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Cognitive Aids: Design Suggestions for the Medical Field

Keaton A. Fletcher (University of South Florida)
Wendy L. Bedwell, Ph.D. (University of South Florida)
Tampa, Florida, United States of America

The high task and emotional demands of healthcare drain individual cognitive, affective, and physical resources. When these resources are depleted, practitioners are no longer able to vigilantly prevent system-based errors from occurring. Cognitive aids have frequently been suggested—and implemented—as a method to reduce the cognitive load associated with medical practice. Although cognitive aids can offer true benefits, haphazard implementation and overuse has led to "checklist fatigue." To avoid this misuse and to maximize the benefits of these beneficial tools, we suggest that cognitive aids should be clear, easy to use, adaptable to the context, properly trained prior to implementation, pilot tested, and based on a needs-analysis. Furthermore, it appears that best practices for one type of cognitive aid in one context cannot necessarily be generalized to another. Therefore, this qualitative synthesis of the literature aims to provide three contextual factors to consider when addressing an issue with a cognitive aid. Designers and administrators need to consider the skill type that will be addressed, the physical, social, and organizational environment in which the aid will be utilized, as well as the experience level of the targeted users.

INTRODUCTION

A frequent recommendation of health care training research is the implementation and utilization of cognitive aids. A cognitive aid is a presentation of prompts aimed to encourage recall of trained information in order to increase the likelihood of desired behaviors, decisions, and outcomes (Harrison, Manser, Howard, & Gaba, 2006). Justification for cognitive aids ranges from the intuitive notion that any opportunity to decrease the cognitive load on healthcare practitioners should increase performance to empirical evidence of their successful use (Harrison et al., 2006). Attempts to implement cognitive aids in the healthcare field, however, have been less successful given issues including lack of use, lack of usability, and general discomfort (Andersen, Jensen, Lippert, & Østergaard, 2010; Arora et al., 2012). Checklists, in particular, have been frequently debated as to their functionality (Bosk, Dixon-Woods, Goeschel, & Pronovost, 2009; Hales, Terblanche, Fowler, & Sibbald, 2008; Ko, Turner, & Finnigan, 2011; Paull et al., 2010).

OBJECTIVES

First we operationalize six generalized types of cognitive aids. A full-range review of cognitive aids is beyond the scope of this project, but we believe that these six aid types, while not exhaustive, include the most commonly used cognitive aids in healthcare. Based on these six types of cognitive aids, we suggest three critical contexts to consider during the development of effective cognitive aids for healthcare professionals: skill type (Table 1), user experience level (Table 2), and environment of implementation (Table 1).

COGNITIVE AID TYPES

Checklists, which are arguably one of the most abundantly used cognitive aids, are defined as organized tools that outline criteria or steps, simplify concepts, and aid in information recall (Hales et al., 2008). In general, checklists should be clear, in-depth, and in order (Hales et al., 2008; Harrison et al., 2006; Luten et al., 2002).

Alarms, another frequently used set of cognitive aids, are defined as auditory warnings that increase situational awareness and vigilance, and advise required actions (Catchpole, McKeown, & Withington, 2004). Overall, alarms should signal severity, location, and be unique to each event type(Catchpole et al., 2004; Celi, Hassan, Marquardt, Breslow, & Rosenfeld, 2001).

Physical tools encompasses a vast array of physical utensils that are aimed to reduce human error, such as differently sized tubes, pre-loaded syringes, etc. To be useful, physical tools should be cost-effective, easy to use, and pilot tested by the intended users (Catchpole et al., 2007; Celi et al., 2001; Luten et al., 2002).

Mobile applications (apps) are downloadable applications meant to be used on mobile phones, tablets, or other electronic devices. These can include programs that access the electronic medical/health records (EMR/EHR). Apps should be easy to use and flexible (Celi et al., 2001; Hales et al., 2008).

Mnemonic devices are patterns of letters used to represent and aid in the recall of connected ideas. A commonly used mnemonic in healthcare is SBAR (Situation, Background, Assessment, Recommendation). Mnemonic devices should be easy to remember and be in order of the procedure (Hales et al., 2008).

Reminders are physical reminders such as posters, signs, warnings, or pictures placed in visible areas with the intention of bringing to mind particular ideas, behaviors, or concepts. In general, reminders should signal importance and be clear (Harrison et al., 2006; Luten et al., 2002).

CONTEXT CONSIDERATIONS

Skill Type

A distinction has arisen in the literature between technical skills and non-technical skills in the field of healthcare. Technical skills are the trainable abilities needed

by an individual to complete a task. Technical skills require high levels of repetition and training to be learned and have a rapid rate of decay if they are not practiced. On the other hand, non-technical skills are trainable abilities required to work with others whether they are healthcare teammates, the patient, or her family (Bleetman, Sanusi, Dale, & Brace, 2012). These skills, or rather the lack of, have been implicated in a large number of medical errors and fatalities (Arora et al., 2012; Kohn, Corrigan, & Donaldson, 2000). As such, training and interventions for teamwork and communication skills have become increasingly common. Cognitive aids can be useful to prevent the decay of both technical and non-technical skills; however, there are certain differences between the two types of skills that should determine the final product. Extrapolating from learning theories (Heimbeck, Frese, Sonnentag, & Keith, 2003; Keith & Frese, 2005), cognitive aids regarding technical skills should be precise, leave no room for interpretation or error (Luten et al., 2002), and also be discrete so as to not alarm patients. Cognitive aids for non-technical skills should be less precise while still remaining informative (Heimbeck et al., 2003; Keith & Frese, 2005). There are many ways to properly interact with others, while there is only one way to appropriately bandage a wound to protocol. Furthermore, cognitive aids for non-technical skills can and should be in plain sight (Luten et al., 2002), so as to be a constant reminder to practitioners, as well as a signal to patients about the kind of culture the hospital is striving for. One might go so far as to suggest that there be cognitive aids for patients, making them feel more confident in their ability to be active participants in their own care.

Experience level of users

Keeping the type of skill in mind, the designer of a cognitive aid must then decide on the experience level of her audience. Learning theory coupled with intuition would suggest that novices have a different need for cognitive aids than do experts (Kraiger, Ford, & Salas, 1993). While both groups would benefit from cognitive aids, most would agree that a first-year surgery intern will need much more detail on how to conduct a laparoscopic cholecystectomy than a veteran surgeon. Yet, the automatization of the task that makes the veteran surgeon more efficient than the first-year intern may also make her susceptible to errors of negligence (Burke & Hutchins, 2007). How, then, should one balance these competing needs? Too much detail will cause the veteran to ignore the cognitive aid, while not enough will result in an ineffective and potentially harmful tool for novices. Ideally, personalizable or adaptable aids should be implemented. If that is not feasible, perhaps making all details available while clearly highlighting key points would strike an ideal balance. For non-technical skills, it is unlikely that there will be a difference in needs based on work experience or training. Again, the patient and her family could be a potential audience who would require very different cognitive aids than those for physicians, nurses, or medical technicians. Regardless, keeping the potential audience in mind during development of cognitive aids will result in effective tools that are actually used, particularly if the potential users are involved in the development process.

Environment of implementation

Beyond the type of skill and potential audience, the environment of implementation should be considered when designing cognitive aids (Ko et al., 2011). Cognitive aids for a private family practice should look quite different than those designed for the emergency department. Not only do the skills required, both technical and non-technical, differ, but so does the user's ability to depend on an aid. Factors such as how frequently the user will be working in a team, if the user will be interacting with patients while utilizing the aid, how quickly decisions have to be made, etc. need to be considered when designing cognitive aids. For example, a cognitive aid for the initial assessment of a patient should look different for a triage nurse than for a nurse in a family practice. Though both nurses need to complete similar tasks, the triage nurse likely has fewer resources with respect to time and space. These demands should shape her cognitive aid so it will be useful for her, which might make it less useful for the family practice nurse despite having the similar responsibilities and potentially similar experiences.

TAKEAWAYS

Overall, the healthcare field has seen many more problems with the implementation of cognitive aids than aviation, a field against which health care is frequently compared. This is largely due to the expansiveness of what falls under the umbrella of the healthcare field. The wide variety of roles, experience levels, and environments culminates in a plethora of unique demands. One cannot expect a general cognitive aid to be useful in all environments, by all users, and yet we see this strategy prevail in the literature. In order to maximize the effectiveness of cognitive aids so as to increase patient safety and practitioner efficacy, we must consider the type of skill being trained, the target audience, and the environment of implementation. To do this, we must include potential users in the development process as well as designing easily adaptable cognitive aids. If we can do this, we will make great strides toward cognitive aids that have levels of use similar to those of the airline industry. Developers and administrators simply need to remember that context matters and this is a situation when "one size does not fit all."

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Aid	Use:	Best Practices:
Checklist	• **Technical skills** • Rare events • Frequent events with many steps	• Flexible across contexts • Unobtrusive • Context-specific pilot testing
Alarm	• **Technical skills** • Events that demand attention	• Consistent across contexts • Generalizable pilot testing
Physical tools	• **Technical skills** • System can prevent human error	• Based on needs-analysis • Consistent across contexts • Consistently trained across contexts
Apps	• **Technical or non-technical skills** • Calculations are needed • Immediate access is needed • Reminders are needed • Individualization is important	• Adaptable/specific to context • Unobtrusive • Used sparingly
Mnemonic	• **Non-technical skills** • Communication • Self-monitoring	• Consistent across/within contexts
Reminders	• **Non-technical skills** • General climate enforcement	• Welcoming/respectful • Consistent with context culture • Made with the patient in mind

Table 1. Suggestions for cognitive aids based on skill type and implementation context.

Aid	For Novices	For Experts
Checklist	• Be clear • **Be in-depth** • Be in order	• Be clear • **Highlight key step** • Avoid overuse
Alarm	• Signal severity/location • **Be unique per event** • Be trained	• Signal severity/location • Be consistent across contexts
Physical tools	• Be easy to use • Be pilot tested • Be trained	• Be easy to use • Be pilot tested • Be trained
Apps	• Preserve device battery • Flexible • Be trained	• **Easy to use** • **Unobtrusive** • Flexible • Be trained
Mnemonic	• Be easy to remember • **Be in order** • Learned early/trained	• Be easy to remember • **Based on needs analysis** • Trained
Reminders	• Signal importance • Be clear • Welcoming/respectful	• Signal importance • Be clear • Welcoming/respectful

Table 2. Suggestions for cognitive aids based on user experience level.