

# Human Factors

## Managing Failures in Human Performance



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## Background

Human factors engineering is the science of designing tools, tasks, information and work systems to be compatible with the abilities of human users, including both physical and cognitive abilities. It provides a system-based approach to reducing undesirable human performance by concentrating on the conditions under which people work, and building defenses to avert errors and violations or to mitigate their effects.<sup>1</sup> In other words, the approach helps diagnose the underlying causes of different types of errors and violations in order to:

- a) Identify the most effective improvement strategies; and
- b) Avoid strategies that are unlikely to be effective in a given situation.

## Purpose

Categories of undesirable human performance (e.g., errors and violations), the workplace factors that promote them, and improvement redesign strategies are described in great depth in literature about human factors, behavioral science and quality improvement. While not intended to replace independent study, this Human Factors series was developed to help connect these concepts and disciplines in a concise and useful way.

These documents are intended to help the user:

- Identify the possible types and causes of undesirable human performance.
- Dig deeper into the causes of unsafe acts that precede adverse events and near misses.
- Understand the conditions and system components that prevent people from performing as expected.
- Select the improvement strategies that are most likely to be effective in managing the causes of poor human performance, and avoid those that are unlikely to be effective.

## Limitations

These documents do not address the full range of human performance problems. Rather, they can aid a user in identifying redesign strategies that are most likely to be effective for errors of execution and of planning, and for violations in which poor outcomes are unintended.

The Redesign/Intervention Strategies suggested in the three guidelines documents (“Planning Errors,” “Execution Errors,” and “Violations”) are broad concepts that are not intended not stand alone. To develop an effective intervention, knowledge of the conditions and context surrounding the performance gap are essential.

Finally, while brief definitions and examples of certain improvement strategies are provided in the Glossary, these documents do not attempt to describe how to design (e.g., what constitutes a good reminder) or to implement proposed redesign/intervention strategies. This information is covered in great detail by other sources, including those referenced in this document, under “Recommended Reading.”

## Categories of Failure in Human Performance

The documents in this series focus on three categories of failure in human performance—Planning Errors, Execution Errors, and Violations—and the features of a system, process, tool, or work environment that contribute to the occurrence of each.

The terms “failure in human performance,” “performance failure,” “undesirable, unexpected or poor human performance,” and “unsafe acts” are used interchangeably in this series, but will, wherever possible, be categorized and referenced as one of the following:

- **Planning Errors:** Planning errors are those in which the actions conform to the plan, but the plan is inadequate to achieve its intended outcome (e.g., planning to get gas at your favorite gas station, but not having sufficient gas to get there). These are unintended failures, commonly called mistakes.
- **Execution Errors:** Execution errors are those in which a person’s plan is adequate, but his/her actions fail to go as planned (e.g., planning to go to the store after work and driving home instead). These are unintended failures of execution, and are commonly termed slips or lapses.
- **Violations:** Violations are intentional deviations from safe operating procedures, standards or rules. The focus of these documents are on violations in which the actions are intended (e.g., skipping a step in order to save time), but any possible bad consequences or outcomes are not intended. These documents do not address cases in which both the violation and the damaging outcome are intended.

## Recommended Reading

This series originates from ideas more fully developed in the publications listed below. We highly recommend a review of these key books to promote a deeper understanding of human factors and design strategies that are likely to improve performance:

- Norman DA. *The Design of Everyday Things*. New York: Doubleday; 1988.
- Reason J. *Human Error*. New York: Cambridge University Press; 1990.
- Reason J. *Managing the Risks of Organizational Accidents*. Brookfield, VT: Ashgate Publishing; 1997.

For additional information about human factors, behavioral science and quality improvement:

- Krause TR. *The Behavior-Based Safety Process: Managing Involvement for an Injury-Free Culture*. New York, NY: Van Nostrand Reinhold, International Thomson Publishing Company; 1997.
- Langley GJ, Nolan KM, Norman CL, et al. *The Improvement Guide: A Practical Approach to Enhancing Organizational Performance*. New York: Jossey-Bass Inc.; 1996.
- Petersen D. *Human Error Reduction and Safety Management (3rd Edition)*. New York: Van Nostrand Reinhold; 1996.
- Salvendy G, ed. *Handbook of Human Factors and Ergonomics (2nd Edition)*. New York: John Wiley & Sons; 1997.

<sup>1</sup>Reason, J. Human error: Models and management. *BMJ*. 2000; 320: 768-770.

Follow these steps when reviewing any individual instances of undesirable, unexpected or poor human performance.

## Process for Reviewing Individual Failures

Individual Instances of Performance Failure		
Step	Description	Example
1	Describe the instance of undesirable or unsafe human performance.	Nurse A didn't administer medications to Patient X at time of discharge.
2	Use the "Categories of Performance Decision Tree" to determine the type of error or violation. You may need to discuss with the individual involved.	Planning Error: The nurse didn't know what she was supposed to do.
3	Review the three Guidelines documents ("Planning Errors," "Execution Errors," and "Violations") to further diagnose the causes or reasons behind the performance. You may need to discuss with the individual involved.	Nurse A was unsure of what to do because it was her first day on the job as a float nurse. She is unfamiliar with our organization's discharge process, which is different from the process at her last organization.
4	Describe the general context in which the unsafe act occurred: conditions that affected the person involved, how this act might relate to other individuals, and how similar circumstances may affect work in other areas.	We now know that Nurse A was temporary; we frequently have new or temporary nurses working at our organization.
5	Review the redesign or intervention considerations that correspond to the causes identified in Step 3.	Reallocate the task to another nurse, and provide additional training and back up for new hires.
6	Develop an action plan based on the strategy that is most likely to be effective in the context described in Step 5.	This and other critical tasks should be completed by nurses familiar with the process; if not possible, new hires should be paired with seasoned nurses until they are familiar with their role.

Follow these steps when reviewing any general performance failures that involve multiple people.

## Process for Reviewing General Failures

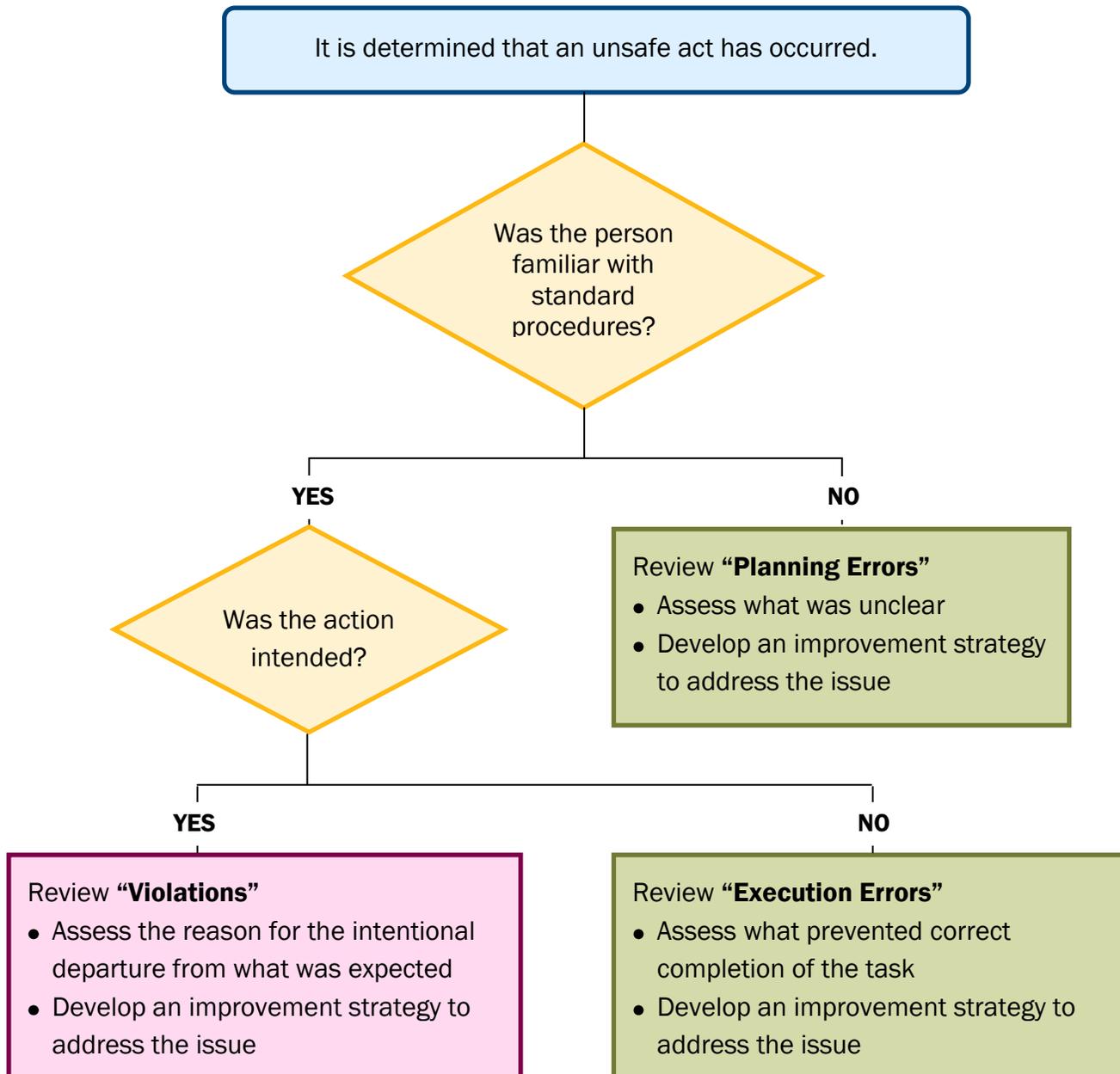
Performance Failures Involving Multiple People*		
Step	Description	Example
1	Describe the process in which problems have been identified.	Ensuring that surgical patients receive prophylactic antibiotics within one hour prior to surgical incision.
2	Describe the difference, or gap, between what should happen and what does happen.	Patients in our facility often receive antibiotics within one and-a-half to three hours prior to surgical incision.
3	List possible/known causes or reasons for the gap (generally requires discussion with those involved in the process or task).	<ol style="list-style-type: none"> <li>1) It is unclear who is responsible for administering antibiotics. There are a few staff members who do it frequently, but sometimes different people do it.</li> <li>2) Those who did administer antibiotics sometimes forget to check the clock and document the time of administration.</li> <li>3) Sometimes the time of administration is not documented because staff members are juggling multiple tasks, and know that the patient received the antibiotic on time, which is what's important.</li> <li>4) Staff members thought that 2 hours was the standard timeframe. There is also a general perception that providers would not agree to an earlier antibiotic administration time without evidence of an increased benefit.</li> </ol>
4	Use the "Categories of Performance Decision Tree" to label the reasons in Step 3 as Planning Errors, Execution Errors, or Violations.	<ol style="list-style-type: none"> <li>1) Planning Error -                             <ul style="list-style-type: none"> <li>▪ No standard process exists, and it is unclear who is responsible for performing the task or how it should be done, or</li> <li>▪ Due to a recent change in the process, some staff are unfamiliar with the new procedures or persist in the old process because they disagree with the change.</li> </ul> </li> <li>2) Execution Error -The correct plan was in place, but staff forgot or were distracted by more urgent tasks.</li> <li>3) Violation - Sometimes, conflicting goals mean that staff members must choose between two or more important tasks.</li> </ol>

Performance Failures Involving Multiple People*		
Step	Description	Example
5	Select the design/intervention strategies that are appropriate to the causes identified in Step 3.	<ol style="list-style-type: none"> <li>1) Consider developing a process with input from end users; utilize good process design techniques, and clearly define responsibilities within the process.</li> <li>2) Simplify the processes.</li> <li>3) Redistribute tasks as appropriate.</li> <li>4) Provide appropriate training/education for staff about new processes; address barriers to acceptance and buy-in.</li> </ol>
6	Modify the intervention to fit the situational context.	<ol style="list-style-type: none"> <li>1) Develop a process for ensuring the timely administration of antibiotics that includes a clear definition of responsibilities.</li> <li>2) As much as possible, avoid distracting the individual(s) responsible for administration and documentation.</li> <li>3) Reassign the administration task to a specific individual (e.g., scrub, circulating nurse, or anesthesiologist), and ensure that everyone is aware that this is the person responsible.</li> <li>4) Review available literature and provide education to staff and academic detailing to physicians about the process change and how that change will impact internal processes.</li> </ol>

\*Note: When reviewing acts involving more than one person, multiple categories of performance may be relevant, and multiple interventions may be needed to address the issue.

These questions will help you avoid assumptions about the nature of human performance problems, and identify planning errors, execution errors and violations.

## Categories of Performance



Planning errors occur when the organization's plan is incorrect, causing a performance failure to occur. Such errors are not intentional.

## Guidelines for Managing Planning Errors

Reasons for the Error	Redesign/Intervention Considerations
Staff are <b>unsure</b> of what to do, because of a new process or change to an old process, or are <b>unaware</b> that a specific action needs to take place.	<ul style="list-style-type: none"> <li>• Reallocate tasks to other staff members who have the appropriate knowledge or experience.</li> <li>• Provide appropriate training and education for newer employees.</li> </ul>
<b>No process exists</b> or it is <b>unknown</b> or <b>unclear</b> .	<ul style="list-style-type: none"> <li>• Create a process, or speak with staff to determine why the process is unknown or unclear; examine work tools and flow of process.</li> <li>• Consider developing a process with input from staff and redesign the process; be sure to use good design techniques.</li> </ul>
The infrequency of the task causes the staff to <b>forget</b> the process.	<ul style="list-style-type: none"> <li>• Assign the task to a specialist (who will do it more frequently).</li> <li>• Use memory aids, reminders or prompts to help people remember how and when to perform steps in the process.</li> </ul>
Staff does not know <b>who is responsible</b> for performing a task.	<ul style="list-style-type: none"> <li>• Clearly define individual responsibilities.</li> <li>• Assign individuals as backup in case the primary staff members are unavailable.</li> </ul>
Staff does not know or understand <b>why</b> a task should be done in a particular way, and does not adhere to the process.	<ul style="list-style-type: none"> <li>• Identify barriers to knowledge and provide appropriate training and education to address those barriers.</li> <li>• Clearly convey the benefits of the process.</li> </ul>
Some staff <b>don't believe the science</b> , and may not give up preferred practices and patterns because the old science seems to work just fine.	<ul style="list-style-type: none"> <li>• Identify and address the barriers to buy-in (e.g., knowledge deficit, reluctance to change).</li> <li>• If possible, demonstrate how the new process will positively impact them.</li> </ul>
Staff are <b>used to an old process</b> and don't know there is a new way.	<ul style="list-style-type: none"> <li>• Provide appropriate training/education.</li> <li>• If necessary, use memory aids, reminders or prompts.</li> </ul>
The correct work forms, equipment and/or supplies are <b>not available</b> or are <b>not working</b> properly.	<ul style="list-style-type: none"> <li>• Ensure that a process is in place for obtaining and maintaining work forms, supplies so everything is available when needed.</li> <li>• If there is a breakdown in this process, determine what caused it.</li> </ul>

Execution errors occur when the organization's plan is correct, but there was a breakdown while staff was carrying out the plan. Such errors are not intentional.

## Guidelines for Managing Execution Errors

Reasons for the Error	Redesign/Intervention Considerations
<p>The person <b>knew</b> the correct plan, but <b>forgot</b> due to <b>distractions</b> or <b>interruptions</b>.</p>	<ul style="list-style-type: none"> <li>• Utilize memory aids, reminders and prompts, or create checklists to help staff remember where they are in a given process.</li> <li>• Simplify the process, and minimize distractions and interruptions.</li> <li>• If necessary, conduct independent checks or simplify processes.</li> </ul>
<p>While performing the task, the person <b>got confused</b> (due to look-alike steps), or <b>forgot</b> which step he/she was on, or was <b>interrupted</b>, and returned to a different step in the task rather than the intended.</p>	<ul style="list-style-type: none"> <li>• "Mistake-proof" the processes, and limit the functions that are possible. Create memory aids to improve a person's ability to know he/she is correctly carrying out the appropriate task.</li> <li>• If necessary, conduct independent checks.</li> </ul>
<p>A <b>gap in time</b> between decision and action led to the execution error. The person made a decision about the task, but because it wasn't scheduled to be carried out immediately, he/she <b>forgot</b> during the time gap.</p>	<ul style="list-style-type: none"> <li>• Utilize memory aids and prompts.</li> <li>• Decrease the amount of time between the decision and action.</li> </ul>
<p>Previous experience or <b>old habits</b> led the person to incorrectly perform an action, despite recent training.</p>	<ul style="list-style-type: none"> <li>• Utilize memory aids and prompts.</li> <li>• Ensure that decision support tools are available to all staff.</li> </ul>

Violations occur because of an intended deviation from safe, approved practices.

## Guidelines for Managing Violations

Reasons for the Error	Redesign/Intervention Considerations
Staff may feel they <b>don't have to</b> follow a process, intentionally not doing a task because routine violations are permitted and correct behaviors are not reinforced. These individuals may feel that they are above the rules because of their position or experience.	<ul style="list-style-type: none"> <li>• Ensure that all policies are consistently enforced.</li> <li>• Provide positive, consistent and timely feedback for desired behaviors.</li> </ul>
The person becomes <b>frustrated</b> and finds a workaround for a task because the correct work forms, supplies and/or equipment not being readily accessible.	<ul style="list-style-type: none"> <li>• Redesign aspects of the task to eliminate the source of the frustration.</li> <li>• Ensure that all forms, supplies and equipment are accessible and convenient.</li> </ul>
In some cases, staff may violate a policy because they are doing <b>what they think is best</b> for the patient.	<ul style="list-style-type: none"> <li>• Review the policy and update if it is too restrictive, inappropriate or outdated.</li> <li>• Alter processes to allow for contingencies and special cases.</li> </ul>
The staff member has to choose between two or more important tasks that both need to be completed.	<ul style="list-style-type: none"> <li>• Distribute tasks evenly among available staff. Simplify processes.</li> </ul>
A staff member knows what should be done, but chooses to ignore the current process and does it <b>the way it has always been done</b> previously.	<ul style="list-style-type: none"> <li>• Identify and address barriers to buy-in.</li> <li>• Reward correct behavior and eliminate positive consequences for violating the process.</li> </ul>
Staff members choose to violate the rules because there are <b>positive consequences</b> for doing so (e.g., saved time).	<ul style="list-style-type: none"> <li>• Remove any negative consequences of performing the correct behavior, making it easier to do the right thing.</li> <li>• Reward correct behavior and eliminate positive consequences for violating processes.</li> </ul>

**Double Checks:** Occur when someone performs a task, then asks another person to check the work completed for correctness. **Example:** One nurse completes a dose calculation and asks another nurse to check his/her answer.

**Education:** Knowledge and development resulting from a process. Education is the most popular intervention in healthcare but is often employed in the wrong circumstances. Education is appropriate when people make errors because they do not know what to do, or how to do something, or the science has changed and they are used to doing the task differently. **Example:** The science of treating patients with chronic pain or diabetes has changed in the last 15 years. If practitioners do not know the new science and are still treating their patients the same way as they did 15 years ago, then education can help them learn the new science. Coupling education with memory aids can be very effective.

**Independent Checks:** Occur when two people perform a task at the same time and compare the outcome for validity. **Example:** One nurse completes a dose calculation and asks another nurse to calculate the dose on her own. After finishing, they compare answers. Independent checks are stronger than double checks because a person's eyes tend to see what the brain expects to see when checking someone else's work, possibly causing him/her to think an incorrect answer is correct.

**Memory Aids:** Method of publishing an organization's correct plan for all staff to access (e.g., in a book, on a piece of paper, or in a computer program) rather than relying on one person's memory. Memory aids are something that people can use when their short-term memory is not sufficient or when their long-term memory is not precise enough to manage the desired information. **Example:** A physician's desk reference or a "Pain Management Form" created by a nursing home to help practitioners through the process of pain management.

**Mistake-proofing:** Improving processes or designs to prevent errors from occurring or to make mistakes obvious at a glance. Mistake-proofing is appropriate when people are likely to make errors due to similar or complicated steps. Memory aids are helpful in detecting or mitigating the effects of errors that cannot be prevented effectively. **Examples:** The simplification of a process or tool to reduce the likelihood of an error; a checklist to help prevent a process step from being omitted; a computer program with a "forcing function" that does not allow the user to move to the next screen without all the required patient information being entered.

**Process:** Systematic set of steps taken to reach an identified outcome. Creating a new process or altering a current process are solutions to planning errors. Creating a process is appropriate when there no process exists or the current process requires significant change. Altering a process is appropriate when the current process does not address the needs of the users, or when the current process has unrealistic expectations (e.g., that people will perform perfectly every time). **Example:** A physician's office that needs to routinely test its patients with diabetes may establish a registry to aid in the process of identifying overdue patients.

**Prompts:** Cues that act as reminders for what actions should be taken next. Prompts are appropriate to use at steps in a process when people tend to lose their place; when someone is unlikely to remember the next step; or when there are a number of potential options. **Example:** Defibrillators that signal if the pads have been placed incorrectly.

**Reminders:** Anything that brings to attention an action that needs to be accomplished. Unlike a prompt, a reminder is always present, which can cause people to "stop seeing it." Reminders should be used when there is a risk of forgetting something, when attention is likely to be diverted, or when vigilance is required. **Examples:** A "sticky note" on a door, phone, or refrigerator reminding the reader of an action to perform; signs hanging in maternity rooms reminding everyone to wash their hands before holding the new baby.