



CHAPTER NINETEEN

CAUSE AND EFFECT DIAGRAMS

Chapter Purpose

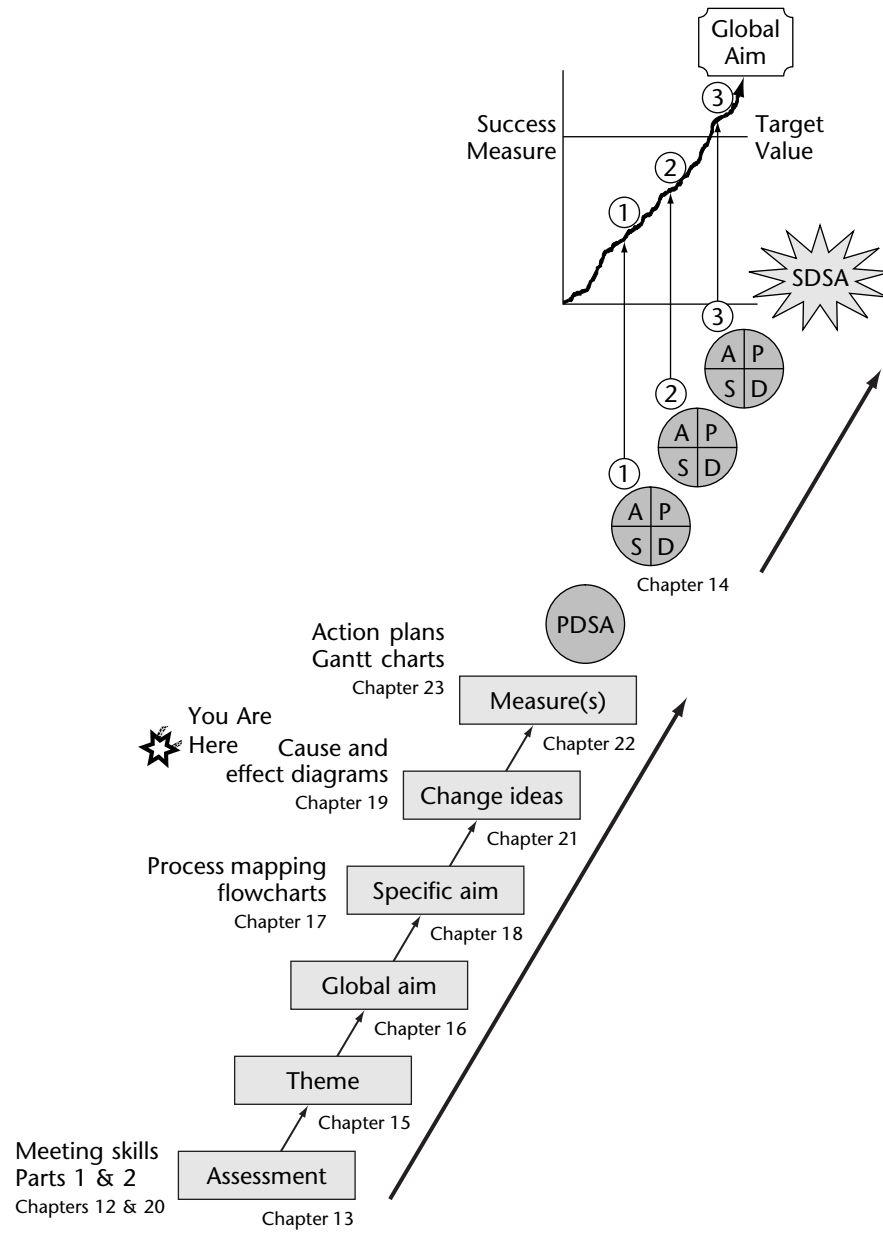
Aim. To define cause and effect diagrams and the process of creating them to gain deeper knowledge of the factors that contribute to end results.

Objectives. At the completion of this session, you will be able to

- Define cause and effect diagrams (fishbone diagrams).
- Describe the principle of the web of causation in relation to a fishbone diagram.
- Create a cause and effect diagram specific to the outcome you are studying.
- Describe the function of cause and effect diagrams in the big picture of improvement.
- Develop a process to engage all staff in the creation and modification of a fishbone diagram.

Cause and effect diagrams give you yet more information about causal factors influencing your specific aim and related processes. As described in this chapter, constructing such a graphic can help microsystem members understand the forces that are contributing to a specific aim and thereby identify what might be changed to attain improvement goals. Figure 19.1 shows you where the cause and effect diagram fits in the improvement ramp.

FIGURE 19.1. IMPROVEMENT RAMP:
CAUSE AND EFFECT DIAGRAMS.



What Is a Cause and Effect Diagram?

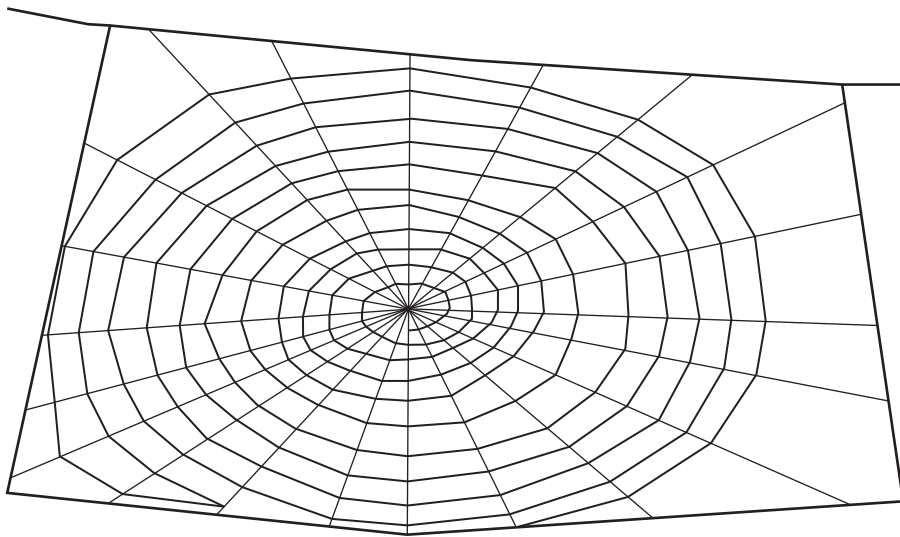
A *cause and effect diagram* is an analysis tool that depicts the possible causes that contribute to a single effect. First described in 1968 by a committee of the Japanese Union of Scientists and Engineers (JUSE) led by Kaoru Ishikawa (1976), it has also been called an *Ishikawa diagram* and, because it resembles the skeleton of a fish, a *fishbone diagram*.

Brian MacMahon (MacMahon & Pugh, 1970) described exploring causes and effects as creating a *web of causation*. He noted that outcomes are almost always the result of many interrelated causes and rarely the result of a single cause. He suggested that we are best served when we think of results as being produced by such a causal network, that is, by a system of causes that combine to produce an effect (or effects). Graphically depicted, this concept more closely resembles a spider's web than a simplistic cause and effect, "x causes y" diagram (see Figure 19.2).

MacMahon would argue, for example, that the acorn does not *cause* the oak tree. The web of causation for the oak tree includes interactions of soil, water, temperature, sunshine, nightfall, nutrients, an acorn, and freedom from harm caused by predators, illness, and injury.

Although MacMahon's spider web model is a wonderful way to think about causes and effects in the real world, a cause and effect diagram in the

FIGURE 19.2. WEB OF CAUSATION.



form of a fishbone diagram often provides a straightforward way to translate a web of interactions into an easy-to-construct and easy-to-understand visual display that helps people get started with designing and testing changes for improvement.

Why Use a Fishbone Diagram?

The fishbone diagram is an important scientific tool used to identify and clarify the causes of an effect of interest. When lead improvement team members construct such a diagram, it allows them to build a visual theory about potential causes and effects that can be used to guide improvement work. The fishbone diagram can stimulate the formation of *hunches* worth empirically testing, using plan-do-study-act (PDSA) cycles.

In addition, the fishbone diagram promotes a disciplined use of major categories of potential causes. As a result, rather than allowing people to focus on a few top-of-the-mind areas, it facilitates deeper thinking about possible causation. Finally, it can help the team answer the question of where to begin the process of improvement.

What Is the Structure of a Fishbone Diagram?

As we said earlier, the fishbone diagram looks like a fish skeleton consisting of a spine and attached bones, as shown in Figure 19.3. The big bones attached directly to the spine represent major categories of causation. Some examples of commonly used major categories are process, equipment, materials, people, and environment.

Once the major categories are defined, the discrete causal elements (specific causes and contributing factors) within each category are listed on the smaller bones attached to the big bones. With the diagram shown in Figure 19.3, asking the question Why is this a cause? five times will result in getting to the multiple causes of the outcome of interest.

What Does a Completed Fishbone Look Like?

Figure 19.4 is a fishbone diagram that shows many of the factors that contribute to the undesirable result of medical appointments that last much longer than needed. The main causal categories are people, equipment, materials, environment, and process. The details within each category reflect *why* the category is a

FIGURE 19.3. FISHBONE DIAGRAM.

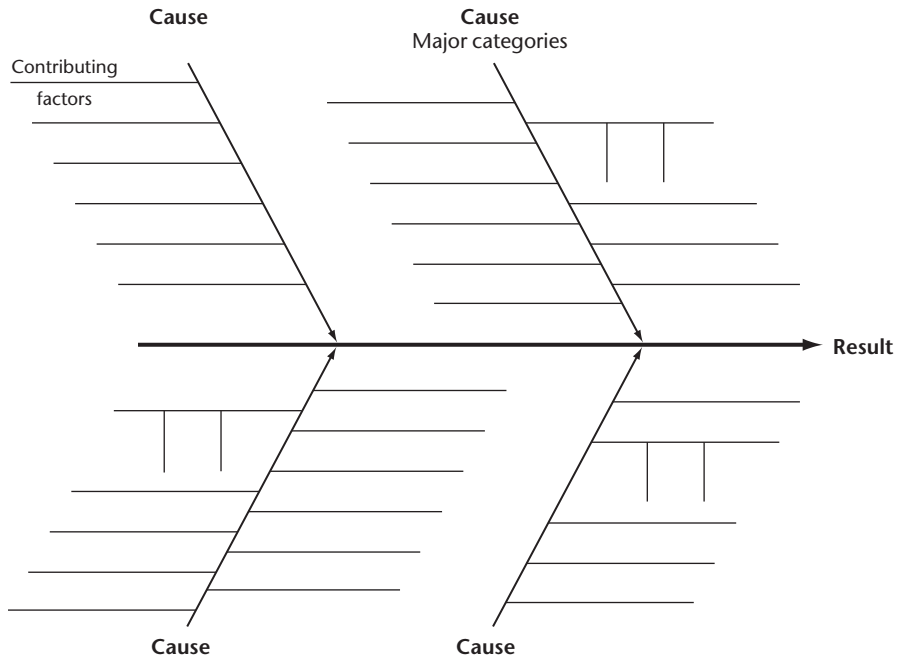
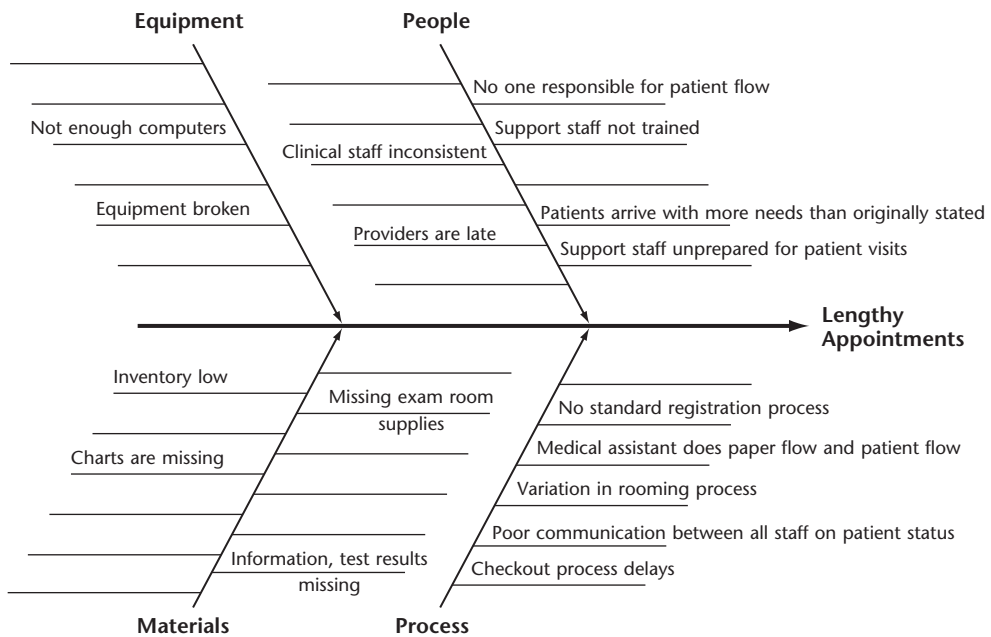


FIGURE 19.4. FISHBONE DIAGRAM SHOWING CAUSES OF LENGTHY APPOINTMENTS.



cause, illustrating the many waits, delays, and flow problems that are specific causes of this (undesired) effect.

What Are Some Tips for Creating a Fishbone Diagram?

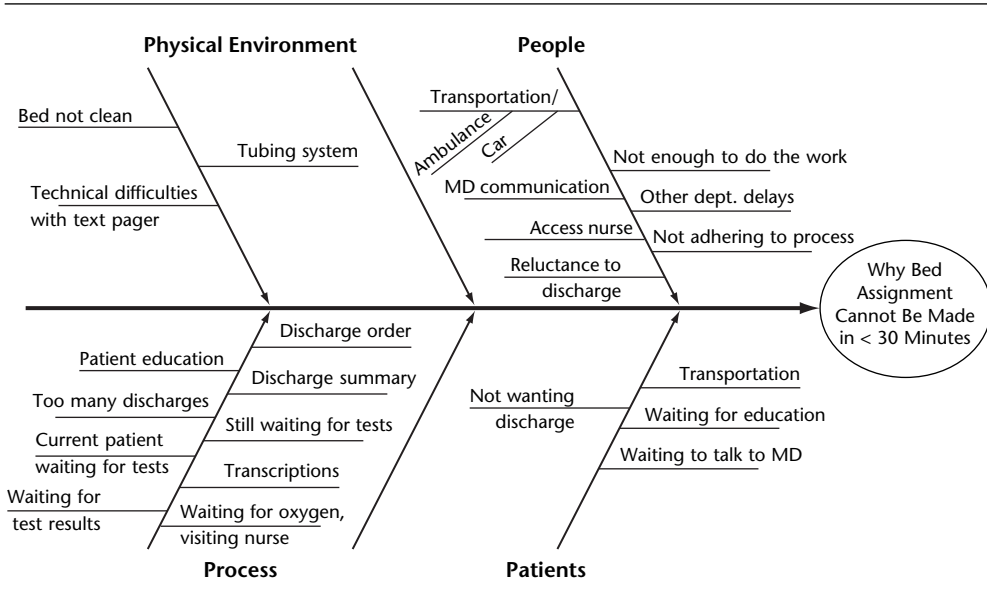
- Review the specific aim that you want to work on.
- Clarify the effect. It is important that everyone involved is clear about the effect, or the outcome of interest, which can be stated as an *undesired* result (such as lengthy appointments) or as a *desired* result (such as a hypertensive patient whose blood pressure is under control) or as a *neutral* result (such as the amount of time it takes to place a patient ready to be discharged from the emergency department in an inpatient unit bed.)
- Determine the major categories of causation that contribute to the effect, and brainstorm to identify the detailed causes within these larger categories. Visual display of the categories can often stimulate broader thinking about potential detailed causes. However, sometimes it is easier for a team to work the other way—from the particular to the general categories. To do this, lead improvement team members hold a session in which they brainstorm causes leading to an identified result by writing possible causes on Post-it Notes, grouping the notes according to similarity of ideas, and then giving a category name to each major grouping. This is called *affinity grouping*.
- Refine the fishbone diagram. Once the process is completed, review the diagram, and consider whether causes should be re-sorted and whether categories should be split or aggregated to make the most sense.
- Share the fishbone diagram with others, and use their feedback to improve it. Once you have created a draft fishbone, post it in a place where all members of the microsystem can review it and add their comments. This can result in a more accurate cause and effect diagram and greater shared understanding of the findings.

Case Studies

Intermediate Cardiac Care Unit (ICCU)

Using the selected specific aim of the ICCU concerning the timeliness of assigning patients to beds, the lead improvement team created a fishbone to identify the reasons why the admissions department could not get a bed for a new admission within thirty minutes of the initial phone call (see Figure 19.5).

FIGURE 19.5. FISHBONE DIAGRAM FOR ICCU BED ASSIGNMENT.



Note: VN = visiting nurse.

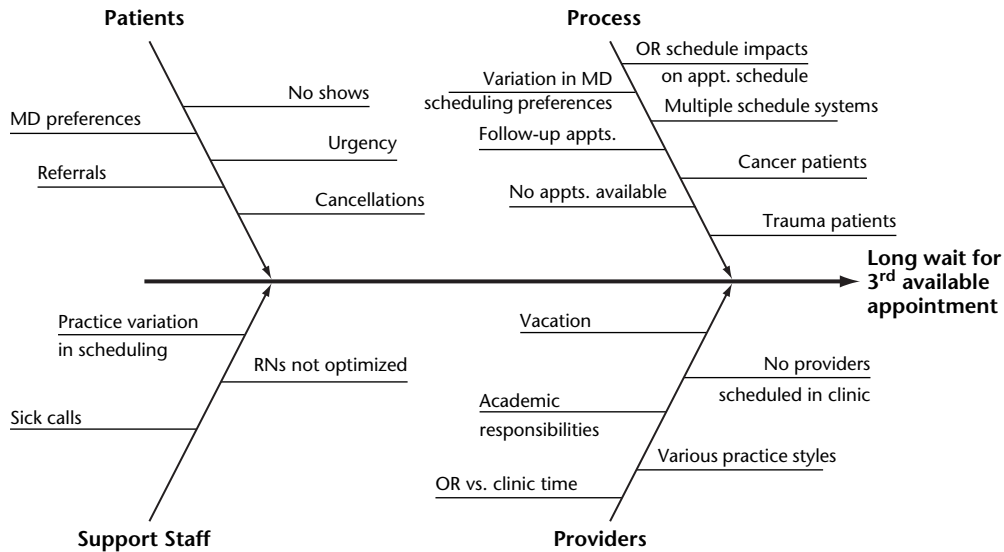
Plastic Surgery Section

The lead improvement team created a cause and effect diagram showing the causes of the backlog of appointments keeping patients from being seen in a timely manner (see Figure 19.6). The main categories included patients, processes, providers, and support staff.

Review Questions

1. What is a fishbone diagram?
2. How would you describe a web of causation?
3. What are the benefits of using cause and effect diagrams as an improvement tool?
4. What is a common structure used to draw cause and effect diagrams?
5. How do you make a fishbone diagram when you are in an improvement team?
6. How might you engage all members of your microsystem in creating and refining a fishbone diagram?

FIGURE 19.6. FISHBONE DIAGRAM FOR PLASTIC SURGERY APPOINTMENT BACKLOG.



Note: OR = operating room.

Between Sessions Work

1. Create a fishbone diagram to show the causes that contribute to your specific aim.
2. Display the draft fishbone diagram for all to review and modify.
3. Make the modifications to the fishbone diagram based on feedback.

References

Ishikawa, K. (1976). *Guide to quality control*. Tokyo: Asian Productivity Organization.
 MacMahon, B. T., & Pugh, T. F. (1970). *Epidemiology: Principles and methods*. Boston: Little, Brown.