Research Findings:
Technology and Clinician Cognitive Overload – Easing the Pain
Clinicians Have Limited Capacity to Process Information

The clinical care environment is growing ever more complex. Clinicians need to process and coordinate increasing amounts of knowledge, information, and context stemming from an explosion of clinical data. They also must manage and record massive amounts of information throughout their clinical care duties due to the burdens imposed by regulatory and billing documentation requirements.

It’s no surprise that cognitive overload affecting clinical care team members is an increasing concern. After all, while information complexity has been increasing exponentially by the decade, human beings’ capacity to understand, process, and retrieve information has not evolved nearly as quickly.

Our capacity to process information from the environment through working memory is limited. This means that when care team members are overburdened by distractions, excessive information, or inefficient processes, their cognitive capacity becomes overloaded.

Cognitive Overload Affects Clinical Quality and Can Contribute to Burnout

Cognitive overload has significant consequences. A study of emergency room physicians showed that interruptions and multitasking (both contributors to cognitive overload) are significantly associated with increased prescription errors. A study of nurses showed a correlation between cognitive complexity and nursing errors. Cognitive overload can contribute to burnout, which leads to personal and professional dissatisfaction and increased likelihood of errors and safety events, higher turnover, and diminished health.

In healthcare, technology is one of the major forces shaping changes in clinical practice, communication, and collaboration. Over the past decade, the electronic health record (EHR) has been the dominant technology change agent, often with unintended consequences of increasing cognitive burden and pulling healthcare professionals away from time with patients.

But is all healthcare technology necessarily imposing a burden that lessens the quality of practice and patient care for team members?

Hospital Leaders Weigh in on How Technology Can Hurt – and How It Can Help

In this study, Vocera®, in partnership with HIMSS Analytics, now part of Definitive Healthcare, sought to understand:

- The signs and symptoms of cognitive overload
- How technology contributes to cognitive burden
- Whether and how technology improvements and investments can mitigate cognitive burden.

We surveyed 323 clinical and IT leaders via HIMSS Analytics Logic online, and onsite at the HIMSS 2019 annual conference (see the Survey Demographics section for more details).
We asked respondents to tell us what, if any, signs of cognitive overload they have seen or heard of in their clinical environments. Seventy-seven percent reported that clinicians appeared stressed or overwhelmed. Almost two-thirds said cognitive overload makes clinicians reluctant to adopt new technologies, and more than half said clinical team members ignore or fail to notice actionable alerts – an issue with potential to affect quality and safety.

Clinical respondents, who are more likely than IT respondents to have direct exposure to clinical workflows and patient care environments, were more aware of nearly every symptom of cognitive overload. Interestingly, when we separated leaders (those with titles of director or higher) from frontline team members, leaders showed a strong awareness of the ramifications of cognitive overload, recognizing more signs on average.
In many industries, technology has been introduced to streamline processes and minimize cognitive burden on workers. Our survey data suggests that in healthcare, technology has had the opposite effect on clinical team members. We asked our respondents whether technology is a help or a hindrance to cognitive overload. Forty-two percent said that technology contributes considerably or significantly to cognitive overload. Another 44% said it contributes at least moderately.

**Technology Contributes to Clinicians’ Cognitive Overload**

To what extent do technology-based tasks contribute to cognitive overload of clinicians (nurses, physicians, etc.) at your facility?

- Not at all (1)
- Slightly (2)
- Moderately (3)
- Considerably (4)
- Significantly (5)

<table>
<thead>
<tr>
<th>Level</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Not at all</td>
<td>2%</td>
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<tr>
<td>Slightly</td>
<td>13%</td>
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<tr>
<td>Moderately</td>
<td>44%</td>
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<tr>
<td>Considerably</td>
<td>33%</td>
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<tr>
<td>Significantly</td>
<td>9%</td>
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Cognitive Overload Score: 3.34

Percentage based on percent of respondents. "Cognitive Overload Score" is determined by assigning numerical values to the answer options, weighting the values, and dividing the weighted total by the total respondent count. Answer options were: (Significantly, 5; Considerably, 4; Moderately, 3; Slightly, 2; Not at all, 1).
Not surprisingly, respondents overwhelmingly identified documenting and charting in the EHR as a source of cognitive overload. But more than half point to alarms, retrieving data from EHRs, and trying to communicate with fellow care team members via technology as sources of cognitive burden. The likely reason is that many current systems such as pagers and standalone texting platforms are not integrated into a streamlined workflow. And since cognitive overload stems from the cumulative effects of multiple stimuli, each problematic task contributes to the overall burden.

Which of the following technology-based tasks contribute to the cognitive overload of clinicians (nurses, physicians, etc.) at your facility?

- Documenting and charting in the EHR: 70% (80% of All Respondents, 77% of IT Roles, 77% of Clinical Roles)
- Navigating multiple concurrent alert and alarm notifications of varying priority: 60% (60% of All Respondents, 58% of IT Roles, 55% of Clinical Roles)
- Retrieving data and orders from the EHR: 47% (65% of All Respondents, 55% of IT Roles, 55% of Clinical Roles)
- Trying to communicate with a doctor, nurse, or other care team member via technology: 48% (54% of All Respondents, 52% of IT Roles, 52% of Clinical Roles)
- Identifying and trying to communicate with an on-call physician or specialist: 35% (49% of All Respondents, 42% of IT Roles, 42% of Clinical Roles)
- Remembering complicated procedures for working with certain medical devices: 31% (31% of All Respondents, 30% of IT Roles, 30% of Clinical Roles)
- Paying attention to overhead paging: 15% (17% of All Respondents, 16% of IT Roles, 16% of Clinical Roles)
- Other: 4% (6% of All Respondents, 5% of IT Roles, 5% of Clinical Roles)
- None: 1% (1% of All Respondents, 1% of IT Roles, 1% of Clinical Roles)
When we asked respondents which technology improvements would have the greatest impact on reducing cognitive overload for clinicians, 62% cited intelligent workflows to route alerts and alarms more efficiently as a top solution. And while IT leaders see more value in integration of communication systems with the EHR, clinical leaders place higher value on interface usability and enabling communication with the right care team member at the right time.

Intelligent Workflows Have the Most Potential to Reduce Cognitive Overload

Which of the following approaches to improving technology in the clinical environment do you believe would have the greatest impact on reducing the cognitive overload on clinicians (nurses, physicians, etc.)? Maximum of three responses accepted

- Application of intelligent workflows to route alerts, alarms, and data more efficiently: 67% (All Respondents), 59% (IT Roles), 62% (Clinical Roles)
- Technology interfaces designed to improve usability: 51% (All Respondents), 59% (IT Roles), 55% (Clinical Roles)
- Technology to enable communication with the right care team member at the right time: 47% (All Respondents), 59% (IT Roles), 58% (Clinical Roles)
- Integration of communication solutions with the EHR: 42% (All Respondents), 57% (IT Roles), 51% (Clinical Roles)
- Integration of medical devices with clinical communication platforms: 39% (All Respondents), 39% (IT Roles), 38% (Clinical Roles)
- Reduction of overhead paging: 7% (All Respondents), 5% (IT Roles), 6% (Clinical Roles)
- Other: 5% (All Respondents), 4% (IT Roles), 5% (Clinical Roles)
- None: 0% (All Respondents), 0% (IT Roles), 0% (Clinical Roles)
While almost two-thirds of respondents think intelligent workflows to route alerts, alarms, and data more efficiently would reduce cognitive overload, only 45% have these solutions on their 2019 technology investment roadmaps. Large health systems (those with 501 or more beds) have more investment plans than smaller organizations and priorities are similar regardless of size.

Across almost every category of investment, leaders are more aware of plans to invest in improvements than are frontline team members. Leaders may be able to alleviate some frontline stress by communicating clearly about upcoming improvement plans.

Which of the following approaches to improving technology in the clinical environment are on your organization's roadmap for 2019?

<table>
<thead>
<tr>
<th>Approach</th>
<th>Large: 501+ beds (N = 142)</th>
<th>Medium: 101 - 500 beds (N = 125)</th>
<th>Small: &lt;100 beds (N = 56)</th>
<th>All Respondents (N = 323)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology interfaces designed to improve usability</td>
<td>55%</td>
<td>47%</td>
<td>39%</td>
<td>49%</td>
</tr>
<tr>
<td>Integration of communication solutions with the EHR</td>
<td>52%</td>
<td>48%</td>
<td>32%</td>
<td>47%</td>
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<tr>
<td>Technology to enable communication with the right care team member at the right time</td>
<td>48%</td>
<td>55%</td>
<td>23%</td>
<td>47%</td>
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<tr>
<td>Application of intelligent workflows to route alerts, alarms and data more efficiently</td>
<td>42%</td>
<td>54%</td>
<td>25%</td>
<td>45%</td>
</tr>
<tr>
<td>Integration of medical devices with clinical communication platforms</td>
<td>41%</td>
<td>39%</td>
<td>21%</td>
<td>37%</td>
</tr>
<tr>
<td>Reduction of overhead paging</td>
<td>14%</td>
<td>17%</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td>Other</td>
<td>9%</td>
<td>12%</td>
<td>7%</td>
<td>10%</td>
</tr>
<tr>
<td>We do not have plans to lessen the cognitive burden of clinical information technology</td>
<td>4%</td>
<td>5%</td>
<td>29%</td>
<td>9%</td>
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</table>
When we zeroed in on communication technologies that would minimize the cognitive burden on clinicians, respondents identified mobile solutions as having the greatest potential to alleviate the pain. Seventy-one percent of respondents identified mobile apps that enable care coordination and communication across multiple care team members as a top solution, while 67% said proactively pushing relevant EHR data to the right nurse at the right time on his or her mobile device would help.

### Mobile Apps Top the List of Communication Solutions to Reduce Cognitive Burden

Thinking specifically about communication solutions, which, if any, of the following would have the greatest impact on reducing clinicians (nurses, physicians, etc.) cognitive burden from technology?

- Mobile app that enables care coordination and communication across multiple care team members: 71%
- Proactively pushing relevant EHR data to the right nurse at the right time on his/her mobile device: 67%
- Filtering and prioritizing alerts and alarms: 53%
- Mobile app that lets housekeeping update the EHR with bed-ready status and pushes bed-ready status to nurses: 19%
- Communication solution that reduces the need for overhead paging by enabling direct broadcast communication with groups: 16%
- None: 4%

All Respondents (N = 323)

Maximum of three responses accepted
Tackling Cognitive Overload Is Important to Organizational Success

We asked respondents how important managing and minimizing cognitive burden on clinicians is to overall organizational success. Seventy-seven percent said tackling cognitive overload is very or extremely important to success.

Clinical respondents, who spend more time in clinical environments and interacting with fellow clinicians, place especially high priority on reducing cognitive burden. More than a third of clinical respondents said it’s extremely important, versus less than a quarter of IT respondents.

How important is managing and minimizing cognitive burden on clinicians (nurses, physicians, etc.) to your overall success as a healthcare organization?

<table>
<thead>
<tr>
<th>Importance Score</th>
<th>IT Roles (N = 148)</th>
<th>Clinical Roles (N = 138)</th>
<th>All Respondents (N = 323)</th>
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<tbody>
<tr>
<td>Not at all important (1)</td>
<td>2%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Slightly important (2)</td>
<td>3%</td>
<td>1%</td>
<td>2%</td>
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<tr>
<td>Moderately important (3)</td>
<td>15%</td>
<td>26%</td>
<td>20%</td>
</tr>
<tr>
<td>Very important (4)</td>
<td>46%</td>
<td>44%</td>
<td>46%</td>
</tr>
<tr>
<td>Extremely important (5)</td>
<td>23%</td>
<td>39%</td>
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Discussion: How Healthcare Leaders Can Harness the Humanizing Potential of Technology

Clinical and IT leaders alike cite challenges of technology contributing to cognitive overload in the clinical environment – but they also see solutions. That’s because technology in and of itself is not the root cause of the problem; the root cause is technology implemented without the appropriate interfaces, integration, and workflow considerations.

Technology in the clinical environment contributes to cognitive overload when it adds to information or task complexity. Rhonda Collins, DNP, RN, Chief Nursing Officer at Vocera, summarizes the challenges this way, “As a clinician in a hospital environment, you constantly segment what is important and urgent. When you receive too many pieces of information at once, you become overloaded and have difficulty segmenting. This can lead to mistakes. When you must constantly split your attention among multiple sources and pay attention to too many things simultaneously, you can become overloaded and unable to focus on critical patient care tasks.”

To help minimize cognitive burden, technology needs to simplify and streamline clinical communication and workflows. It has to help clinicians zero in on the most important information and must provide relevant clinical context while simultaneously weeding out extraneous information. And it needs to give care teams a single, common source of information and standardized protocols for communication so all team members can collaborate effectively.

“A hospital that’s standardized on a single clinical communication and collaboration (CC&C) platform for all clinicians is positioned to employ strategies to address cognitive overload,” explained Dr. Collins. “Working memory is limited in capacity and duration. Hospitals need to offload clinicians’ need to retrieve, retain, and record information, and make it easier to communicate. A comprehensive CC&C platform can make all the difference.”
Survey Demographics

The web survey link was open between December 13, 2018 and March 6, 2019. HIMSS19 onsite collection occurred between February 12 and 14, 2019.

100% involved in the use of healthcare technology at their healthcare organization

- Healthcare System: 51%
- 501+ Beds: 44%
- Executive Level: 55%
- IT Roles: 46%
- Clinical Roles: 43%

Role Grouping

- All Respondents (N = 323)
- IT Roles (N = 148)
- Clinical Roles (N = 138)

Role/Job Title

- IT Roles (N = 148)
- Clinical Roles (N = 138)
- Business Roles (N = 37)

Figures are rounded to the nearest whole number.
Survey Demographics

### Bed size
- Large: 501+ beds (N = 142) - 39%
- Medium: 101 - 500 beds (N = 125) - 44%
- Small: <100 beds (N = 56) - 17%

### Organization type
- Hospital that is part of a delivery system - 36%
- Standalone hospital - 25%
- Academic medical center - 21%
- Corporate offices of a healthcare system - 15%
- Accountable care organization - 3%
- Other - 1%

All Respondents (N = 323)
Vocera delivers the leading platform for clinical communication and workflow. Our mission is to simplify and improve the lives of healthcare professionals and patients while enabling hospitals to enhance quality of care and operational efficiency.

Nearly 1,600 hospitals and health systems have selected our solutions to enable care teams to communicate and collaborate using smartphones or our hands-free, wearable Vocera Smartbadge and Vocera Badge.

Our platform is interoperable with more than 140 clinical and operational systems. Vocera (NYSE: VCRA) has the resources and fortitude to help ensure your long-term success with our solutions. Learn more at www.vocera.com and follow @VoceraComm on Twitter.