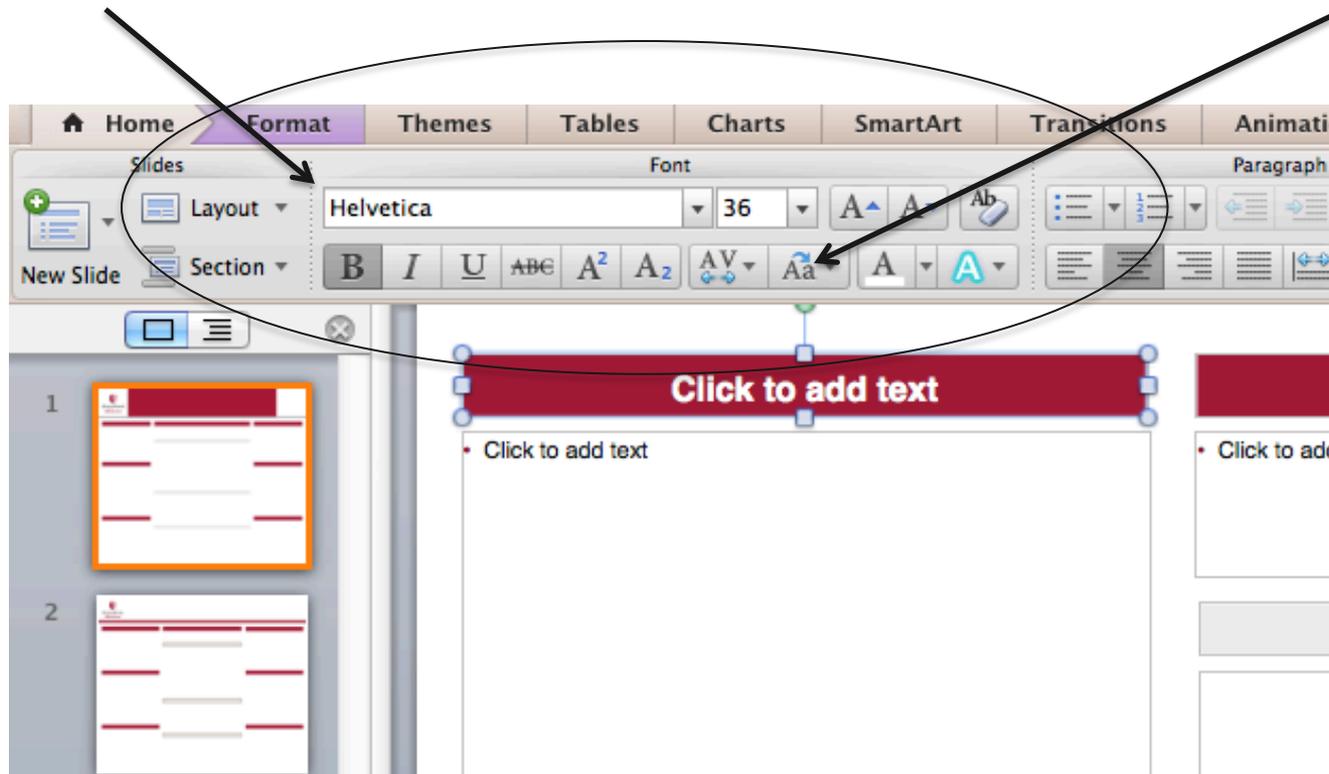
The font Helvetica color choices are: Black, Red and
Choose *only* from the **Theme Color Palette** options.





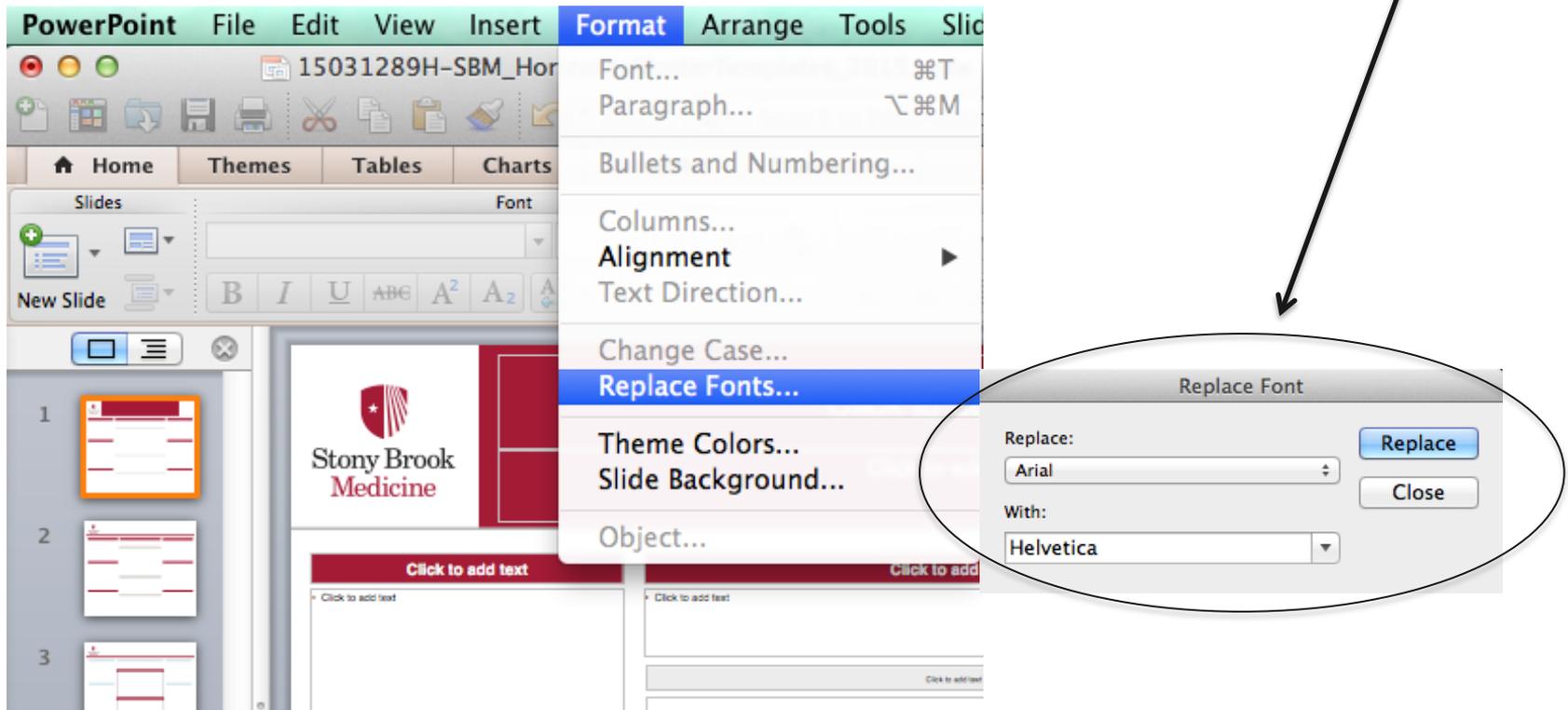
Font: Helvetica

Brand consistency is key. Only use the font Helvetica.
Use Regular, *Italic*, **Bold**, ***Bold Italic***, CAPS regular and **CAPS BOLD**.



Replace Fonts to Helvetica

If your PowerPoint Template does not say “Helvetica” go to:
Format (drop-down menu), Replace Fonts, With: Helvetica, Replace.





Font Sizes

1. Title: **85 point**
2. Author(s): **54 point**
3. Locations/Institution: **36-40 point**
4. Sub-Headings: **36 point**
5. Body text: **24 point**
6. Captions: **18 point**

- To be **legible 14 feet** use **72 pt.**
- To be **legible 12 feet** use **60 pt.**
- To be **legible 10 feet** use **48 pt.**
- To be **legible 6 feet** use **30 pt.**

The wireframe shows a slide layout with the following elements:

- 1**: Title area (dark red background, white text)
- 2**: Author(s) area (dark red background, white text)
- 3**: Sub-Headings area (dark red background, white text)
- 4**: Main body text area (white background, dark red text)
- 5**: A smaller text area within the main body (grey background, dark red text)

Additional elements include the Stony Brook Medicine logo in the top left and a placeholder instruction in the top right: "Drag picture to placeholder or click icon to add".

Colors: Can you read me now?

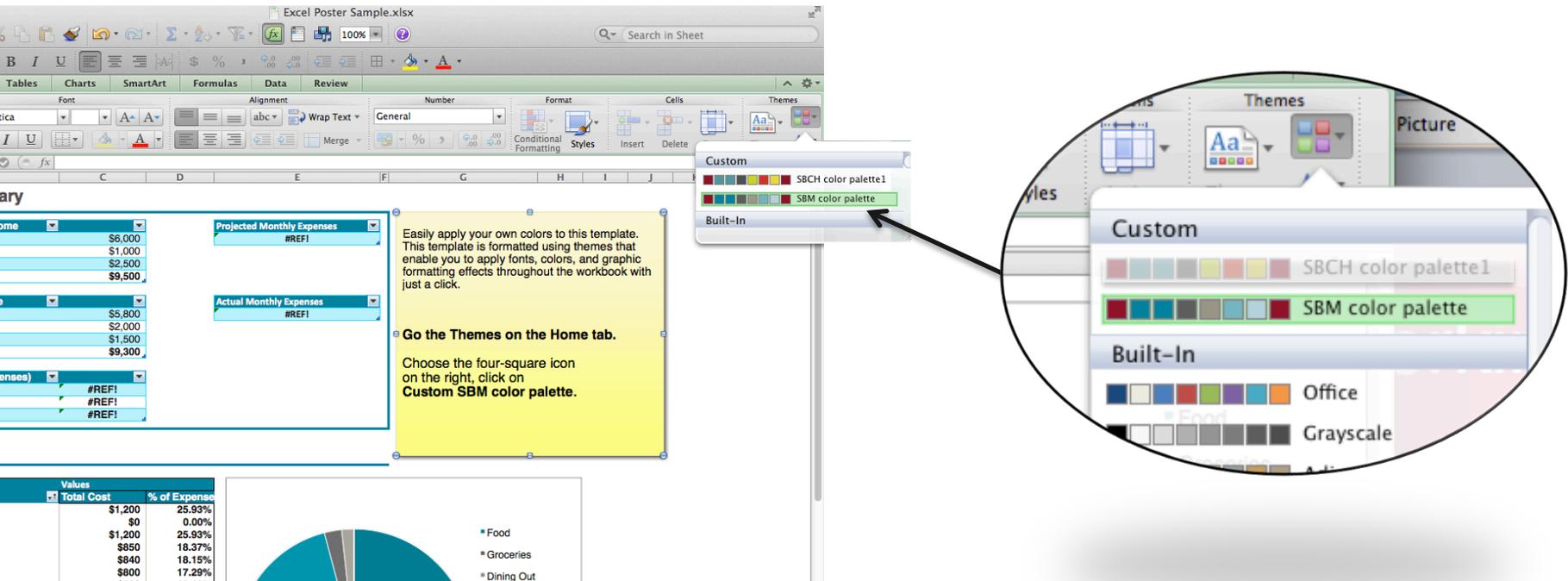
Working in Excel

Apply the SBCH Theme Color Palette to Excel charts, graphs and tables:

- Double click on the **Home** tab, **Themes**, **Colors** and choose **Custom**.

(PC users click on **Page Layout**, **Colors**)

SBM color palette



Excel Poster Sample.xlsx

Excel interface showing the **Home** tab, **Themes**, and **Colors** options. The **Custom** option is selected in the **Colors** dropdown menu, showing the **SBM color palette**.

Go to the Themes on the Home tab.
Choose the four-square icon on the right, click on **Custom SBM color palette**.

Values	Total Cost	% of Expense
	\$1,200	25.93%
	\$0	0.00%
	\$1,200	25.93%
	\$850	18.37%
	\$840	18.15%
	\$800	17.29%

Legend for Pie Chart:

- Food
- Groceries
- Dining Out



Working in Excel

An Excel file has been supplied for reference.

File name:
SBM_Excel
Graphic
Sample.xlsx

Excel file example

Budget Summary

Projected Monthly Income		Projected Monthly Expenses	
Income 1	\$6,000		#REF!
Income 2	\$1,000		
Extra income	\$2,500		
Total income	\$9,500		
Actual Monthly Income		Actual Monthly Expenses	
Income 1	\$5,800		#REF!
Income 2	\$2,000		
Extra income	\$1,500		
Total income	\$9,300		
Balance (income - expenses)			
Projected Balance			#REF!
Actual Balance			#REF!
Difference			#REF!

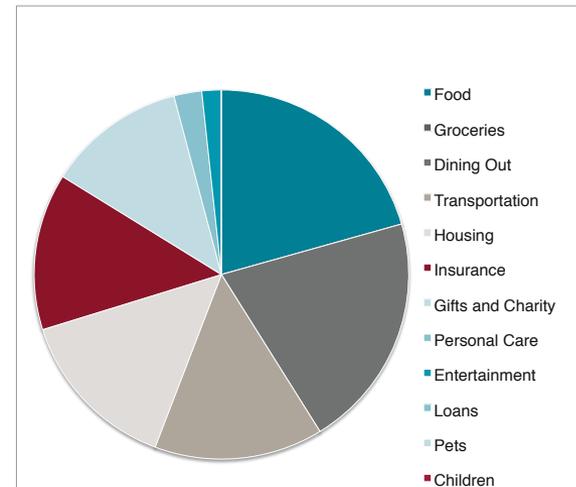
Easily apply your own colors to this template. This template is formatted using themes that enable you to apply fonts, colors and graphic formatting effects throughout the workbook with just a click.

Select Themes on the Home tab.

Choose the four-square icon on the right and click on Custom SBM color palette.

Expense Overview

Budget Categories	Values	
	Total Cost	% of Expense
Food	\$1,200	25.93%
Groceries	\$0	0.00%
Dining Out	\$1,200	25.93%
Transportation	\$850	18.37%
Housing	\$840	18.15%
Insurance	\$800	17.29%
Gifts and Charity	\$700	15.13%
Personal Care	\$140	3.03%
Entertainment	\$98	2.12%
Loans		0.00%
Pets		0.00%
Children		0.00%
Taxes		0.00%
Savings or Investments		0.00%
Grand Total	\$4,628	100.00%

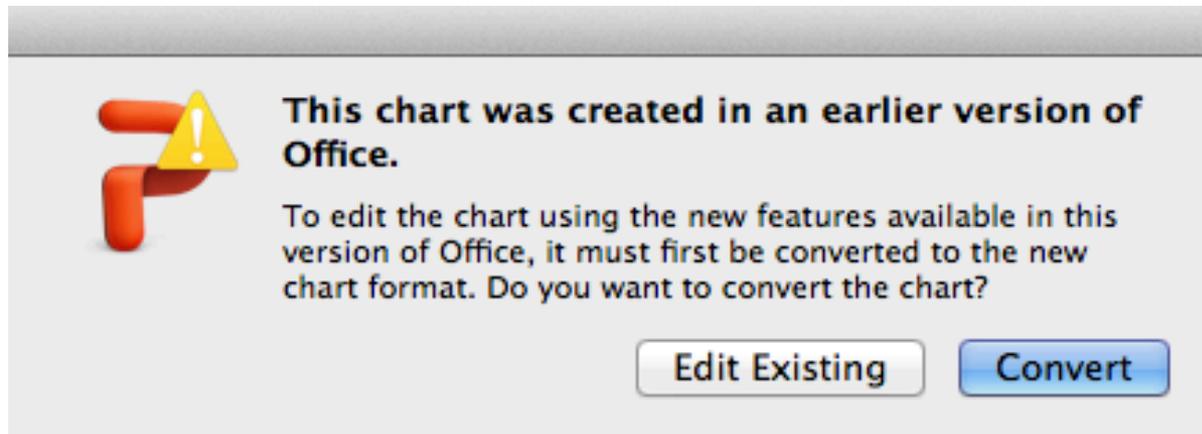


Edit Charts, Graphs and Tables

You can adapt the color and font format theme within PowerPoint for your Excel charts, graphs and tables.

There are two options:

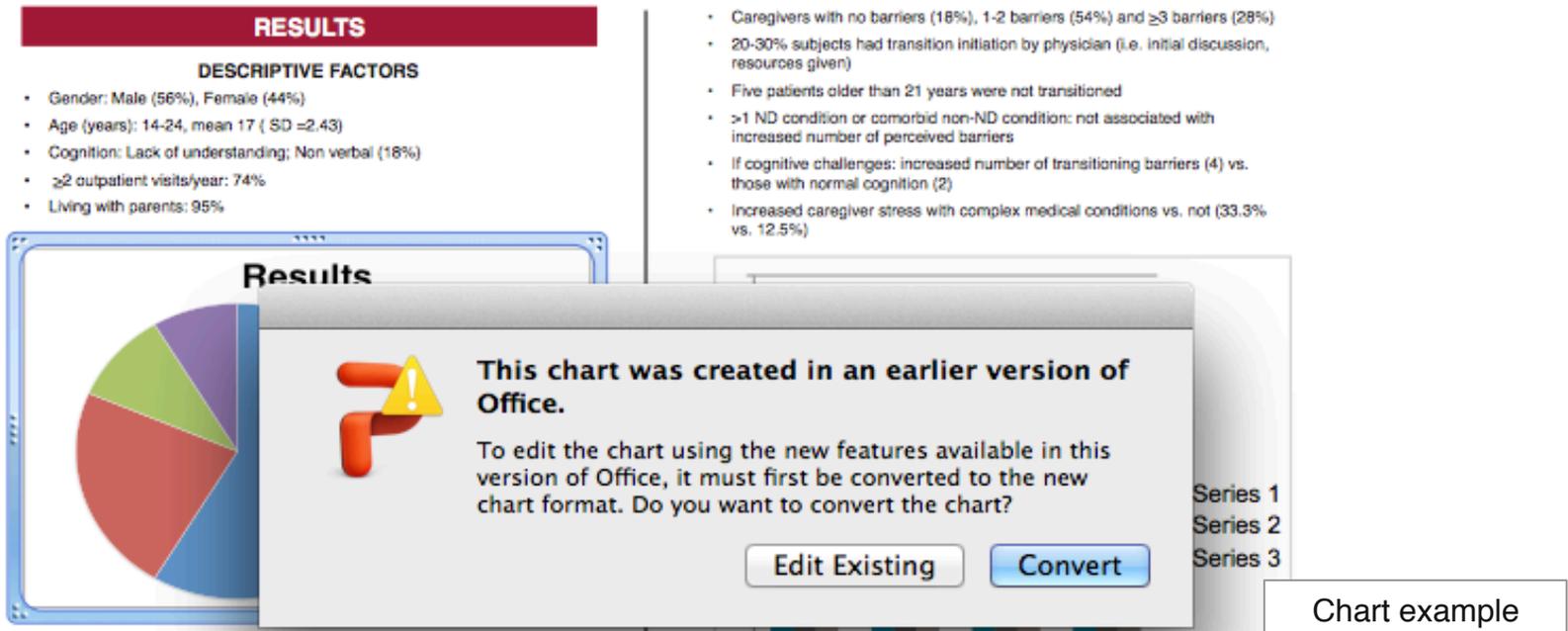
- Double click on the Chart, Graph or Table
- Choose **Edit Existing** or **Convert**



What is Edit Existing and Convert?

Edit Existing: Allows you to modify an original Excel file.

Convert: Allows you to convert the original Excel file to PowerPoint's theme and color palette options.



RESULTS

DESCRIPTIVE FACTORS

- Gender: Male (56%), Female (44%)
- Age (years): 14-24, mean 17 (SD =2.43)
- Cognition: Lack of understanding; Non verbal (18%)
- ≥2 outpatient visits/year: 74%
- Living with parents: 95%

- Caregivers with no barriers (18%), 1-2 barriers (54%) and ≥3 barriers (28%)
- 20-30% subjects had transition initiation by physician (i.e. initial discussion, resources given)
- Five patients older than 21 years were not transitioned
- >1 ND condition or comorbid non-ND condition: not associated with increased number of perceived barriers
- If cognitive challenges: increased number of transitioning barriers (4) vs. those with normal cognition (2)
- Increased caregiver stress with complex medical conditions vs. not (33.3% vs. 12.5%)

Results

This chart was created in an earlier version of Office.

To edit the chart using the new features available in this version of Office, it must first be converted to the new chart format. Do you want to convert the chart?

Series 1
Series 2
Series 3

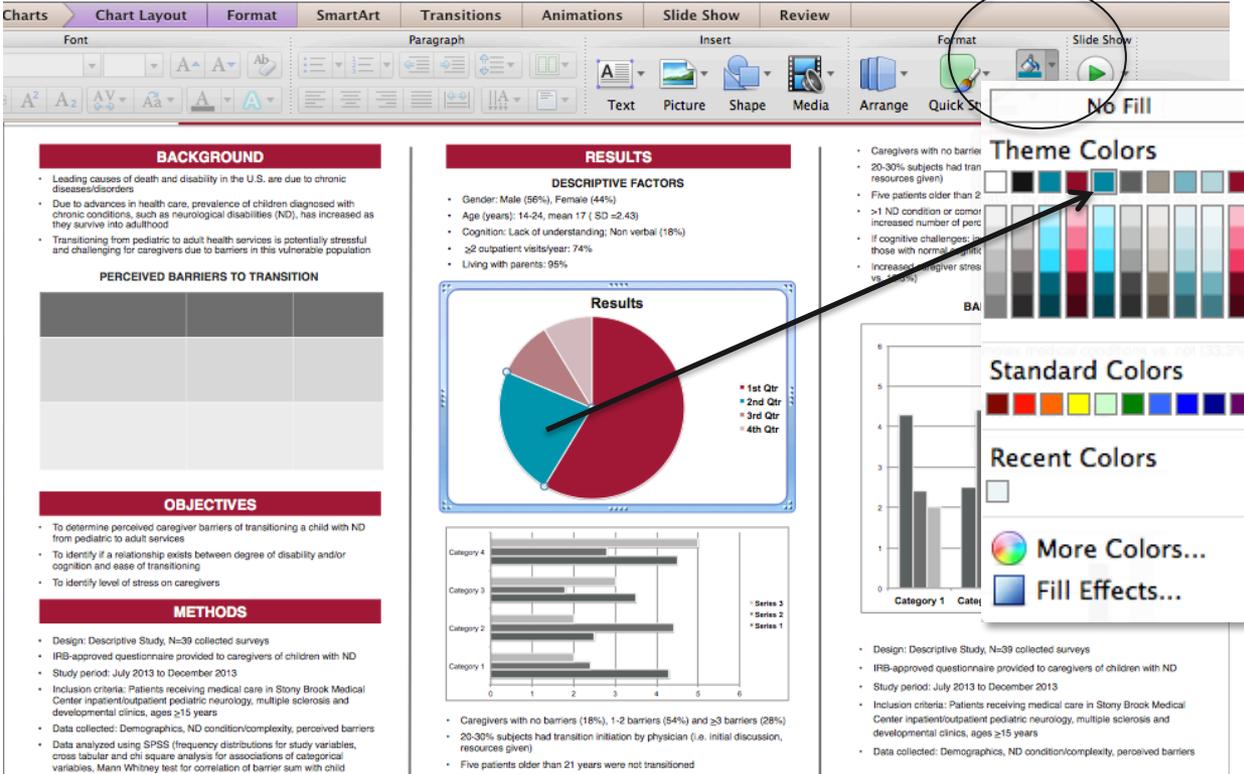
Chart example

Edit Existing Convert

Convert Images with Fill Color

Custom color “Converted” images:

- Click on the inner image. The section will be highlighted.
- Go to **Fill Color** .
- Choose an Accent Color from the Theme Colors palette.



The screenshot shows the Microsoft Word ribbon with the **Format** tab selected. The **Fill Color** icon (a paint bucket) is circled in red. A dropdown menu is open, showing the **Theme Colors** palette. An arrow points from the **Theme Colors** palette to a pie chart in the document. The document content is as follows:

BACKGROUND

- Leading causes of death and disability in the U.S. are due to chronic diseases/disorders
- Due to advances in health care, prevalence of children diagnosed with chronic conditions, such as neurological disabilities (ND), has increased as they survive into adulthood
- Transitioning from pediatric to adult health services is potentially stressful and challenging for caregivers due to barriers in this vulnerable population

PERCEIVED BARRIERS TO TRANSITION

OBJECTIVES

- To determine perceived caregiver barriers of transitioning a child with ND from pediatric to adult services
- To identify if a relationship exists between degree of disability and/or cognition and ease of transitioning
- To identify level of stress on caregivers

METHODS

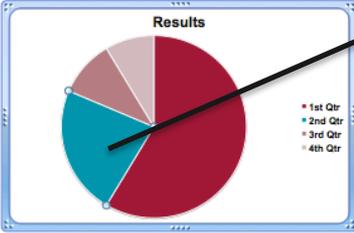
- Design: Descriptive Study, N=39 collected surveys
- IRB-approved questionnaire provided to caregivers of children with ND
- Study period: July 2013 to December 2013
- Inclusion criteria: Patients receiving medical care in Stony Brook Medical Center inpatient/outpatient pediatric neurology, multiple sclerosis and developmental clinics, ages ≥15 years
- Data collected: Demographics, ND condition/complexity, perceived barriers
- Data analyzed using SPSS (frequency distributions for study variables, cross tabular and chi square analysis for associations of categorical variables, Mann Whitney test for correlation of barrier sum with child

RESULTS

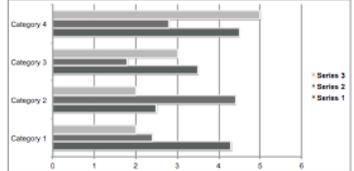
DESCRIPTIVE FACTORS

- Gender: Male (56%), Female (44%)
- Age (years): 14-24, mean 17 (SD =2.43)
- Cognition: Lack of understanding; Non verbal (18%)
- ≥2 outpatient visits/year: 74%
- Living with parents: 95%

Results



Bar Chart



- Caregivers with no barriers (18%), 1-2 barriers (54%) and ≥3 barriers (28%)
- 20-30% subjects had transition initiation by physician (i.e. initial discussion, resources given)
- Five patients older than 21 years were not transitioned

Additional text on the right side of the document:

- Caregivers with no barrier
- 20-30% subjects had transition initiation by physician (resources given)
- Five patients older than 21
- >1 ND condition or comor
- increased number of pers
- if cognitive challenges: in
- those with normal cognit
- increased caregiver stress
- vs. 20%)

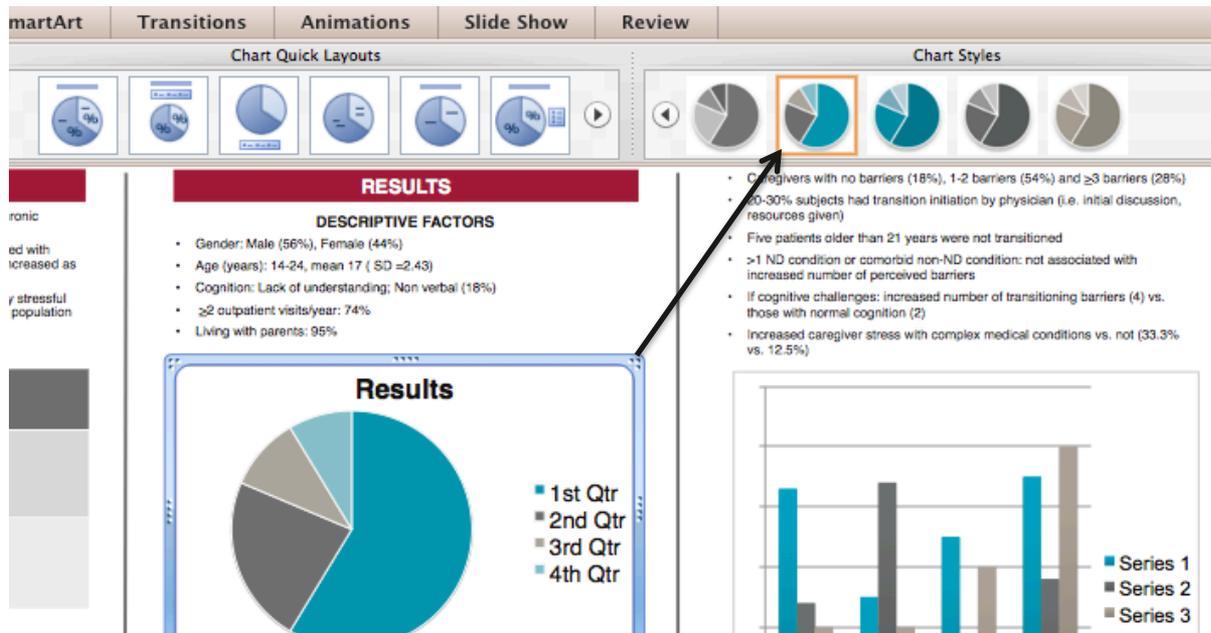
Design: Descriptive Study, N=39 collected surveys
 IRB-approved questionnaire provided to caregivers of children with ND
 Study period: July 2013 to December 2013
 Inclusion criteria: Patients receiving medical care in Stony Brook Medical Center inpatient/outpatient pediatric neurology, multiple sclerosis and developmental clinics, ages ≥15 years
 Data collected: Demographics, ND condition/complexity, perceived barriers

Chart example

Convert Images with Chart Styles

Custom color “Converted” images:

- Click on the graph. The section will be highlighted.
- Go to **Chart Layout, Format, Chart Styles**.
- Choose a chart style from the SBM Theme Color Palette.



The screenshot shows a presentation software interface with a slide titled "RESULTS". The slide contains a "DESCRIPTIVE FACTORS" section with a list of bullet points, a pie chart titled "Results", and a bar chart. The pie chart is divided into four quadrants, and the bar chart has three series. The "Chart Styles" panel is open, and a specific style is highlighted with a blue border and an arrow pointing to the pie chart on the slide.

DESCRIPTIVE FACTORS

- Gender: Male (56%), Female (44%)
- Age (years): 14-24, mean 17 (SD =2.43)
- Cognition: Lack of understanding; Non verbal (18%)
- ≥2 outpatient visits/year: 74%
- Living with parents: 95%

Results

- 1st Qtr
- 2nd Qtr
- 3rd Qtr
- 4th Qtr

Bar Chart Legend:

- Series 1
- Series 2
- Series 3

Text on the right side of the slide:

- Caregivers with no barriers (18%), 1-2 barriers (54%) and ≥3 barriers (28%)
- 20-30% subjects had transition initiation by physician (i.e. initial discussion, resources given)
- Five patients older than 21 years were not transitioned
- >1 ND condition or comorbid non-ND condition: not associated with increased number of perceived barriers
- If cognitive challenges: increased number of transitioning barriers (4) vs. those with normal cognition (2)
- Increased caregiver stress with complex medical conditions vs. not (33.3% vs. 12.5%)

Chart example

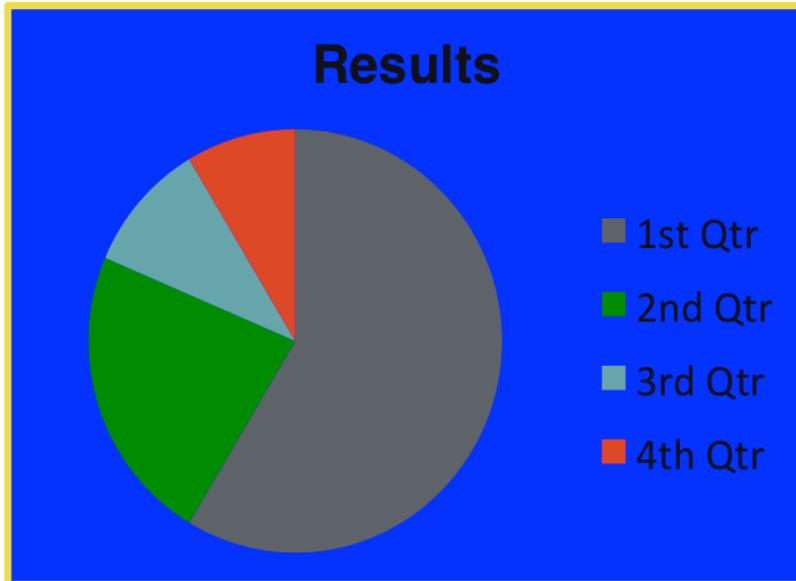


Charts

Charts should be LARGE and as simple as possible.

- Always use a 3 point, gray rule outer box with a white background.
- Use black text.

Bad



Good

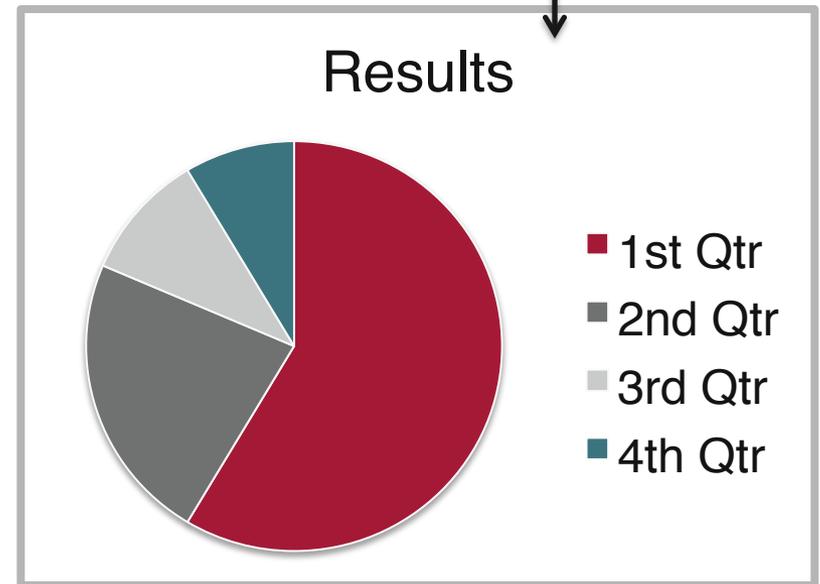


Chart example

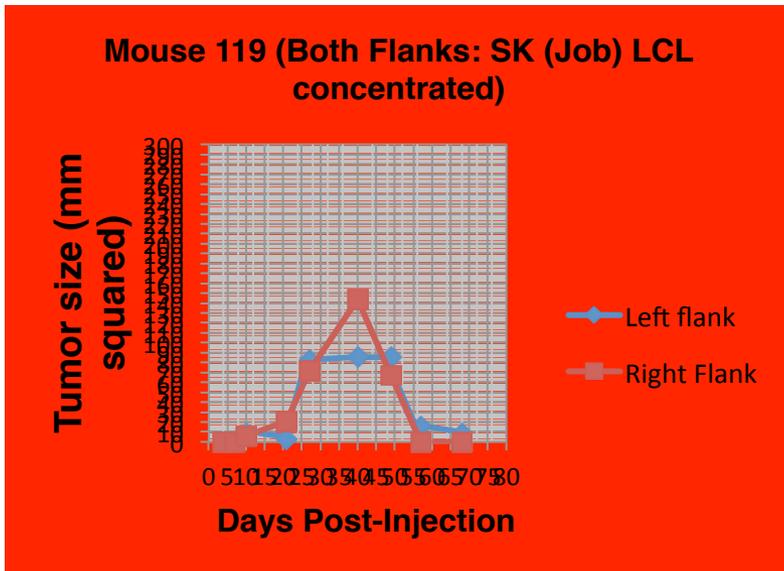


Graphs

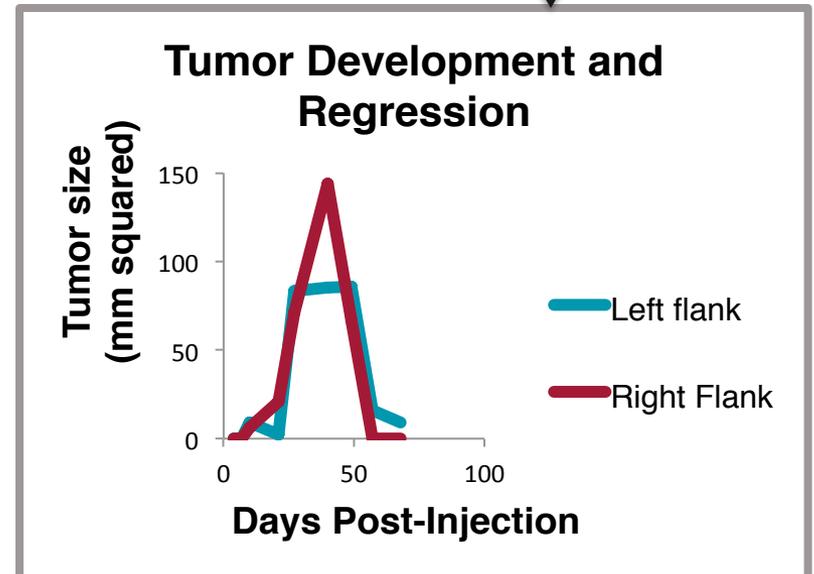
Graphs should be **LARGE** and as simple as possible.

- Always use a 3 point, gray rule outer box with a white background.
- Use black text.

Bad



Good



Graph example



Figures

Be sure to include a brief caption for your figures, and explicitly refer to the figure in the text.

- When adding an image to your poster, use a **3 point, gray rule border** with a **white background**. This will give the image a clean “framed” look.
- All text associated with a figure image must be in black.

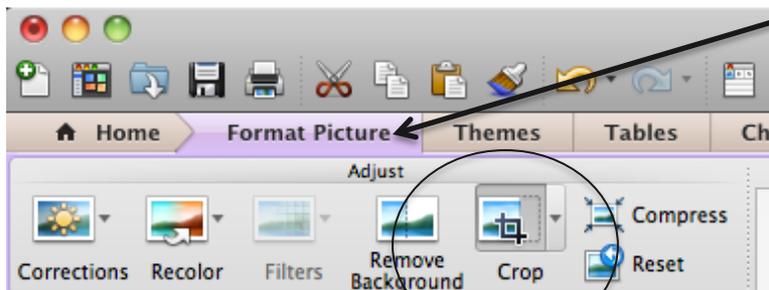
Black text within figures reads best from a distance.



How to Crop an Image

Using the crop tool will *not* distort (stretch or elongate) your image.

- Highlight the image, go to the Ribbon area, **Format Picture**, **Crop**.



Perceived Barriers of Transitioning Patients with Neurological Disabilities from Pediatric to Adult Care Medicine

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BACKGROUND

- Leading causes of death and disability in the U.S. are due to chronic diseases/disorders
- Due to advances in health care, prevalence of children diagnosed with chronic conditions, such as neurological disabilities (ND), has increased as they survive into adulthood
- Transitioning from pediatric to adult health services is potentially stressful and challenging for caregivers due to barriers in this vulnerable population

PERCEIVED BARRIERS TO TRANSITION

TABLE		

OBJECTIVES

- To determine perceived caregiver barriers of transitioning a child with ND from pediatric to adult services
- To identify if a relationship exists between degree of disability and/or cognition and ease of transitioning
- To identify level of stress on caregivers

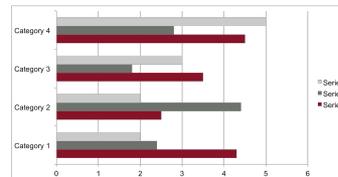
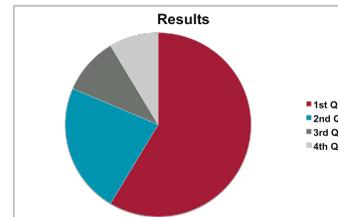
METHODS

- Design: Descriptive Study, N=39 collected surveys
- IRB-approved questionnaire provided to caregivers of children with ND
- Study period: July 2013 to December 2013
- Inclusion criteria: Patients receiving medical care in Stony Brook Medical Center inpatient/outpatient pediatric neurology, multiple sclerosis and developmental clinics, ages ≥ 15 years
- Data collected: Demographics, ND condition/complexity, perceived barriers
- Data analyzed using SPSS (frequency distributions for study variables, cross tabular and chi square analysis for associations of categorical variables, Mann Whitney test for correlation of barrier sum with child complexity. All analyses run at $p < 0.05$)
- Caregivers with no barriers (18%), 1-2 barriers (54%) and ≥ 3 barriers (28%)
- 20-30% subjects had transition initiation by physician (i.e. initial discussion, resources given)
- Five patients older than 21 years were not transitioned
- >1 ND condition or comorbid non-ND condition: not associated with increased number of perceived barriers
- If cognitive challenges: increased number of transitioning barriers (4) vs. those with normal cognition (2)
- Increased caregiver stress with complex medical conditions vs. not (33.3% vs. 12.5%)

RESULTS

DESCRIPTIVE FACTORS

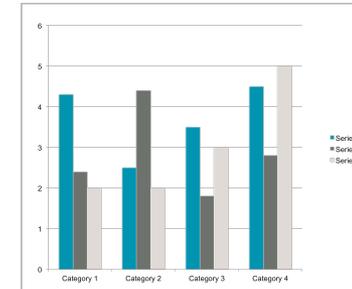
- Gender: Male (56%), Female (44%)
- Age (years): 14-24, mean 17 (SD =2.43)
- Cognition: Lack of understanding: Non verbal (18%)
- ≥ 2 outpatient visits/year: 74%
- Living with parents: 95%



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CONCLUSION

- Difficulty in transitioning care for children with ND is related to lack of physician initiated discussion and caregiver fear of trusting a new physician
- Cognitive delays rather than complexity of the child's medical condition increase caregiver barrier perceptions, but both affect the level of parental stress
- Transitioning model programs for pediatricians may aid the transition process by providing awareness, focused training, referrals to adult care and improved partnership with Med-Peds/Family Medicine
- Outcome goal : to avoid suboptimal future medical care for those at risk and provide reassurance to caregivers

Objectives:

- To estimate the average pool sizes of folate distributed within the plasma, the cell, and the mitochondria.
- To develop mathematical models that represent these pool sizes and mimic real bodily responses to day-to-day changes in diet and metabolism.
- To test these models against experimental data, as well as make predictions.

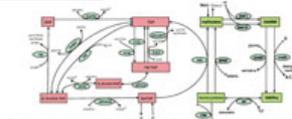


Figure 1. Reduced folate status, and increased 5,10-methylenetetrahydrofolate (5,10-MTHF) levels, are associated with increased risk of neural tube defects (NTDs). The rate of gene transcription is 0.001. The rate of gene translation is 0.001. The rate of protein degradation is 0.001. The rate of protein synthesis is 0.001. The rate of protein binding is 0.001. The rate of protein unbinding is 0.001. The rate of protein phosphorylation is 0.001. The rate of protein dephosphorylation is 0.001. The rate of protein acetylation is 0.001. The rate of protein deacetylation is 0.001. The rate of protein ubiquitination is 0.001. The rate of protein deubiquitination is 0.001. The rate of protein glycosylation is 0.001. The rate of protein deglycosylation is 0.001. The rate of protein nitrosylation is 0.001. The rate of protein denitrosylation is 0.001. The rate of protein palmitoylation is 0.001. The rate of protein depalmitoylation is 0.001. The rate of protein hydroxylation is 0.001. The rate of protein dehydroxylation is 0.001. The rate of protein methylation is 0.001. The rate of protein demethylation is 0.001. The rate of protein phosphorylation is 0.001. The rate of protein dephosphorylation is 0.001. The rate of protein acetylation is 0.001. The rate of protein deacetylation is 0.001. The rate of protein ubiquitination is 0.001. The rate of protein deubiquitination is 0.001. The rate of protein glycosylation is 0.001. The rate of protein deglycosylation is 0.001. The rate of protein nitrosylation is 0.001. The rate of protein denitrosylation is 0.001. The rate of protein palmitoylation is 0.001. The rate of protein depalmitoylation is 0.001. The rate of protein hydroxylation is 0.001. The rate of protein dehydroxylation is 0.001. The rate of protein methylation is 0.001. The rate of protein demethylation is 0.001.

Background:

Folate, or vitamin B9, is important for the synthesis of thymidine, a pyrimidine, and purines. Deficiency in folate is associated with megaloblastic anemia, cancer, cardiovascular disease, neurological disorders, and neural tube defects in infants. Folate metabolism provides the rate-limiting step for DNA synthesis and DNA and histone methylation (Fig. 1). Reduced folate status affects these critical cellular activities and also increases the level of homocysteine, a highly reactive amino acid that is associated with cell damage. It has been shown that increased folate intake by pregnant women can help reduce the risk of infant neural tube defects, presumably due to a reduction in plasma homocysteine levels. Folate metabolism occurs within cells, but their levels are typically measured in the plasma. It is therefore critical to understand the relationship between the concentrations of folate in the plasma and the cell.

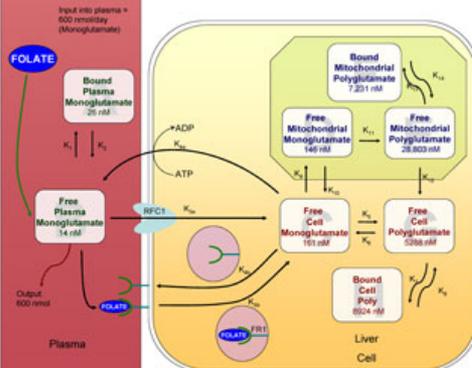


Figure 2. Transport and storage of folate in the plasma and in the liver and cell. K₁ represents rate of transport and binding.

A Compartment Model for the Transport and Storage of Folate

Mentor: Dr. H. Frederik Nijhout Biology Department, Duke University
Tiffany J. Chen

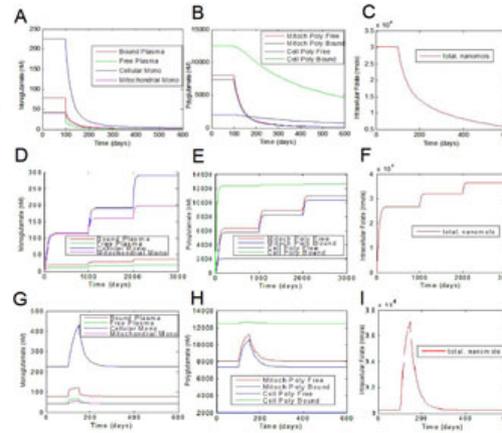


Figure 3. Response of folate pools to a 50-day pulse of 1000 nmol/day. The model correctly simulates the sizes of the folate pools in the various compartments, including the cytosol, the mitochondria and the fractions bound to proteins in those compartments.

Methods:

Various pool values for plasma and intracellular folate were collected from experimental data (Figure 2). We made predictions for pool values that are not readily available. These predictions were based on known distribution of the various folate pools within the body. For example, 50% of body folate is stored in the liver – the liver contains 2 compartments. These are the cytosol and the mitochondria, each containing three general pools, monoglutamate, free polyglutamate, and bound polyglutamate. These individual pools have different proportions in the cytosol and the mitochondria.

After pool values were established, we assumed that transport of molecules between pools were based on first-order mass-action kinetics. We used Michaelis-Menten equations for the bound polyglutamate pools, because there is a limited amount of protein that will bind to folate – mainly glycine N-methyltransferase (GNMT), one of the enzymes in the methionine cycle (Fig. 1). In addition, we used Michaelis-Menten kinetics for the transport of folates in and out of the cell via Reduced Folate Carrier 1 (RFC1), Folate Receptor 1 (FRI), and an ATP-dependent exporter (Fig. 2).

Rate constants, or k-values, were calculated by assuming certain fluxes between pools. These fluxes were determined by known rates of gain and loss of folate in different compartments where these rates were known, and by adjusting the relative rates of input and output to obtain the right pool sizes between compartments in cases where the absolute rates were not known.

Experiments were performed by varying folate intake. These were performed to determine half-lives of the pools, as well as to determine how the pools reacted to example experimental conditions from the literature.

Results:

1. The Model

The model correctly simulates the sizes of the folate pools in the various compartments, including the cytosol, the mitochondria and the fractions bound to proteins in those compartments.

2. Predicted half-life of folate.

After we removed the constant input of folate into the system, all pools diminished over time, some more quickly than others (Figures 3A, 3B). We can also see in figure 3C that the approximate half-life for total intracellular folate is 80 days, which is close to predicted values of around 80-100. Bound polyglutamate seems to decrease at a much slower rate than the other pools.

3. Reaching steady-state values.

The time for the total intracellular pools to reach steady-state typically ranged from 300 to 500 days, which corresponds well with data from the literature. Consistent with the idea that there is a correlation between intracellular folate pool size, polyglutamation, and protein binding, all types of polyglutamate pools do in fact take longer to reach a steady-state value (Figures 3D, 3E).

4. Response to pulsed folate input.

The input of folate was increased to 1000 nmol/day for 50 days. Model plasma levels were quick to rise and fall with the sudden changes, which predicts that free as well as loosely bound monoglutamates will react quickly to changes in folate intake (Fig. 3C). Out of the polyglutamate pools, the model predicts that both bound pools will take longer to return to steady-state, although the mitochondrial bound polyglutamate will take the longest of all of the pools (Fig. 3H).

Conclusions:

We have constructed a mathematical compartment model for folate that takes into account the different methods of transport, as well as retention in the plasma, cell, and mitochondria. We have compared the output of this model with results from current experiments, and have found that the model accurately simulates data from the literature. This model will form the foundation for future studies on the metabolism, transport and sequestration of folates under various genetic and environmental conditions.

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Author disclosures of potential conflicts of interest and author contributions are found at the end of this article. Address correspondence to Tiffany J. Chen, Department of Biology, Duke University, Box 90100, Durham, NC 27708. E-mail: tjchen@duke.edu. Received 10/10/2011; accepted 11/10/2011. Copyright © 2011, the American Physiological Society. This article is distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/2.0/).



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