Clinical Medicine and Health Research Journal (CMHRJ)
Volume 04, Issue 02, March - April, 2024
Page No. 858-865,

Research Article

Introduction to Different Diagrams Commonly Used in Literature

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Received: 26 February, 2023 Accepted: 28 March, 2024 Published: 03 April 2024

Abstract:

Diagrams help researchers and authors communicate and visualize complex concepts, data, and relationships effectively to a broader audience, including scientists, students, and the general public (Garcia-Retamero & Cokely, 2017). Visual representations can convey information more clearly and succinctly than paragraphs of text (Divecha et al., 2023; Duquia et al., 2014; Nguyen et al., 2021). Diagrams can take various forms, such as flowcharts, organizational charts, network diagrams, Venn diagrams, and others, and they are commonly used in various fields like business, engineering, science, education, and software development to illustrate processes, systems, relationships, and concepts. They help organize information, clarify relationships, identify patterns, and display data in an organized and visually attractive manner (Divecha et al., 2023; Duquia et al., 2014; Nguyen et al., 2021).

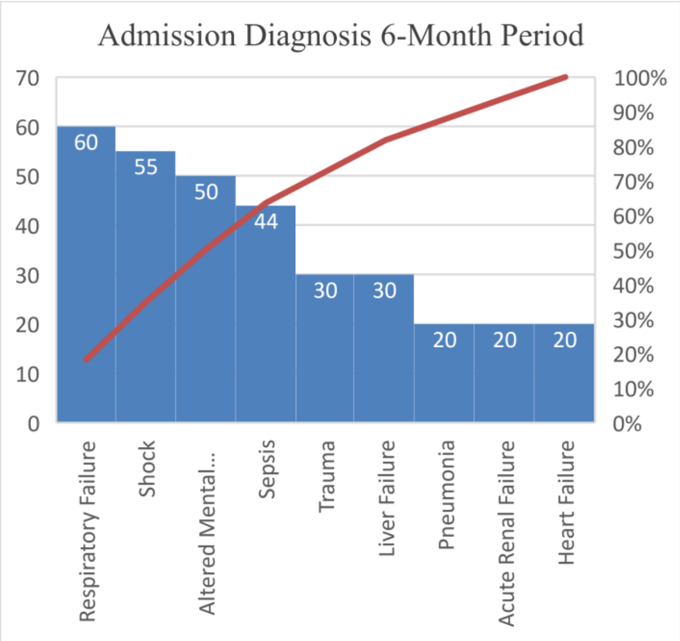
Common Types of Diagram

Pareto Chart

A Pareto chart is a tool that combines a bar graph with a line graph to visualize the data. It is commonly used to highlight the most remarkable factors contributing to a particular issue or problem (Alkiayat, 2021). The visual nature of Pareto charts makes them an effective communication tool, allowing stakeholders to grasp the key issues and potential solutions in a short time (Alkiayat, 2021). They facilitate data-driven discussions and help teams align on priorities. In conclusion, Pareto charts are powerful tools for sorting and prioritizing factors based on their relative impact. They are instrumental in problem identification, analysis, and decision-making processes across various industries and disciplines (Alkiayat, 2021).

Figure 1 is a Pareto chart, which prioritizes causes of admission from the most to least occurrence in 6 months. It shows that respiratory failure was the first cause of admission to the hospital in the six months.

Figure 1

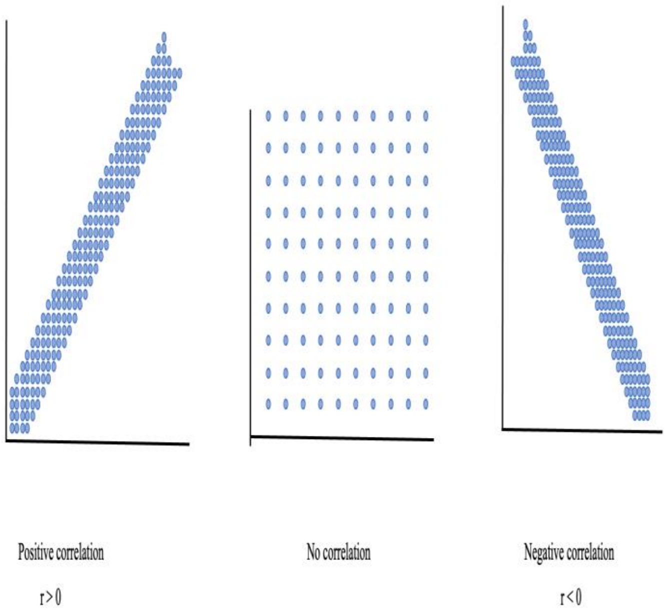


Scatter Diagram

A scatter diagram, also called a scatter plot, is a tool for showing the relationship between continuous variables. In a scatter plot, each data point is represented individually with a dot on the chart, and the horizontal axis (x-axis) and vertical axis (y-axis) plot the two variables (Sainiani, 2016).

Scatter diagrams visually depict the relationship or correlation between two variables. They help us to understand whether there is a pattern, trend, or association between the two variables being compared. The pattern displayed in a scatter plot can provide insights into the relationship between the two variables. When both variables increase simultaneously, a positive correlation is created. In a negative correlation, one variable increases while the other decreases. When there is no correlation, variables stay unrelated (Pelletier et al., 2017). Scatter diagrams are commonly used in fields such as statistics, data analysis, research, quality control, and scientific studies to explore and visualize relationships between variables and to make informed decisions based on data patterns (Sainiani, 2016; Rensink, 2017). **Figure 2** indicates three possible correlations on scatter plots: positive and negative, and there is no correlation between two variables plotted on the X and Y-axis.

Figure 2



Pelletier, L. R., & Beaudin, C. L. (2017). *HQ solutions: resource for the healthcare quality professional*. Lippincott Williams & Wilkins.

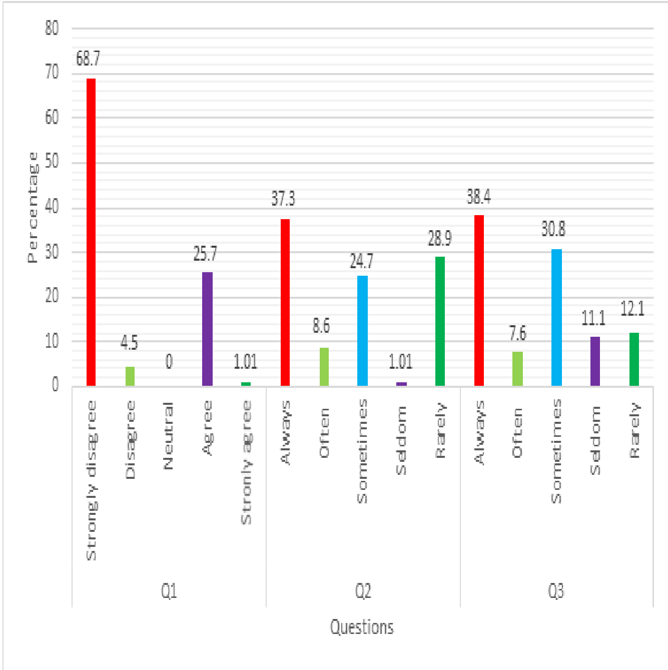
Bar Chart

A bar chart is a tool to visualize data via rectangular bars to display and compare categorical data. Each bar's length or height corresponds to the value of the data it displays(Pelletier et al., 2017). Bar charts assist us in categorical data representation, visual comparison, distribution, and interpretation. Bar charts are widely used in various fields such as business, finance, marketing, education, and research to show comparisons, trends, and distributions in categorical data, and they are versatile and can be applied to various data sets (Pelletier et al., 2017).

Even though bar charts are an effective tool for visualizing categorical data, they may not be suitable for displaying data with numerous categories or showing trends over time (Midway, 2022).

Figure 3 shows the percentage of participants' responses to three survey questions on the Likert Scale in A Qualitative Study on the Effects of Health Literacy in a Population with Hypertension at Blossom Health Care Center, Kabul City, Afghanistan.

Figure 3



Khan, A., Tidman, M. M., Najib, H., & Darmal, I. (2023). A Qualitative Study on the Effects of Health Literacy in Population with Hypertension at Blossom Health Care Center, Kabul City, Afghanistan. *Journal of Health and Medical Sciences*, *6*(3), 15-25.

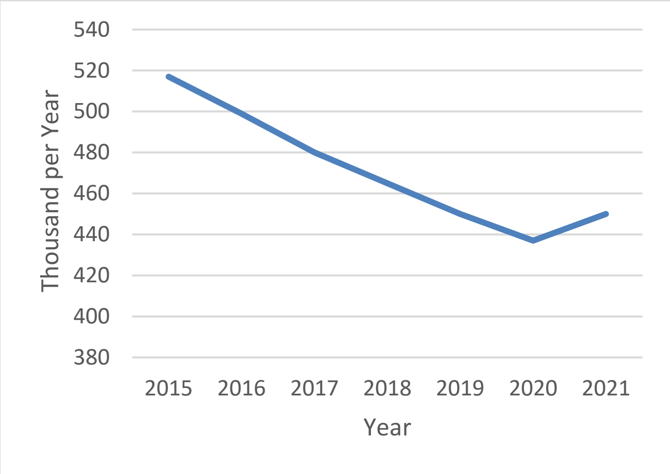
Line Chart

A line chart visualizes data via a series of data points connected by lines. It is commonly used to identify changes over time or to display trends between continuous variables. Line charts can assist us in showing time-series data, identifying trends, interpolating data, showing multiple series, comparing data, and labeling and annotating data. Line charts are commonly used in finance, economics, healthcare, and environmental sciences to visualize data trends over time, forecast future values, track performance, and communicate insights effectively (Slutsky, 2014; Fausset et al., 2008).

Line may not be the best choice for showing trends over time for discrete data points or categorical data. In such cases, bar charts or scatter plots may be more suitable. Line charts are powerful tools for visualizing trends and patterns in time-series data. They provide a clear and effective way to communicate how data changes over time. They are widely used in various industries for analysis, reporting, and decision-making based on historical trends (Slutsky, 2014; Fausset et al., 2008; Peebles & Ali, 2015; Wang et al., 2018).

Figure 4 shows the trend in the number of incidents of multi-drug-resistant tuberculosis globally from 2015 to 2021.

Figure 4

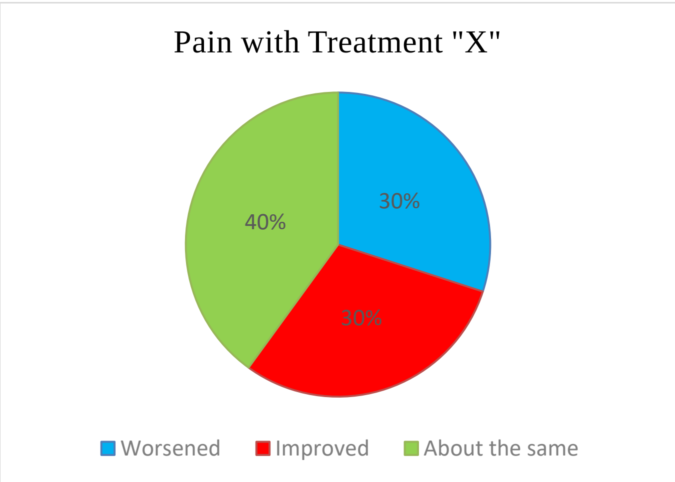


World Health Organization (2024). 2.3 drug resistance tuberculosis. https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2022/tb-disease-burden/2-3-drug-resistant-tb.

Pie Chart

A pie chart displays a proportion of a whole data set in a circular statistical graphic divided into slices to illustrate numerical proportions (Zhao & Gaschler, 2008). We can use the pie chart to represent data proportion, compare data, and label data. Pie charts are commonly used in business presentations, annual reports, marketing campaigns, and surveys to show market share, budget allocations, demographics, and other categorical data. (Zhao & Gaschler, 2008; In & Lee, 2017; Midway, 2020). **Figure 5** shows the proportion of patients whose pain improved, worsened, or stayed about the same after the medication "X."

Figure 5



Box Plot

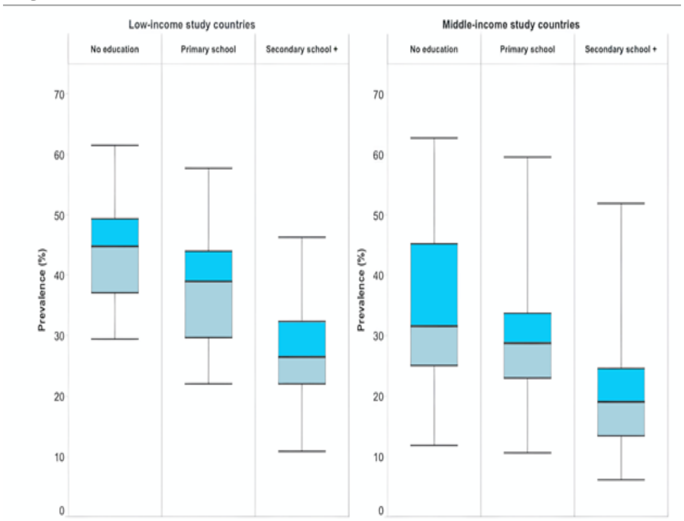
A box plot or a box-and-whisker plot is a tool to represent statistical data in graphs that demonstrate the spread of a dataset along with essential statistical measures. The essential characteristics of box plots are that they display the first quartile (Q1), median (second quartile or Q2), third quartile (Q3), and maximum. These values help us to summarize the data's central tendency, spread, and skewness (Hu, 2020; Krzywinski & Altman, 2014; William et al., 1989).

The box in a box plot represents the interquartile range (IQR), the range of values between Q1 and Q3. The length of the box indicates the spread of the middle 50% of the data. A line inside the box represents the median. The whiskers extend from the top and bottom of the box to display the variability of the dataset outside the upper and lower quartiles, excluding outliers. The length of the whiskers can vary based on the data distribution and the chosen method for determining outliers (Hu, 2020; Krzywinski & Altman, 2014; William et al., 1989).

Box plots are commonly used in various fields, such as statistics, data analysis, scientific research, and quality control, to summarize and compare datasets, identify outliers, and visualize the spread of data concisely. They provide a concise and informative way to visually represent data distribution and critical statistics such as the median, quartiles, and outliers (Hu, 2020; Krzywinski & Altman, 2014; William et al., 1989).

Figure 6, the box plot shows stunting prevalence in children aged less than five years by mother's education in 30 low-income and 36 middle-income countries. In each subgroup, the top and bottom lines show maximum and minimum values, the middle line shows the median and the grey box highlights the interquartile.

Figure 6



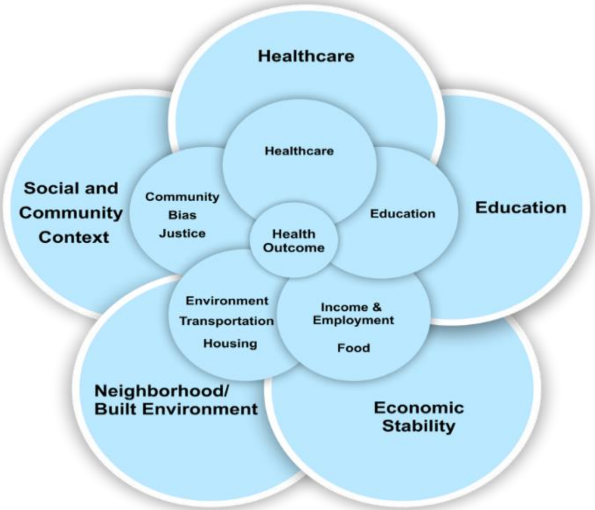
World Health Organization (2015). State of inequality: Reproductive, maternal, newborn, and child health. https://www.who.int/docs/default-source/gho-documents/health-equity/state-of-inequality/state-of-inequality-reproductive-maternal-new-born-and-child-health.pdf.

Venn Diagram

A Venn diagram is a tool that can demonstrate the relationships between different sets or groups of data. The Venn diagram uses overlapping circles or other shapes to illustrate the sets' intersections, commonalities, and differences (Poythress & Sun,1972; Chow & Rodgers, 2005). Moreover, the Venn diagram can represent the overlap of sets, intersections, union, and disjoint sets. Venn diagrams are used in various fields, such as mathematics, logic, statistics, computer science, biology, and business(Jia et al., 2021). They are helpful in organizing information, illustrating logical relationships, and solving problems involving multiple categories. They are valuable tools for organizing information, analyzing relationships, and communicating complex concepts clearly and concisely (Jia et al., 2021).

Figure 7 is a Venn diagram that shows the social determinants of health.

Figure 7

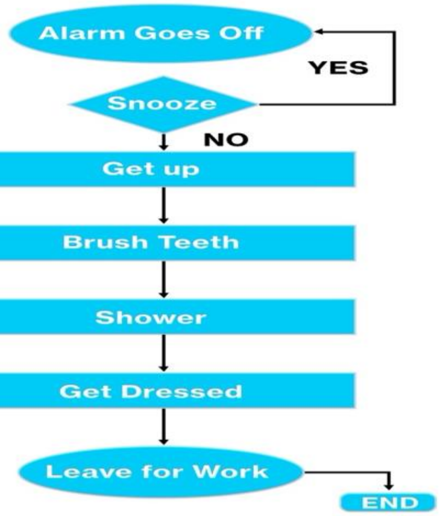


Lines, L. M., Long, M. C., Humphrey, J. L., Nguyen, C. T., Scanlon, S., Berzin, O. K. G., Brown, M. C., & Bir, A. (2022). *Artificially Intelligent Social Risk Adjustment: Development and Pilot Testing in Ohio*. RTI Press.

Flow Chart

A flowchart is a diagram visually representing a process or algorithm (Kimber et al., 2018). It uses different shapes connected by arrows to show the flow of steps in a sequence. Flowcharts are commonly used in various discipline, such as programming, business, engineering, education, and more. Flowcharts are used to document processes, troubleshoot issues, design systems, and improve workflow efficiency. Also, flowcharts come in different types, such as basic flowcharts, swim lane flowcharts (cross-functional flowcharts), workflow diagrams, data flow diagrams, and more, each serving specific purposes in process analysis and communication (Antonacci et al., 2021; Pelletier & Beaudin, 2017). (See **Figure 8**).

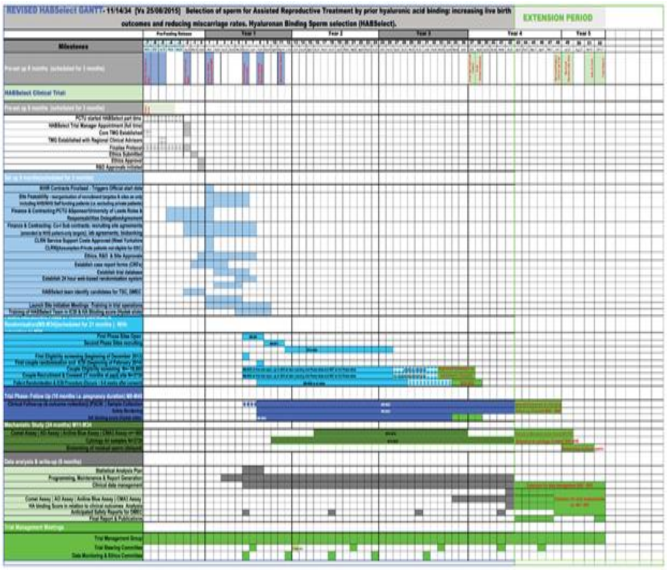
Figure 8



Gantt Chart

A Gantt chart demonstrates a visual representation of a project schedule, and it shows the start and finish dates of various elements of a project (Pelletier & Beaudin, 2017). Gantt charts are used to plan, track, and manage projects effectively (Nahmias, 2001). A Gantt chart's fundamental characteristics and components are tasks, timelines, bars, dependencies, milestones, progress, resource allocation, and critical path. Gantt chart can provide project managers and teams with a clear visual representation of the project schedule, deadlines, dependencies, and progress. Furthermore, it helps in effective planning, monitoring, and communication throughout the project lifecycle, facilitating better decision-making and successful project completion (Nahmias, 2001). **Figure 9** shows the Gantt chart for sperm selection for assisted reproduction by prior hyaluronan binding: the HABSelect randomized controlled trial.

Figure 9



Kirkman-Brown, J., Pavitt, S., Khalaf, Y., Lewis, S., Hooper, R., Bhattacharya, S., Coomarasamy, A., Sharma, V., Brison, D., Forbes, G., West, R., Pacey, A., Brian, K., Cutting, R., Bolton, V., & Miller, D. (2019). *Sperm selection for assisted reproduction by prior hyaluronan binding: The HABSelect RCT*. NIHR Journals Library.

Pictogram

A pictogram is a diagram that uses pictures, icons, or symbols to represent data or information (Merks et al., 2022). Pictograms make complex data more visually appealing and accessible to a broad audience, including those with limited literacy or language barriers (Merks et al., 2022). Pictograms can be used in various fields, such as statistics, transportation (e.g., road signs), instructional manuals, marketing materials, healthcare (e.g., hospital signage), and more (Joshi & Kothiyal, 2011). Overall, pictograms offer a visually appealing and accessible way to communicate data and information effectively, making complex concepts more accessible to comprehend and enhancing overall communication outcomes (Pascuet et al., 2008). **Figure 10** indicates the intended meaning of different pictograms.

Figure 10

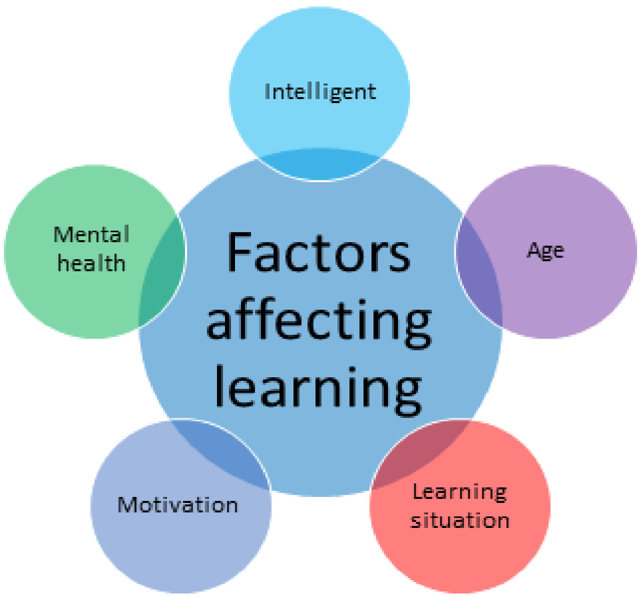
Mourad, N., Younes, S., Mourad, L., Fahs, I., Mayta, S., Baalbaki, R., El Basset, W., Dabbous, M., El Akel, M., Safwan, J., Saade, F., Rahal, M., & Sakr, F. (2023). Comprehension of prescription orders with and without pictograms: tool validation and comparative assessment among a sample of participants from a developing country. *BMC Public Health*, *23*(1), 1926. https://doi.org/10.1186/s12889-023-16856-5.

Mind Map

A mind map is a tool to demonstrate ideas, concepts, or tasks associated with and arranged around a central key concept or idea (Buzan & Buzan, 2002; Palaniappan et al., 2023). Mind maps can be used to organize information in a hierarchical and structured manner visually (Buzan & Buzan, 2002; Farrand et al., 2002) and it can be mapped can be used in various settings, including project planning, decision-making, learning, writing, goal setting, time management, problem analysis, and creative thinking via visually organizing information in a structured and interconnected manner (Farrand et al., 2002). Mind maps help us understand complex ideas better, enhance creativity, improve productivity, and communicate concepts effectively (Buzan & Buzan, 2002).

Figure 11 is an example of a mind map showing factors affecting learning.

Figure 11



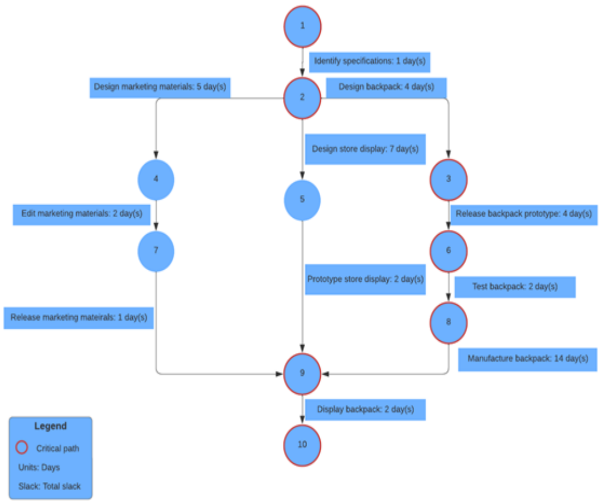
Shrivastava, S. R., & Shrivastava, P. S. (2024). From Chaos to Clarity: Use of Mind Maps as a Tool to Ensure Better Learning among Medical Students. *Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive & Social Medicine*, *49*(1), 233–236. https://doi.org/10.4103/ijcm.ijcm_312_23.

PERT Chart

A PERT chart is an acronym for Program Evaluation Review Technique, and it is a visual demonstration of a project's schedule that can assist us to plan, coordinate, and track the various tasks and milestones involved in completing a project (Malcolm et al., 1959). Essential characteristics of PERT charts are that tasks or activities are displayed as nodes (also known as events) connected by arrows showing the sequence in which tasks must be accomplished. Nodes may also include the task name, estimated duration of time, and dependencies (Hudson & Laken, 2015; Malcolm et al., 1959).

The critical path in a PERT chart is the most extended sequence of dependent tasks that determines the shortest possible project completion duration. Tasks on the critical path have zero slack or float, which indicates any delay in these tasks can impact the timeline in the project. (Hudson & Laken, 2015; Malcolm et al., 1959). Creating a PERT chart involves identifying tasks, estimating durations, determining task dependencies, and sequencing tasks logically to construct the project schedule (Hudson & Laken, 2015; Iheonu & Achom, 2023); (see **Figure 12**)

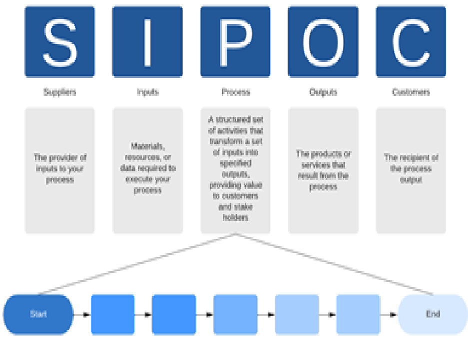
Figure 12



SIPOC Diagram

A SIPOC diagram can be used to define and map out a process or system in process improvement. SIPOC is an acronym for Suppliers, Inputs, Processes, Outputs, and Customers. Essential elements of a SIPOC diagram are suppliers, which entail entities or sources that provide the necessary inputs for the process to function (Pelletier et al., 2017; Ptacek & Motwani, 2011). Inputs are the resources, materials, information, or data used or transformed within the process(Pelletier et al., 2017; Ptacek & Motwani, 2011). Inputs are typically received from suppliers and are essential for producing outputs. The process component highlights the steps and activities needed to transform inputs into desired outputs. Finally, outputs represent the results or products generated by the process. The results could entail tangible goods, services, reports, or other deliverables that adress the customers' needs (Pelletier et al., 2017; Ptacek & Motwani, 2011); (see **Figure 13**).

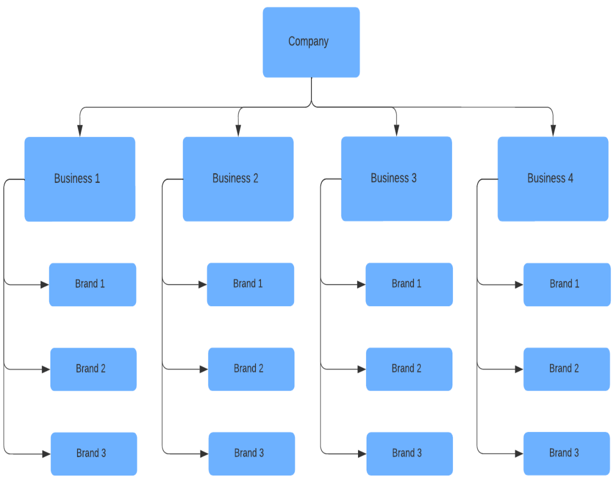
Figure 13



Organizational Chart

An organizational chart demonstrates an organization's hierarchical structure (Lee, 2022). It indicates the relationships and relative ranks of its parts and positions or jobs, depicting how information and responsibilities flow within the organization. Organizational charts display organizational structure, clarify roles and responsibilities, and facilitate decision-making (Lee, 2022). (See **Figure14)**

Figure 14

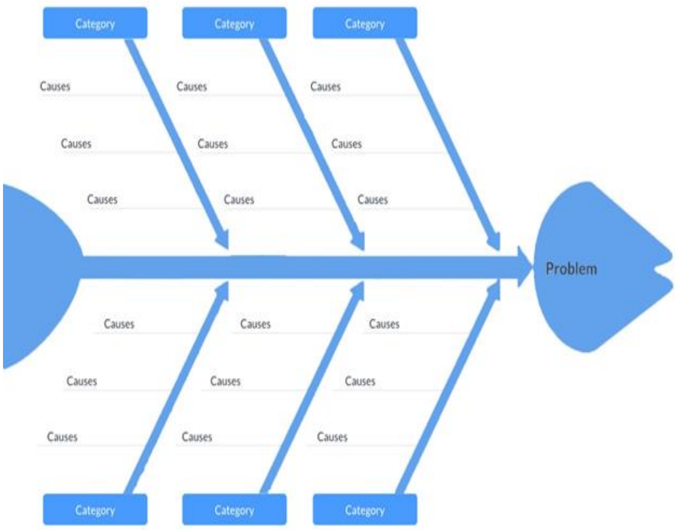


Fishbone Diagram

A fishbone diagram is also named the Ishikawa diagram or a cause-and-effect diagram. It is a tool that can assist in identifying and organizing potential causes of a problem or an effect of a problem in a process. In this diagram, a horizontal line represents the problem or effect being analyzed, and several diagonal lines branch off from the central line to show different categories of potential causes of the problem under investigation. These categories are typically labeled to organize the causes. Categories in a Fishbone diagram can be classified as the 6 Ms (Manpower, Method, Machine, Measurement, Material, Mother Nature) or the 4 Ps (Policies, Procedures, People, Plant) (Gartlehner et al., 2017; shikawa,1985; McDowel et al., 2016). It is crucial to clearly define the problem, identify major issues leading to the problem, and analyze and prioritize causes for further investigation or action.

Fishbone diagrams can assist us in structured analysis and visual representation of a problem. They provide a clear visual representation of cause-and-effect relationships, and their structured approach and visual representation make them an effective tool for problem-solving, quality management, and process improvement efforts in various disciplines (Juran & Gryna, 1988). (see Figure 15).

Figure 15



Conclusion

In conclusion, diagrams in every fields are invaluable tools for enhancing comprehension, communication, visualization, and interpretation of scientific information. They contribute to the advancement of knowledge, promote effective science communication, and enrich the scholarly experience for both researchers and readers.

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