Errors in after-hours phone consultations: a simulation study

Erel Joffe,[1,2] James P Turley,[1] Kevin O Hwang,[3] Todd R Johnson,[1] Craig W Johnson,[1] Elmer V Bernstam[1,3]

▶ Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bmjqs-2013-002243).

[1]School of Biomedical Informatics, The University of Texas Health Science Center, Houston, Texas, USA
[2]Department of Hematology and Bone Marrow Transplantation, Tel Aviv Medical Center, Tel Aviv, Israel
[3]Department of Internal Medicine, Medical School, The University of Texas Health Science Center, Houston, Texas, USA

Correspondence to
Dr Elmer Bernstam, School of Biomedical Informatics, The University of Texas Health Science Center, 7000 Fannin, Suite 600 Houston, TX 77030, USA;
Elmer.V.Bernstam@uth.tmc.edu

Received 19 June 2013
Revised 31 October 2013
Accepted 9 November 2013
Published Online First 13 December 2013

To cite: Joffe E, Turley JP, Hwang KO, *et al*. *BMJ Qual Saf* 2014;**23**:398–405.

ABSTRACT

Background After-hours out-of-hospital phone consultations require physicians to make decisions based on information provided by a nurse over the phone.

Methods We conducted a simulation study to evaluate physicians' actions following communication of key information. 22 nurses were asked to call physicians with six cases based on the six most common reasons for after-hours phone calls. We evaluated physicians' actions following the communication of key clinical information: A *situation cue* described a patient's problem (eg, confusion). A *background cue* described a specific clinical finding regarding the cause of the problem (eg, patient's sodium is low). For each cue we defined a list of indicators, based on the medical literature, to ascertain whether physicians acted upon the provided information (which was defined as addressing at least one of the indicators).

Results A total of 108 phone consultations (containing 88 situation and 93 background cues) were analysed. Situation cues were communicated in 90% (79/88) of the calls and background cues in 33% (31/93). Physician acted upon the provided information in 57% (45/79) and 48% (15/31) of the communicated situation and background cues, respectively. When the background cues were not communicated, physicians asked questions expected to elicit the cue in 12% of the cases. Responding to the situation cue was associated with longer conversations and active inquiry by the physician.

Conclusions After-hours phone calls are error prone. Both nurse communication and physician decision-making are problematic. Efforts to improve patient safety in this setting must address both communication and decision-making.

INTRODUCTION

Discontinuities in care due to communication failures have been associated with preventable adverse events.[1] These failures may occur at any time, but the risk is higher at night or during weekends (after-hours).[2] Inpatient after-hours phone communications are a clinical scenario in which a nurse consults a physician (who is on-call but may be outside of the hospital) regarding an acute patient problem using a telephone. These calls are usually limited to verbal communication, take place in a setting where scarce resources and fatigue are the rule, and are usually characterised by a paucity of information.[2] For example, often the consulted physician is not the primary physician responsible for the patient, and may have received only a very brief 'sign out' (eg, '40-year-old with pneumonia, doing well') or is entirely unfamiliar with the patient. Furthermore, nurse–physician communication is error prone due to different communication cultures specific to each profession (regardless of whether it takes place over the phone).[3 4] Considering the frequency of on-call phone communications, there is surprisingly little research regarding potential risks and adverse outcomes resulting from these calls.

In previous work, we found that a limited set of problems account for the majority of after-hours phone calls.[2] We attempted to improve nurse–physician communication by providing a problem-specific communication tool that lists the necessary data to be communicated under these common clinical scenarios.[5] We based the tool on the Situation-Background-Assessment-Recommendation (SBAR) framework, which is the most commonly implemented communication framework in healthcare.[6] Notably, previous evaluations of SBAR tools in healthcare have yielded mixed results.[7] Several studies proclaim great success in institution-wide implementations of the SBAR framework,[8 9] while other studies found no effect and even worse performance.[10 11] We found that a

problem-specific SBAR tool did not improve communication of key information between nurses and physicians.[5] Specifically, in the majority of cases nurses stated the reason for the call (eg, patient is confused) but failed to communicate pertinent information about the cause (eg, patient's sodium is 119). This was observed regardless of whether they used the SBAR forms (that were designed to guide data extraction and communication). In this study, we addressed physician decision-making. Specifically, we evaluated physicians' actions following the communication of key information by nurses and whether physicians were able to elicit the information when not provided by the nurse.

METHODS

A simulation study was conducted at the Texas Medical Center (Houston, Texas, USA) from May 2010 to May 2011. In all, 22 pairs, each consisting of a registered nurse and an internal medicine physician (attending or senior resident responsible for fielding after-hours calls from nurses on a regular basis), were enrolled in the study. Both nurses and physicians had to be practicing on general internal medicine wards at the time of the study.

We presented each nurse with six clinical scenarios (table 1). We based the scenarios on actual patient records from a local tertiary-care hospital. Cases were selected by two experts (internists) (EVB, KOH) for representing a moderate diagnostic challenge in the context of the six most common reasons for after-hours calls (fever, glucose management, behaviour problems, medication prescription, blood pressure and pain).[2] The rationale was that in order to evaluate whether physicians considered the communicated information in diagnosis and management of patients we must present some challenge. For example, a common reason for an after-hours call is blood glucose management. The reflexive response of a physician in such a case might be to ask about the glucose level and decide about insulin dosage. In our experiment, we presented a case where there was an order for insulin in the presence of normal blood glucose and a concomitant order for glucose (ie, a treatment for elevated blood potassium level). Consideration of the communicated information would direct the physician away from simple management of blood glucose to the evaluation and management of elevated blood potassium level.

Each case had at least one cue that was required in order to resolve the clinical scenario. There were two types of cues. A *situation cue* answered the question 'what is wrong with the patient that is prompting the call?' For example, the patient is disoriented and pulled out his intravenous line. These cues were used to evaluate the physician's understanding of the general situation and generate a differential diagnosis. A *background cue* was a specific clinical finding that answered the question 'why does this particular patient suffer from this problem?' For example, very low sodium level in a patient with acute confusion. These were used to determine whether the physician understood the aetiology of the patient's problem and was able to act on this understanding. We asked nurses to review the patient records, extract information (with or without the aid of an SBAR form) and then call the physician requesting instructions on how to manage the clinical scenario. For a detailed description of the SBAR forms and methodology for evaluating their utility in communicating information see[5].

For each call we noted whether the situation/background cues were communicated. Then, for cases where the information was communicated, we evaluated the appropriateness of physicians' responses. We considered physician responses to be 'appropriate' responses if there was any indication that the physician had considered and acted upon the provided information.

We defined the set of appropriate responses using a guide-book for the on-call physician and the UpToDate knowledge base (see online supplementary appendix A).[12 13] For the situation cues we defined the elements of an appropriate differential diagnosis or what further questions/diagnostic workup was indicated. For example, in a young patient with an acute confusion (situation cue) a physician is expected to consider infection, metabolic or electrolyte abnormalities, stroke or other organic brain damage and medication/drug/alcohol related confusion.[14 15] Indication that the physician has indeed considered the situation cue would therefore include questions regarding a possible infection, medications and substance abuse, laboratory tests and head imaging.[14 15] For the background cues we established what the appropriate orders should be. For example, given confusion which is associated with low sodium (background cue), a physician could either repeat blood tests to validate the diagnosis; give intravenous fluids with sodium; order a limit on free water intake; or admit to the intensive care unit.[16]

We defined physicians' responses as appropriate if, following a communicated situation cue, they had asked about *any* of the possible diagnoses on the differential diagnosis, and if following a communicated background cue, they had ordered *any* of the indicated orders (table 1, see online supplementary appendix A). In real clinical practice, a physician is expected to consider *all* major diagnoses on the differential, and address *all* active problems associated with these diagnoses. However, since there are often multiple reasonable strategies for a given clinical scenario, and since it is difficult to precisely define 'appropriate response' we used a much more lenient measure, focusing on whether physicians acted upon the communicated information rather than the adequacy of their medical decision. Figure 1 presents the study design.

Table 1 Clinical scenarios, cues and measures of evaluating appropriateness of physicians' actions

Presented scenario	Situation cue	Expected action*	Background cue	Expected action*
Fever case: A 43 y/o man admitted several days ago with a UTI, has a 101.5° fever and 2–3 loose stools	Persistent fever in a hospitalised patient/ patient under antibiotic treatment	Evaluation for healthcare associated or complicated infection. Asked about *any* of: recent hospitalisation, recent antibiotics use, other source of infection, presence of a complicated UTI or non-infectious cause of fever†	Back surgery 1 month ago or prior hospitalisation until 4 days ago	*Any* of: Broadened antibiotic coverage, or ordered imaging for epidural abscess or asked about evidence for surgical site infection
Glucose case: A 48 y/o man has a standing order for insulin but blood glucose is 90 mg/dL	There is also an order for glucose 50% (a standard Tx for high potassium levels)	Evaluation for the cause of elevated potassium. Asked about *any* of: current medications, renal function or acid/base values	Patient is treated with tacrolimus (may cause elevated potassium levels)	*Any* of: Asked for tacrolimus level, reduced dose or requested a nephrological consultation
Behaviour (Confusion) case: A 19 y/o man admitted for sickle cell crisis is disoriented and pulled out his IV line	The patient is confused	Evaluation for an acute change in mental status. Asked about *any* of recent opiate therapy, substance abuse or ordered any of: discontinue opiates, blood glucose, electrolytes or head CT	Patient has a new low sodium level (119 mg/dL) and a persistently high WBC count (23 000)	*Any* of: Treated low sodium, evaluated and treated for an infection
High Blood Pressure case: An 85 y/o woman has a high blood pressure of 180/90 mmHg	None†	None†	Home treatment with clonidine was discontinued (causes rebound high blood pressure); the patient has received large volumes of fluids	*Any* of: Reinstituted clonidine Tx., stopped fluid Tx. or ordered diuretic Tx
Medication case: A 31 y/o woman has difficulty sleeping and asks for a sleeping pill	The patient was admitted for acute liver injury	Refrained from benzodiazepines or asked about comorbidities (eg, respiratory compromise) or conflicting drugs	The patient is treated at home with a CPAP for obstructive sleep apnoea	Refrained from any sleep medication until CPAP treatment was reinstated
Chest Pain case: A 61 y/o woman presents with chest pain	The patient has swelling of her leg	Suspicious for pulmonary embolism. *Any* of: CTA, D-dimer, V/Q scan, lower extremity venous US or dedicated examination	None‡	None‡

*A complete list of the evaluation criteria can be found in online supplementary appendix A.
†There were no relevant 'appropriate responses' for the situation cue of the High Blood Pressure case (the blood pressure in itself was not high enough to warrant a comprehensive evaluation).
‡There were no relevant 'appropriate responses' for the background cue of the Chest Pain case (the patient had multiple comorbidities that could have been responsible for chest pain. Thus, we made the decision to present the background cue of leg-swelling to the nurse subjects and excluded it from the analysis).
CPAP, continuous positive airway pressure; CTA, CT angiogram; IV, intravenous; Tx, treatment; US, ultrasound; UTI, urinary tract infection; V/Q, ventilation/perfusion scan; WBC, white blood cell; y/o, year old.

As we were using cases based on actual patient records, there were no relevant 'appropriate responses' for the situation cue of the High Blood Pressure case (the blood pressure in itself was not high enough to warrant a comprehensive evaluation) and for the background cue of the Chest Pain case (the patient had multiple comorbidities that could have been responsible for chest pain. Thus, we made the decision to present the background cue of leg-swelling to the nurse subjects and excluded it from the analysis).

The Fever case included a misleading detail, a description of 2–3 loose stools suggesting the possibility of a *Clostridium difficile* infection. However, there were no other data to support the diagnosis (ie, overt diarrhoea, leucocytosis, etc). In this case, physicians' actions were deemed adequate only if they had entertained an alternative diagnosis to that suggested by the misleading detail.

Nurses were asked to come to the laboratory (ie, simulated internal medicine ward), while physicians were contacted by phone (ie, simulated 'out of hospital' call). Physicians did not receive any sign-out information about the patients prior to the experiment. Subjects were told we are conducting a study to evaluate the communication between nurses and physicians without any additional details. Hence, both nurses and physicians were blinded to the objectives of the study and to the evaluation measures. Experiments were scheduled when it was convenient for the subjects. We provided nurses with a medical record (including an admission note, progress notes, medical orders, medication, nursing notes, laboratory and imaging results) and a bedside (nursing) chart (with vital signs, intake/output, etc). We used actual hospital forms to ensure that nurses worked with records that were as close as possible to records used in routine clinical practice. The expert panel made sure that the records covered all the

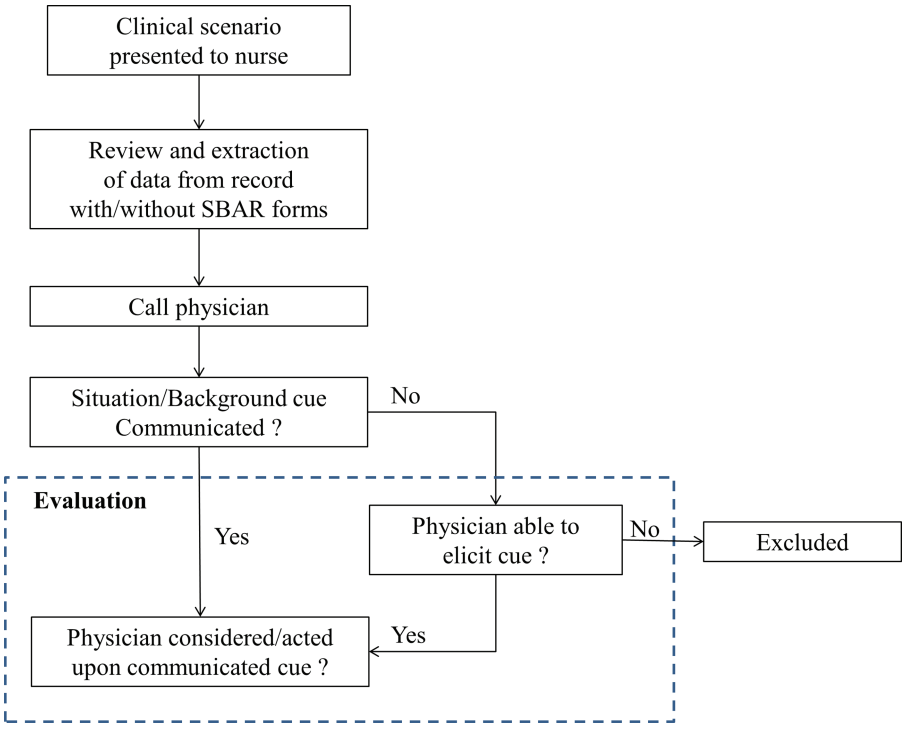

Figure 1 Study design.

pertinent data for the evaluation of each clinical scenario. Records were minimally modified to fit the clinical scenario, and to comply with the requirements for de-identification. The nurse subject could ask the nurse conducting the experiment (JPT) about physical exam findings for which there were scripted answers. If the question fell outside of the scripted answers, no information was given. The cumulative time to review the six records was limited to 2 h. Calls were not time-limited and were recorded by video and audio (MP3) and analysed by a single non-blinded reviewer (EJ). To avoid possible biases we refrained from using subjective measures in the evaluation (table 1).

We noted what information was communicated by the nurse, including erroneous information, and what additional information the physician requested. Evaluation was based on the data elements listed on the SBAR forms (see online supplementary appendix B). The rationale was that the SBAR forms listed a set of data elements that an expert panel deemed to be required for an appropriate evaluation of the type of case.[5] We recorded the time that elapsed between the beginning of the phone conversation and when the reason for the call was communicated; the total length of the call; number and types of data items communicated regarding the patient's situation other than the situation cue (eg, patient identification and location, whether the problem was urgent); and the number and type of data items communicated regarding the patient's background other than the cue (eg, reason for hospitalisation, prior medical history, vital signs, medication). Physicians were also evaluated for their ability to elicit required information regarding the situation and background cues when these were not provided by the nurses (eg, asking for the most recent laboratory results in the confused patient). Online supplementary appendix C presents a transcription of one session including comments to indicate the steps of the study, the positions where the situation and background cues were provided as well as communication of situation data elements, background data elements, assessment and plan.

Statistical analysis

Randomisation and allocation of cases to subjects were based on a Latin Square randomisation table.[17] Statistical analyses were performed using SPSS (V.20, IBM Inc., Chicago, Illinois, USA). We used generalised estimating equations (GEEs) to evaluate the association between adequacy of physicians' actions and properties of the communication. We chose GEEs due to repeated measures within subjects and cases, missing observations and non-normal distribution of our data.[18] We conducted the analysis sequentially. First, we assessed models based on different distributions (normal, Poisson and negative-binomial distributions for numerical variables, and binomial distribution for binary variables). Then, we found the best fitting correlation matrix (unstructured, independent or compound symmetry). We chose the model with the lowest Quasi likelihood under Independence Criterion.

Ethical considerations

This study was approved by the Committee for the Protection of Human Subjects (the UTH IRB). All the

participants gave written informed consent and received a US$50 gift card. Any potentially identifying information in the patients' records was erased.

RESULTS

Of the 132 (22 nurse–physician pairs×6) phone calls, 12 were cancelled (two pairs) due to a no-show of the nurse or inability to contact the physician, nine were cancelled by the nurse conducting the experiment due to time constraints, and three were excluded from analysis due to errors in the case presentation (eg, background cue inadvertently presented with the case). A total of 108 phone consultations by 20 nurse–physician pairs were analysed. Of these, 88 cases contained a situation cue and 93 cases contained a background cue. In all, 57 cases were delivered without the SBAR form and 51 cases with the SBAR form. (In previous work we demonstrated that there was no difference in the communication between the groups.[5])

In 14% of the cases (12/88), nurses failed to communicate the situation cue (table 2). Of these, in 42% (5/12) the nurses actually reported a misleading finding (eg, new onset fever rather than persistent fever). In 58% (7/12), the physicians asked questions aimed at eliciting the situation cue, but received the correct answer in only three cases. In summary, the situation cue was communicated in a total of 79 cases (independently by the nurse in 76 and elicited by the physician in three).

In 72% (67/93) of the cases, nurses failed to provide the background cue. Of these, in 7% (5/67) the nurses actually reported incorrect information (eg, a normal sodium level when the sodium was actually low). The physicians asked questions meant to elicit the cue in 12% (8/67) of the unreported background cues, and received the correct answer in five of the cases. In summary, the background cue was communicated in a total of 31 cases (independently by the nurse in 26 and elicited by the physician in five).

Physicians acted upon the communicated information (ie, appropriately) following 57% (45/79) of the communicated situation cues and 48% (15/31) of the communicated background cues. Providing an appropriate response was case dependent (30%–88%, p=0.001). In 25 cases, both the situation and the background cues were communicated. Of these, physicians acted appropriately regarding the situation cue in 72% (18/25). There was no association between nurses' use of a problem-specific SBAR form and the appropriateness of physicians' actions (p=0.5 for the situation cues, p=0.14 for the background cues). Online supplementary appendix D presents examples of various errors encountered in physicians' responses.

After controlling for the differences between subjects and cases, better performance regarding the situation cue was associated with a more active inquiry by the doctor regarding background information (p<0.001, table 3). Communication of the background cue was not associated with a significant improvement of physician performance regarding the situation cue (p=0.41); however, the sample size was small.

DISCUSSION

In nearly half of the cases (34/79, 43%), physicians failed to recognise and respond to the presentation of common serious clinical situations (eg, change in mental status, high potassium level). In a significant minority of cases (7/25, 28%), physicians failed to address the reason for the call even when presented with both the situation and background cues (eg, failing to address a case of an acute confusion despite the nurse's description of a patient with a behavioural change and a low sodium level). In over half of the cases (16/31, 52%), physicians failed to identify and treat the cause for the clinical condition. This was observed when the background cue involved non-trivial knowledge (eg, tacrolimus associated with high potassium levels) as well as when the knowledge was straightforward (eg, persistent fever in a patient who underwent surgery recently). Failure to communicate the necessary information accounted for a minority of the missed situation cues. On the other hand, inadequate reporting of information accounted for the majority of missed background cues. When nurses did not report the cues, physicians often failed to elicit

Table 2 Rates of provided cues and appropriate actions

Scenario	Situation cue provided	Appropriate actions*	Background cue provided	Appropriate actions*
Behaviour (confusion) (n=17)	100% (17)	88% (15)	53% (8)	75% (6)
Chest pain (n=15)	87% (13)	54% (7)	None	None
Fever (n=17)	77% (13)	31% (4)	30% (5)	20% (1)
Glucose (n=19)	90% (17)	30% (5)	26% (5)	20% (1)
High blood pressure† (n=20)	None	None	45% (6)	67% (4)
Medication (n=20)	95% (19)	74% (14)	35% (7)	43% (3)
Total	90% (79/88)	57% (45)	33% (31/93)	48% (15)

*Percentages presented are from the cases in which the cue was provided.
†The 'High Blood Pressure' and 'Chest Pain' cases had only one cue.

Table 3 Call properties: comparison of appropriate to inappropriate actions

Call properties	Situation inappropriate action* (n=34)	Situation appropriate action* (n=45)	p Value	Background inappropriate action* (n=16)	Background appropriate action* (n=15)	p Value
Information communicated regarding the patient's situation (other than the situation cue)						
Time to state reason for call (s)	44±117	36±39	0.60	84±164	27±29	0.21
Total no. of situation data items	2.3±0.8	2.8±0.8	0.32	2.6±1.0	2.7±1.0	0.64
Independently provided by the nurse	2.2±0.8	2.7±0.8	0.12	2.5±1.0	2.6±0.9	0.75
Situation data items physician asked about	0.1±0.3	0.1±0.2	0.32	0.2±0.5	0.3±0.7	0.47
Information communicated regarding patient's background (other than the background cue)						
Total no. of background data items	5.6±1.9	6.4±2.9	0.92	7.2±2.6	6.8±2.4	0.22
Independently provided by the nurse	4.8±1.9	5.0±2.9	0.41	6.2±2.9	5.3±2.2	0.13
Background data items physician asked about	0.7±1.1	1.3±1.5	<0.001	0.9±1.4	1.4±1.8	0.59
Wrong information reported	9% (3)	9% (4)	0.20	6% (1)	7% (1)	0.96
Reason for admission	88% (30)	87% (39)	0.81	100% (16)	87% (13)	NS†
Medical history	88% (30)	80% (36)	0.90	100% (16)	87% (13)	NS†
Home medications	12% (4)	22% (10)	0.80	44% (7)	40% (6)	0.84
Associated signs and symptoms	35% (12)	18% (8)	0.94	31% (5)	20% (3)	NS†
Vital signs	24% (8)	40% (18)	0.98	50% (8)	40% (6)	0.62
Nurse gave an assessment/recommendation	24% (8)	27% (12)	0.98	18% (3)	28% (5)	
Nurse gave a correct assessment/recommendation	6% (2)	16% (7)	0.34†	6% (1)	33% (5)	0.34
Length of talk (min)	3.5±2.4	6.1±3.6	0.04‡	5.6±2.4	6.3±4.5	0.58

Communication of data items (other than the cues) regarding the patient's situation (eg, patient identification and location, whether the problem was urgent) and the patient's background (eg, reason for hospitalisation, prior medical history, vital signs, medication).
When applicable values are mean±SD.
*Regardless of whether the background cue was communicated.
†Non-significant—statistical analysis not feasible due to a small number of observations.
‡Non-significant due to the number of variables evaluated (ie, type I error inflation).

the relevant information. Appropriate action regarding the situation cue was associated with active inquiry by the physician ($p<0.001$).

Our study has several limitations. First, we evaluated only a limited number of non-trivial clinical scenarios. All cases were based on real patients, concerned the most common after-hours clinical problems and our experts considered the diagnostic challenge in each of these to be typical of those encountered in routine care. Nonetheless, it is possible that some of the cases were challenging resulting in a pessimistic estimation of physician performance. On the other hand, to reduce the possible bias from case selection, and since it is difficult to precisely define 'appropriate response,' we used unrealistically lenient evaluation measures based on an objective list of published indicators. These measures may have resulted in an over-optimistic estimation of performance. Consequently, we could not quantitate the risk to patient safety posed by after-hours calls. Notably, our objective was not to quantify the extent of errors, but rather to evaluate the critical thinking of physicians following the communication of key information in this setting.

A second limitation is that when designing the study, we did not anticipate that nurses would often not communicate important cues, in particular, background cues. Thus, we did not have adequate statistical power to compare physician performance when given all required information (ie, both the situation and the background cues) with cases with missing information. However, a practicing physician is expected to elicit the necessary information from the reporting nurse. This was clearly not observed in our study.

A final limitation stems from conducting this study in a laboratory environment. Nurses and physicians had no prior knowledge of the patients. Further, nurses could not see the patients and were therefore deprived of important information. We cannot exclude the possibility that nurses would have acted differently when an actual physical patient was present for their evaluation and when actual patients depended on their actions. On the other hand, unlike real life settings, nurses were afforded ample time to review the patients' records in a distraction-free environment, and physicians were not sleep deprived when responding to the call.

Why were physicians erring?

The observation that in almost half of the cases physicians failed to act upon the information provided to them is very worrisome. These were common cases (in particular the situation cues), presented to highly

trained physicians and evaluated against unrealistically lenient criteria.

In the following section, we discuss possible reasons for failure in the different cases. As was found in previous studies, the majority of errors we witnessed could be attributed to problems with cognitive processes.[19–21] These include lack of knowledge, failure to recognise the significance of data or failure to synthesise all available data supporting the correct diagnosis (see online supplementary appendix D). In the case of persistent fever and several loose stools for example, 78% of physicians considered the diagnosis of *C difficile* colitis, yet only 31% considered the possibility of other hospital acquired infections. This demonstrates an anchoring effect and how a single detail (eg, loose stools) can focus even the most experienced physicians on a wrong diagnosis.[22] Interestingly, there were no other data to support the diagnosis of *C difficile* colitis (overt diarrhoea, leucocytosis, etc), but it seems that once physicians formulated a diagnosis they stopped searching for additional information (premature closure).[23]

In the Chest Pain case, despite a very suggestive description, only 54% of physicians entertained the possibility of a pulmonary embolus (PE). While similar rates have been cited in the literature,[24] we believe that in this case the reason for the error was a diagnosis momentum. The patient had a previous history of congestive heart failure and evaluated as such, despite a lack of other findings to support the diagnosis.[23] Of the eight physicians who did consider the possibility of PE, only four requested an imaging study of the chest, and of these only two noticed the patient suffered from kidney disease and ordered the indicated ventilation/perfusion scan. These results are consistent with known problems with the management of PE.[24]

Problems with clinical judgment (ie, considering all the relevant information but coming to the wrong conclusion)[20] may have been responsible for lack of treatment in 37% of severe low sodium cases (confused patient), 80% of cases in which a hospital acquired infection (fever) was suspected and for prescribing benzodiazepines in 26% of acute liver injury cases (medication); however, this is unlikely as a sole explanation, considering that these were relatively straightforward cases. Further, it is not clear why in 70% of high potassium cases (glucose) and in 41% of acute confusion (behaviour) cases (both, situation cues that were communicated by most nurses), physicians proceeded directly to symptomatic treatment without attempting to identify a cause for the problem.

We suspect that our findings are attributable to the nature of after-hours phone calls rather than any characteristic of the participating professionals. In clinical practice, these calls are made at times when resources are limited and the physicians are often unfamiliar with the patient. It is also possible that there is a cultural component whereby nurses are looking for 'quick fixes' that would decrease their workload, and physicians favour symptomatic treatment that would suffice until morning when the primary physician resumes responsibility.[25]

Mitigating the risk of phone consultations

After-hours phone calls are potentially dangerous due to communication failures, cognitive limitations, and possibly the limited resources and limited responsibility of the on-call physician. Simple interventions, such as problem-specific templates for communicating patient data, may reduce communication failures.[2] Our results show, however, that such interventions are not effective in isolation.[5 26] It seems that improving communication is necessary, but not sufficient to improve outcomes.

Eliminating phone communications would require significant changes in healthcare processes. Alternative solutions might be to provide access to a shared electronic health record (ie, a comprehensive patient record accessible from outside the hospital)[27] or to develop computerised systems designed to support both communication and decision-making. Establishing the necessary knowledge base and developing practical systems will be challenging for multiple reasons. However, identifying the common reasons for after-hours calls as well as common communication and cognitive errors may guide such efforts. More importantly, recognising and documenting the risk to patient safety associated with after-hours phone consultations are a necessary step toward changing the organisational culture to reduce or eliminate the potential of harm associated with these communications.[25] Further research is needed to identify the extent and impact of adverse outcomes associated with care provided over the phone.

CONCLUSIONS

After-hours phone calls are error prone. Both nurse communication and physician decision-making are problematic. Efforts to improve patient safety in this setting must address both communication and decision-making.

Contributors EJ: analysed data, drafted manuscript, revised manuscript. JPT: helped plan the study, was primarily responsible for conducting the experiments, participated in data analysis, currently convalescing from critical illness, and therefore was not available to approve the final manuscript. KOH: helped plan the study, participated in data analysis, helped draft and revise the manuscript. TRJ: helped plan the study, participated in data collection and analysis, helped revise the manuscript. CWJ: helped plan the study, led the data analysis, helped revise the manuscript. EVB: conceived of the study, obtained funding, supervised data collection and analysis, helped draft and revise the manuscript.

Funding This study was funded in part by a grant from the University of Texas System Patient Safety Committee (to EVB, JPT, KOH and TRJ) and by a training fellowship from the Keck Center Computational Cancer Biology Training Program of the Gulf Coast Consortia (CPRIT Grant No. RP101489 to EJ).

Competing interests None.

Ethics approval Committee for the Protection of Human Subjects at the University of Texas Health Science Center at Houston.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Petersen LA, Brennan TA, O'Neil AC, *et al*. Does housestaff discontinuity of care increase the risk for preventable adverse events? *Ann Intern Med* 1994;121:866–72.
2 Bernstam EV, Pancheri KK, Johnson CM, *et al*. Reasons for after-hours calls by hospital floor nurses to on-call physicians. *Jt Comm J Qual Patient Saf* 2007;33:342–9.
3 Tjia J, Mazor KM, Field T, *et al*. Nurse-physician communication in the long-term care setting: perceived barriers and impact on patient safety. *J Patient Saf* 2009;5:145–52.
4 Manojlovich M. Nurse/physician communication through a sensemaking lens: shifting the paradigm to improve patient safety. *Med care* 2010;48:941–6.
5 Joffe E, Turley JP, Hwang KO, *et al*. Evaluation of a problem-specific SBAR tool to improve nurse-physician phone communication in the after-hours setting: a randomized trial. *Jt Comm J Qual Patient Saf* 2013;39:495–501.
6 Riesenberg LA, Leitzsch J, Little BW. Systematic review of handoff mnemonics literature. *Am J Med Qual* 2009;24:196–204.
7 Cohen MD, Hilligoss PB. The published literature on handoffs in hospitals: deficiencies identified in an extensive review. *Qual Saf Health Care* 2010;19:493–7.
8 Haig KM, Sutton S, Whittington J. SBAR: a shared mental model for improving communication between clinicians. *Jt Comm J Qual Patient Saf* 2006;32:167–75.
9 Woodhall LJ, Vertacnik L, McLaughlin M. Implementation of the SBAR communication technique in a tertiary center. *J Emerg Nurs* 2008;34:314–17.
10 Talbot R, Bleetman A. Retention of information by emergency department staff at ambulance handover: do standardized approaches work? *Emerg Med J* 2007;24:539–42.
11 Field T, Tjia J, Mazor K. Randomized trial of a warfarin communication protocol for nursing homes: An SBAR-based approach. *Am J Med* 2011;124:179.e1–7.
12 Marshall SA, Ruedy J. *On Call Principles and Protocols*. 5th edn. Philadelphia: Elsevier, 2011.
13 Basow DS. ed. *UpToDate*. Waltham, MA, 2013.
14 Confusion/decreased level of consciousness. In: Marshall SA, Ruedy J, eds. *On-call principles and protocols*. 5th edn. Philadelphia: Elsevier, 2011:69–81.
15 Francis J, Young BG. Diagnosis of delirium and confusional states. In: Basow DS, ed. UpToDate: Waltham, MA. 2012. http://www.uptodate.com/contents/diagnosis-of-delirium-and-confusional-states (accessed 18 May 2012).
16 Sterns RH. Overview of the treatment of hyponatremia. UpToDate, Basow DS. ed. UpToDate, Waltham, MA. 2012. http://www.uptodate.com/contents/overview-of-the-treatment-of-hyponatremia (accessed 21 May 2012).
17 Dénes J, Keedwell A. *Latin squares and their applications*. New York: Academic Press, 1974.
18 Pan W. Akaike's information criterion in generalized estimating equations. *Biometrics* 2001;57:120–5.
19 Zwaan L, de Bruijne M, Wagner C. Patient record review of the incidence, consequences, and causes of diagnostic adverse events. *Arch Intern Med* 2010;170:1015–21.
20 Graber ML, Franklin N, Gordon R. Diagnostic error in internal medicine. *Arch Intern Med* 2005;165:1493–9.
21 Elstein AS. Thinking about diagnostic thinking: a 30-year perspective. *Adv Health Sci Educ Theory Pract* 2009;14:7–18.
22 Arzy S, Brezis M, Khoury S. Misleading one detail: a preventable mode of diagnostic error? *J Eval Clin Pract* 2009;15:804–6.
23 Croskerry P. The importance of cognitive errors in diagnosis and strategies to minimize them. *Acad Med* 2003;78:775–80.
24 Roy PM, Meyer G, Vielle B, *et al*. Appropriateness of diagnostic management and outcomes of suspected pulmonary embolism. *Ann Intern Med* 2006;144:157–64.
25 Barber N, Rawlins M, Franklin BD. Reducing prescribing error: competence, control, and culture. *Qual Saf Health Care* 2003;12:29i–32.
26 Winters BD, Pham J, Pronovost PJ. Rapid response teams—walk, don't run. *JAMA* 2006;296:1645–7.
27 O'Malley A, Samuel D, Bond A. After-hours care and its coordination with primary care in the US. *J Gen Intern Med* 2012;27:1406–15.

Appendix A: Reason for call (situation cue) – Evaluation criteria

Acute Confusion – evaluation of the differential diagnosis [1,2]

1. Fluid and electrolyte disturbances – asked about or ordered laboratory tests for sodium or calcium.
2. Infections – asked about any of: fever, evidence of infection, WBC; ordered WBC or cultures; ordered antibiotic treatment.
3. Drug or alcohol toxicity/withdrawal – asked about substance abuse.
4. Metabolic disorders (hypoglycemia, thyroid, B12, uremia, liver failure) – asked about history of thyroid disease or renal/liver failure; asked about or ordered one of the laboratory tests for glucose, TSH, Creatinine, liver functions, B12.
5. Low perfusion states / hypoxemia – asked explicitly about signs of shock or oxygen saturation.
6. Postoperative states – asked about recent surgery.
7. Medications – asked about any of: opioids, sleep medications, antipsychotic, antihistamines, lithium, antiepileptic and antidepressants. Acute or subacute brain lesions – requested brain CT or MRI.
8. Requested a physician to come and evaluate the patient in person.

Persistent fever / fever while on antibiotics – evaluation of the differential diagnosis [3’4]

1. Healthcare associated infection – asked about any of: urinary catheter, indwelling intravenous lines, recent hospitalization or antibiotic treatment (C. difficile colitis was excluded from the evaluation - see methods), decubitus ulcer.
2. Wrong antibiotics – requested a broad spectrum antibiotics (merely asking about culture results was not considered an “adequate” management).
3. Antibiotics not reaching its site – asked about the presence of anatomical problems in the urinary tract or ordered an imaging study of the urinary tract.
4. Noninfectious – asked about/mentioned any of: drug fever, cancer, connective tissue disease, hematoma, pancreatitis, pulmonary embolus, myocardial infarction, ischemic colitis.
5. Requested a physician would come and evaluate the patient in person.

Elevated Potassium (Hyperkalemia) - evaluation of the differential diagnosis [5’6]

1. Renal insufficiency – asked about a history of kidney disease or ordered renal function tests.
2. Medication – asked about any of:
    a. ACE inhibitors and angiotensin receptor blockers.
    b. Potassium-sparing diuretics (e.g., Amiloride and Spironolactone).
    c. NSAIDs such as Ibuprofen, Naproxen, or Celecoxib.
    d. The calcineurin inhibitor immunosuppressants Cyclosporin and Tacrolimus.

    e. Trimethoprim.
    f. Pentamidine.

3. Mineralocorticoid deficiency or resistance. Asked about the presence of any of:
    a. Addison's disease.
    b. Aldosterone deficiency.
    c. Some form of congenital adrenal hyperplasia.
    d. Type IV renal tubular acidosis.
    e. Gordon's syndrome.

4. Tissue destruction – asked about any of: rhabdomyolysis, burns or tumor lysis syndrome.
5. Massive blood transfusion or massive hemolysis.
6. Shifts/transport out of cells asked about any of: acidosis (i.e., pH), beta-blocker therapy, digoxin overdose, or the paralyzing agent succinylcholine.
7. Excess intake – asked about KCL treatment.
8. Requested a physician would come and evaluate the patient in person.

Suspected PE – evaluation of the diagnostic work-up [7]

1. Ordered any of: D-Dimer, CT Angiography, V/Q (Ventilation/Perfusion Scan), Ultrasound, pulmonary angiography, or requested a physician would come and evaluate the patient in person.

Request for sleep medication – evaluation of the diagnostic work-up [8]

1. Made sure there was no liver, renal or respiratory failure.
2. Refrained from benzodiazepines (which are contraindicated in liver failure).
3. Made sure there were no interacting medications (i.e., other sedative hypnotic medications).

<u>Treatment for the patient's active problem (background cue) – Evaluation criteria</u>

Hyponatremia/elevated WBC in an acutely confused patient [3, 9]

1. Repeat laboratory work-up and notification of the results.
2. Fluid restriction.
3. I.V. saline.
4. Central nervous system infection – asked about/ordered any of: nuchal rigidity, ordered a lumber puncture (LP) or a head CT and then an LP.
5. Evaluation or orders for infection – ordered any of: chest X-ray, urinalysis, blood cultures, and antibiotic treatment.

Nosocomial fever/fever post back surgery [10,11]

1. Change antibiotics (any change in antibiotics treatment).
2. MRI/CT of the back.
3. Asked about any evidence of infection at the surgical site.

Hyperkalemia due to Tacrolimus [12]

1. Requested Tacrolimus levels.
2. Discontinued/reduced Tacrolimus dose.
3. Requested nephrological consultation.

Hypertension due to Clonidine withdrawal/ fluid overload [13,14]

1. Re-instituted Clonidine treatment.
2. Stopped fluid treatment.
3. Ordered treatment with a diuretic medication.

Request for sleep medication in a patient requiring CPAP treatment[15]

1. Re-instituted CPAP treatment.

References

1 Marshall SA, Ruedy J. *Confusion/decreased level of consciousness. In On-call principles and protocols*. 5th ed. Philadelphia: Saunders 2011.

2 Francis J, Young BG. Diagnosis of delirium and confusional states. UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA. 2012.http://www.uptodate.com/contents/diagnosis-of-delirium-and-confusional-states (accessed 18 May2012).

3 Marshall SA, Ruedy J. *Fever. In: On-call principles and protocols*. 5th ed. Saunders 2011.

4 Zeiger RF. Nosocomial fever. McGraw-Hill's Diagnosaurus 2.0. http://www.accessmedicine.com.ezproxyhost.library.tmc.edu/diag.aspx?code=114422&aid=3324671&searchStr=fever#3324671 (accessed 18 May2012).

5 Rose BD. Causes of hyperkalemia. UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA. 2012.http://www.uptodate.com/contents/causes-of-hyperkalemia

6 Marshall SA, Ruedy J. *Potassium disorders. In: On-call principles and protocols*. 5th ed. Saunders 2011.

7 Thompson TB, Hales CA. Diagnosis of acute pulmonary embolism. UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA. 2012.http://www.uptodate.com/contents/diagnosis-of-acute-pulmonary-embolism?source=search_result&search=pulmonary+embolism&selectedTitle=3~150 (accessed 18 May2012).

8 Marshall SA, Ruedy J. *Hypnotics, laxatives, analgesics and antipyretics. In On-call principles and protocols*. 5th ed. Saunders 2011.

9 Sterns RH. Overview of the treatment of hyponatremia. UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA. 2012.http://www.uptodate.com/contents/overview-of-the-treatment-of-hyponatremia (accessed 21 May2012).

10 Weinstein R. Health Care–Associated Infections. In: Longo D, Fauci A, Kasper D, *et al.*, eds. *Harrison's Principles of Internal Medicine*. New York: McGraw-Hill 2012. 1112–9.

11 Ropper A, Hauser S. Diseases of the Spinal Cord. In: Longo D, Fauci A, Kasper D, *et al.*, eds. *harrison's Principles of Internal Medicine*. New York: McGraw-Hill 2012. 3366–76.

12 FDA. Prescribing information: Prograf (R); Tacrolimus oral capsules, IV injection. Astellas Pharma US, Inc. 2012.http://www.accessdata.fda.gov/drugsatfda_docs/label/2012/050708s038lbl.pdf (accessed 21 May2012).

13 Kaplan NM, Rose BD. Withdrawal syndromes with antihypertensive therapy. UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA. 2012.http://www.uptodate.com/contents/withdrawal-syndromes-with-antihypertensive-therapy (accessed 21 May2012).

14 Kaplan NM. Perioperative management of hypertension. UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA. 2012.http://www.uptodate.com/contents/perioperative-management-of-hypertension (accessed 21 May2012).

15 Kryger MH. Management of obstructive sleep apnea in adults. UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA. 2012.http://www.uptodate.com/contents/management-of-obstructive-sleep-apnea-in-adults (accessed 21 May2012).

SBAR Medication Checklist

Identify & Situation

Introduction and reason for call

- ☐ Name of Practitioner: _____
- ☐ Your Name: _____
- ☐ Your Position: _____
- ☐ Name of Patient: _____
- ☐ Age of Patient: _____
- ☐ Patient Location: _____
- ☐ State Problem: _____
- ☐ Time of Onset: _____
- ☐ Severity: _____
- ☐ State if call is urgent: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Background: Current Status and Pertinent History

Current Status

- ☐ Associated signs & symptoms: _____
- ☐ Current VS + deviation from patient's norm: _____

  _____
- ☐ Current Medications: _____
- ☐ Name, dose, frequency, route of requested medication ordered/requested: _____
- ☐ Indication of ordered/requested medication: _____
- ☐ If call is about a medication order: who ordered the medication and when was the order written: _____
- ☐ Current electrolytes (K^+,NA^+, CO_2, Cl): _____
- ☐ Routine or PRN interventions pertinent to problem: _____

Previous History

- ☐ Reason for Hospitalization: _____
- ☐ Admitting/ Working Diagnosis: _____
- ☐ Past Medical History: _____
- ☐ Previous calls for same problems: _____
- ☐ Drug allergies or adverse reactions: _____

Assessment

State your assessment of the situation

_____

_____

_____

Recommendation / Request

Request or Recommend Intervention

_____

_____

_____

SBAR Blood Glucose Checklist

Identify & Situation

Introduction and reason for call

- ☐ Person Called: _____
- ☐ Your Name: _____
- ☐ Your Position: _____
- ☐ Your Location: _____
- ☐ Name of Patient: _____
- ☐ Age of Patient: _____
- ☐ Patient Location: _____
- ☐ State Problem: _____
- ☐ Time of Onset: _____
- ☐ Severity: _____
- ☐ State if call is urgent: _____

Notes:

Background: Current Status and Pertinent History

Current Status

- ☐ Current Glucose Reading: _____
- ☐ Previous Glucose Reading: _____
- ☐ Associated Signs & Symptoms: _____
- ☐ Current diet: _____
- ☐ Current Electrolytes (K^+, Na^+, CO_2, Cl): _____
- ☐ Current creatinine: _____
- ☐ Current VS + any deviation from patient's norm: _____
- ☐ Current Medications: _____

Pertinent History

- ☐ Reason for Hospitalization: _____
- ☐ Admitting/ Working Diagnosis: _____
- ☐ Past Medical History: _____
- ☐ Chronic/ Pre-hospitalization medications for glucose control: _____
- ☐ Time & Dose of Last Glucose Control Medication (oral hypoglycemic or insulin): _____
- ☐ Presence/Absence of Sliding Scale Insulin Order – date, time, & last dose administered: _____
- ☐ Presence/Absence of missed hypoglycemia dose in past 24 hours: _____
- ☐ Presence/Absence of infusing IV + type of fluid: _____
- ☐ Presence/Absence of labile glucose history: _____
- ☐ Routine or PRN interventions pertinent to problem: _____
- ☐ Mental Status: _____
- ☐ Skin color, temperature, & moistness: _____
- ☐ Previous calls for same problem: _____
- ☐ Drug allergies or adverse reactions: _____

Assessment

State your assessment of the situation

_____

_____

_____

Recommendation / Request

Request or Recommend Intervention

_____

_____

_____

SBAR Elevated BP Checklist

Identify & Situation

Introduction and reason for call

- ☐ Person Called: _____
- ☐ Your Name: _____
- ☐ Your Position: _____
- ☐ Your Location: _____
- ☐ Name of Patient: _____
- ☐ Age of Patient: _____
- ☐ Patient Location: _____
- ☐ State Problem: _____
- ☐ Time of Onset: _____
- ☐ Severity: _____
- ☐ State if call is urgent: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Background: Current Status and Pertinent History

Current Status

- ☐ Associated Signs & Symptoms: _____
- ☐ Current Electrolytes (K^+, Na^+, CO_2, Cl): _____
- ☐ Highest & Lowest BP in past 48 hours – date & time of each reading: _____
- ☐ Current VS + any deviation from patient's norm: _____
- ☐ Current Medications: _____

Previous History

- ☐ Reason for Hospitalization: _____
- ☐ Admitting/ Working Diagnosis: _____
- ☐ Past Medical History: _____
- ☐ Presence/Absence of chronic pre-hospitalization antihypertensive medications or diuretics: _____
- ☐ Presence/ Absence of pain medication administration – date & time of last dose: _____
- ☐ Presence/Absence of infusing IV+ type of fluid: _____
- ☐ Fluid balance over past 24 & 48 hours: _____
- ☐ Routine or PRN interventions pertinent to problem: _____ _____
- ☐ Previous calls for same problem: _____
- ☐ Drug allergies or adverse reactions: _____

Assessment

State your assessment of the situation

- ☐ Presence/Absence of anxiety or agitation: _____
- ☐ Presence/Absence of peripheral edema: _____
- ☐ Presence/Absence of SOB: _____
- ☐ Presence/Absence of pain: _____
- ☐ Assessment of breath sounds: _____

Recommendation / Request

Request or Recommend Intervention

_____

_____

_____

SBAR Elevated Temperature Checklist

Identify & Situation

Introduction and reason for call

- ☐ Person Called: _____
- ☐ Your Name: _____
- ☐ Your Position: _____
- ☐ Your Location: _____
- ☐ Name of Patient: _____
- ☐ Age of Patient: _____
- ☐ Patient Location: _____
- ☐ State Problem: _____
- ☐ Time of Onset: _____
- ☐ Severity: _____
- ☐ State if call is urgent: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Background: Current Status and Pertinent History

Current Status

- ☐ Current temperature & method of measurement (oral, ear, axillary, rectal): _____
- ☐ Temperature high & low reading over past 24 hours + method of measurement (oral, ear, axillary, rectal): _____
- ☐ Associated Signs & Symptoms: _____
- ☐ Skin color, temperature, moisture: _____
- ☐ Presence/Absence of redness, swelling, temperature, tenderness around incision site: _____
- ☐ Presence/ Absence of SOB, chest pain, cough: _____
- ☐ Presence/Absence of calf tenderness/warmth: _____
- ☐ Presence/Absence of difficulty voiding or change in urine color: _____
- ☐ Current VS + any deviation from patient's norm: _____
- ☐ Current Medications: _____

Previous History

- ☐ Reason for Hospitalization: _____
- ☐ Admitting/ Working Diagnosis: _____
- ☐ Past Medical History: _____
- ☐ Presence/Absence of chest X-ray findings & date of X-ray: _____
- ☐ Presence/Absence of antibiotics: _____
- ☐ Presence/Absence of cultures & date of findings: _____
- ☐ Presence/Absence of antipyretic medications & time last administered: _____
- ☐ Routine or PRN interventions pertinent to problem: _____
- ☐ Previous calls for same problem: _____
- ☐ Drug allergies or adverse reactions: _____

Assessment

State your assessment of the situation

_____

_____

_____

Recommendation / Request

Request or Recommend Intervention

_____

_____

_____

SBAR Pain Checklist

Identify & Situation

Introduction and reason for call

- ☐ Person Called: _____
- ☐ Your Name: _____
- ☐ Your Position: _____
- ☐ Your Location: _____
- ☐ Name of Patient: _____
- ☐ Age of Patient: _____
- ☐ Patient Location: _____
- ☐ State Problem: _____
- ☐ Time of Onset: _____
- ☐ Severity: _____
- ☐ State if call is urgent: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Background: Current Status and Pertinent History

Current Status

- ☐ Location of pain: _____
- ☐ Cause of pain: _____
- ☐ Severity of pain: _____
- ☐ Quality of pain: _____
- ☐ Type and duration of pain episodes: _____
- ☐ Presence/Absence of radiation: _____
- ☐ Interventions that relieve pain: _____
- ☐ Factors that exacerbate pain: _____
- ☐ Associated signs & symptoms: _____
- ☐ State pertinent findings from physical assessment of patient: _____
- ☐ Current VS + deviation from patient's norm: _____
- ☐ Current Medications: _____

Pertinent History

- ☐ Reason for Hospitalization: _____
- ☐ Admitting/ Working Diagnosis: _____
- ☐ Past Medical History: _____
- ☐ Pain medications administered, dose, time last administered, patient response: _____
- ☐ Routine or PRN interventions pertinent to problem: _____
- ☐ Previous calls for same problems: _____
- ☐ Drug allergies or adverse reactions: _____

Assessment

State your assessment of the situation

_____

_____

_____

Recommendation / Request

Request or Recommend Intervention

_____

_____

_____

SBAR Behavior Checklist

Identify & Situation

Introduction and reason for call

- ☐ Person Called: _____
- ☐ Your Name: _____
- ☐ Your Position: _____
- ☐ Your Location: _____
- ☐ Name of Patient: _____
- ☐ Age of Patient: _____
- ☐ Patient Location: _____
- ☐ State Problem: _____
- ☐ Time of Onset: _____
- ☐ Severity: _____
- ☐ State if call is urgent: _____

Notes:

Background: Current Status and Pertinent History

Current Status

- ☐ Description of behavior & duration of episode: _____
- ☐ Level of consciousness: _____
- ☐ Presence/Absence of posing harm to self or others: _____
- ☐ Current blood glucose: _____
- ☐ Current Electrolytes (K^+, Na^+, CO_2, Cl): _____
- ☐ Oxygen Saturation Level: _____
- ☐ Comfort aids offered (e.g. backrub, freshening bed, fresh water, toileting, room darkening, etc.): _____
- ☐ Known causes for anxiety of worry: _____
- ☐ Associated Signs & Symptoms: _____
- ☐ Current VS + any deviation from patient's norm: _____
- ☐ Current Medications: _____

Pertinent History

- ☐ Reason for Hospitalization: _____
- ☐ Admitting/ Working Diagnosis: _____
- ☐ Past Medical History: _____
- ☐ Presence/Absence of anxiolytics or sedatives – date & time of last dose: _____
- ☐ Presence/Absence of chronic, pre-hospitalization medications for neuropsychiatric disorders: _____
- ☐ Routine or PRN interventions pertinent to problem: _____
- ☐ Previous calls for same problem: _____
- ☐ Drug allergies or adverse reactions: _____

Assessment

State your assessment of the situation

_____

_____

_____

Recommendation / Request

Request or Recommend Intervention

_____

_____

_____

Appendix C

This is a transcription of one session. Comments (in square brackets) indicate the positions where the situation and background cues were provided as well as communication of situation data elements (SE), background data elements (BE), assessment and plan. Situation and background data elements refer to items listed on the forms (appendix B) and are summarized in table 3.

1. Study coordinator (SC) provides the scenario

    SC: Patient F has become very agitated and pulled out his IV. So the question is what we do about this.

2. The nurse (N) may ask the study coordinator questions while s/he reviews the record.

    N: Does he remain agitated? Is it only a peripheral or a central?

    SC: It's a peripheral.

    N: and I tried putting it back in or has he calmed down? What's the scenario?

    SC: Well the question is what should we do?

    N: Well he has sickle cell crisis. Is he still in crisis?

    SC: I am not really sure.

    N: Is there a separate sheet for the PCA settings? For how much they'd got? On here it only says Dilaudid. There isn't really dosage or anything. So it doesn't really say how much he had gotten over a 24 hours period.

    SC: You can go check the orders.

    N: Can I ask you one more question? So did he stay agitated after he pulled out his IV? Because there is no indication about this other than the sodium level.

    SC: There is a little rambling speech but he is oriented to place and person but not to time.

    N: and is he combative, or just kind of …

    SC: just agitated.

    [Seventeen minutes go by while the nurse reviews the record]

3. Nurse calls physician (D)

D: This is Dr. **** I am returning your page.

N: Hi Dr. **** this is **** **[SE-name of nurse]**. I am calling regarding the University of Texas Nurse Physician communication study. I am calling you about Mr. F. **[SE-name of patient]** He is a 21 years old male patient **[SE-age of patient]**. He has been here for five days. He came in for sickle cell crisis **[BE-reason for hospitalization]**. He was getting fluids and was on Dilaudid PCA, and right now the only thing he is getting is Norco one tablet **[BE-current medications/treatment with sedatives]**. They are to see whether he can get discharged pretty soon. We are giving fluids and we are giving him pain medications. His reticulocytes count was 18.9 and my main issue today **[SE-time of onset]** was that he got agitated and he pulled out one of his IVs **[situation cue provided]** Right now he is alert and oriented to person and place but not to time **[SE-severity]** and he is just rambling a little bit **[BE-level of consciousness/associated signs and symptoms]**. He is not combative and his other vital signs are intact **[BE-presence or absence of posing harm]**. Blood pressure is 122/52, heart rate, 77, temp 98.8 and his respirations in 18 **[BE-current vital signs]**. His Sodium level though is 119 **[background cue provided]**. He came in on day one a little bit hyponatremic and it has been kind of trending down. So today his sodium is 119; his K is 4.4; his creatinine is 0.6; and his glucose was 82; and calcium is 9.0 **[BE-current electrolytes]**.

Doc: What was his sodium on admission? **[Situation cues considered; this was not a consideration of the background cue as hyponatremia should be treated]**

N: The sodium when he came in was 131. His "ins and outs" for the 24 hours total. In was 2260 and out was 2300.

Doc: and what fluids was he getting?

N: He was getting intermittent litters of NS, and yesterday he got two units of RBC because his hemoglobin was 6 and now his hemoglobin is up to 8.1 and his hematocrit is 23.1 **[BE-following a question by the physician]**.

Doc: and he didn't have any complications with that transfusion.

N: No. None noted.

Doc: and how much Dilaudid has he gotten? [**Situation cue considered]**

N: The last time that he got any IV pain medication was …. One second … was yesterday at noon, and then he got one dose of Morphine after that, and the last pain medication that he got was the Norco at two o'clock.

Doc: He has been on a PCA or no?

N: He was. When he came in they had him on a basal and 0.5 demand every 30 minutes, and now they have stopped the basal I believe either yesterday or the day before…one sec…I am sorry. They started the PCA on day 3, so two days ago, and then stopped the basal yesterday. But the only thing he has had today was the Norco. His meds are. The only thing he has gotten, or the medicine that he has been getting are the Dilaudid, Folic acid, 5000 subq Heparin, Prevacid or Lansoprazole and Magoxide. His Mg today was 1.8.

Doc: Ok. So sorry, one quick question. Do you have his 24 hours Dilaudid requirements?

N: Sure. Hold on. Actually, according to this the only thing… He hasn't been getting any Dilaudid since the day before yesterday.

Doc: Ok. All right. And he doesn't look like somnolent from excessive opiates or anything like that. His respiration rate is ok. [**Situation cue considered]**

N: Right. His respiratory rate is 18. I don't have an O2 saturation though **[BE-following specific question; O2 saturation]**.

Doc: Ok. Well, to sort of answer some of your questions, I know that you were concerned whether or not he could be discharged home. No I don't think

N: Right. Clearly.

Doc: that 119 is concerning. And then he is alert an oriented times 2. [**Situation cue considered]**

N: He is.

Doc: He is?

N: He is. He is alert and oriented to person and place.

Doc: Ok. So I do not think he is going to be able to go home. We are going to have to do a workup on his sodium to see what the acute drop was from and then we will go from there and I'll come by and examine him and try to do a neuro exam. I just want to see if there is anything burning. **[Background cue considered – the physician says she will come in to check the patient]**

N: Ok.

Doc: but for now, no I think I am not going to give you any orders over the phone. I am just going to assess him and then we'll go from there. **[Background cue considered]**

N: You don't want to draw any chemistries so that way you can have it when you get here? **[Nurse suggests a plan]**

Doc: These were just done, right?

N: These are from early early this morning. Like the 5 o'clock labs.

Doc: Yeah, I mean and he hasn't gotten any further fluids?

N: No. Just PO intake.

Doc: Yeah, so for now I think that is fine because I don't think that his labs would have changed significantly from five am and he hasn't gotten anything that would potentially change that right now, and he is not having any seizures or anything like that. So there is nothing that we have to do acutely as far as orders that I have to give you now. So I'll just see the patient and then we will go from there.

N: Ok. Sounds good.

Appendix D

The following appendix contains examples of various errors encountered in physicians' responses. Since it is difficult to precisely define "appropriate response" this study used a very lenient measure of "appropriateness", focusing on whether physicians acted upon the communicated information rather than the adequacy of their medical decision. Appendix D, however, includes, descriptions of errors in clinical management (*) and indications of suboptimal management (†), as identified by the reviewer [EJ], that were not part of the studies' evaluation criteria. For example, ordering a wide spectrum penicillin antibiotic for a patient with a healthcare associated infection and a documented allergy to penicillin. Per our evaluation criteria, this was flagged as an "appropriate" response (i.e., the physician considered the communicated information about recent hospitalization and persistent fever under antibiotics), but the clinical decision itself is questionable.

Case	**Remarks**
Behavior	†MD acknowledges that Cerebrovascular Accident (CVA) may have caused the altered mental status, but only asks to reduce the hydromorphone (Dilaudid) and reevaluate.
Behavior	†RN recommends restraints. MD orders computed tomography (CT) and asks about oxygen saturation but no other questions directed at finding the etiology of altered mental status.
Behavior	MD doesn't investigate at all, just orders restraints.
Behavior	†MD acknowledges sodium but only requests repeat labs and focuses on pain control as the reason for altered mental status.
Behavior	MD orders anxiolytic without looking further for etiology of altered mental status.
Behavior	MD notes mental status change and hyponatremia but doesn't looks for an etiology other than opiate overdose (which have actually been discontinued the previous day). The MD does not give any order to address the hyponatremia.
Behavior	†MD doesn't look for an etiology; orders 500cc 0.9% NaCL + furosemide and recheck of sodium in a patient with altered mental status.
Behavior	†MD doesn't ask any questions directed at finding the etiology. Instead proceeds directly to give orders for CT and cultures.
Behavior	MD acknowledges there is a change of mental status but attributes it to sedating medications without inquiring further.
Behavior	MD acknowledges the hyponatremia and elevated white blood cell count, but doesn't order any workup or treatment; orders haloperidol.
Chest Pain	*RN recommends CT Angiogram (CTA) and MD agrees (despite renal failure)
Chest Pain	†MD recognizes the possibility of pulmonary embolism only after the RN stresses the issue.
Chest Pain	*MD orders CTA despite a significant chronic kidney disease.
Fever	RN suggests the pt. might have urinary tract infection (UTI) in addition to kidney stones. MD fails to address the problem.
Fever	*RN mistakenly reports that blood cultures are positive for *S. Aureus.* MD orders Piperacillin/tazobactam (Zosyn) in spite of penicillin allergy. MD did not look for source of fever just ordered therapy (Tx).

Fever	MD only asks for acetaminophen Tx and for liver function tests to make sure the medication is not contraindicated.
Fever	MD states several times that they should check the culture results but never actually asks the nurse to look for them.
Fever	*MD orders vancomycin despite a likely false positive (contaminated) blood culture.
Fever	†MD focuses only on the possibility of Staph sepsis in a health care associated infection. Doesn't check for other possible etiologies.
Fever	†MD asks about cultures and labs but doesn't ask about the medical history directed at finding the etiology.
Fever	†MD asks for a chest x-ray and orders to escalate antibiotic Tx. without inquiring about the medical history of the patient.
Fever	MD acknowledges persistent fever yet doesn't order anything.
Glucose	Very short talk. The MD thinks it is a simple glucose problem even though the reported order is for 50% Dextrose (D50) and insulin
Glucose	MD fails to recognize the connection between the reported order for insulin + D50 and hyperkalemia.
Glucose	MD fails to notice the connection between hyperkalemia and tacrolimus.
HTN	*MD orders a beta blocker for a patient already being treated with non dihydropyridine calcium channel blocker.
HTN	*MD orders increase of diltiazem without inquiring about heart rate.
HTN	*MD orders increase of diltiazem in spite of noticed bradycardia.
HTN	MD inquires about chronic home meds but never gets an answer.
Medication	MD asks only for age and vitals. Asks nothing relevant to contraindication for sleep medications and orders zolpidem.
Medication	RN stresses discontinued Continuous Positive Airway Pressure (CPAP) therapy twice and still MD disregards. MD orders diphenhydramine despite relative contraindication.
Medication	MD orders a benzodiazepine without asking about liver function tests, even though the RN communicated hospitalization for severe acute liver injury.
Medication	MD disregards CPAP even though RN stresses the issue twice. MD orders benzodiazepine in spite of reported hospitalization for acute liver injury.