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Clinical decisions and time since rest break: An analysis of decision fatigue in nurses

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ABSTRACT

Objective: The present study investigates whether nurses working for a national medical telephone helpline show evidence of 'decision fatigue', as measured by a shift from effortful to easier and more conservative decisions as the time since their last rest break increases.

Methods: In an observational, repeated-measures study, data from ~4,000 calls to 150 nurses working for the Scottish NHS 24 medical helpline (37% of the national workforce) were modelled to determine whether the likelihood of a nurse deciding to refer a patient to another health professional the same day (the clinically safest, but most conservative and resource inefficient decision) varied according to the number of calls taken/time elapsed since a nurse's last rest break and/or since the start of shift. Analyses used mixed-effect logistic regression.

Results: For every consecutive call taken since last rest break, the odds of nurses making a conservative management decision (i.e. arranging for callers to see another health professional the same day), increased by 5.5% ($p=.001$, 95% CI: 2.2%, 8.8%), an increase in odds of 20.5% per work hour ($p<.001$, 95% CI: 9.1%, 33.2%) or 49.0% (on average) from immediately after one break to immediately before the next. Decision making was not significantly related to general or cumulative workload (calls or time elapsed since start of shift).

Conclusions: Every consecutive decision that nurses make since their last break produces a predictable shift towards more conservative, and less resource efficient decisions. Theoretical models of cognitive fatigue can elucidate how and why this shift occurs, helping to identify potentially modifiable determinants of patient care.

Keywords: decision making; fatigue; clinical decisions; nurses; efficiency

INTRODUCTION

"We think, each of us, that we're much more rational than we are. And we think that we make our decisions because we have good reasons to make them." Daniel Kahneman (2012)

In order to make decisions about patients, health professionals must take in and weigh up relevant information and make a choice about the most appropriate course of action to take. While it is tempting to believe that the decisions of health professionals are based entirely on logic and a balanced weighing of the information available, human decision-making is susceptible to a wide range of individual, social and environmental influences. In a highly-cited study of judicial decisions, Danziger, Levav and Avnaim-Pesso (2011) studied the parole decisions of court judges over the course of the working day. While the probability of a judge deciding to release a prisoner on parole at the beginning of the day was ~65%, this fell steadily to nearly 0% as time since the start of the court session wore on, returning to ~65% after a food/rest break and again falling steadily to 0% towards the end of the day.

The pattern reported fits with the psychological phenomenon '*decision fatigue*': a state occurring when mental resources become depleted and/or when motivation to exert mental effort declines over time resulting in a measurable shift towards easier, safer, or more gratifying decisions and actions (Pignatiello, Martin & Hickman, 2018). In the judge's case, the 'safest' and therefore mentally easiest option was to maintain the status quo (denying parole); the more depleted judges became, the more likely they were to select this conservative option until an opportunity arose (in the form of a break) to rest and replenish their resources. Since its publication, re-analyses of the original data and data simulation studies have suggested that non-random ordering of cases before judges and/or explicit planning of cases around breaks is likely to explain some or all of the observed effects (Weinshall-Margel & Shapard, 2011; Glockner, 2016). However, the decision fatigue phenomenon has been observed in multiple contexts where such factors are less likely to be an issue.

Exertion-based depletion effects were first observed more than a century ago with Arai (1912) noting in a study of continuous work over time that "…..continued work brings about a decrease in the efficiency of the [mental] function exercised" (p. 114). Depletion effects are evident in a wide range of contexts with people being, for example, more likely to cheat at effortful tasks late in the day (Kouchaki & Smith, 2014), more likely to give up on diets at the end of the day (McKee, Ntoumani & Taylor, 2014), more likely to accept default options at the end of a series of consecutive decisions (Levav, Heitmann, Hermann & Iyengar, 2010) and less able to perform well on cognitive tests later in the day (Sievertsen, Gino & Piovesan, 2016). Within the healthcare context, compliance with hand hygiene protocols declines predictably from the start to the end of shifts (Dai, Milkman, Hofmann & Staats, 2015; Chudleigh, Fletcher & Gould, 2005), gastorenterologists are more likely to detect polyps during morning than afternoon colonoscopies (Chan, Cohen, & Spiegel, 2009), and doctors prescribe more unnecessary antibiotics towards the end than the start of clinic sessions (Linder, Doctor, Friedberg, Reyes Nieva, Birks, Meeker & Fox, 2014).

These decision fatigue effects have been primarily conceptualized as either the result of ‘ego depletion’, that is a decrease in the availability of the mental resources required to exert effortful self-control (Baumeister, Pratlavsky, Muraven & Tice, 1998; Baumeister, 2002), or of a progressive reduction in the motivation required to continue expending effort on the same task (Inzlicht & Schmeichel, 2012; Inzlicht, Schmeichel & Macrae, 2014; Kurzban, Duckworth, Kable & Myers, 2013). Recent registered replication reports (i.e. collections of independently conducted direct replications which follow an identical protocol) find no evidence of the former, self-control specific, ego-depletion effect (Hagger, Chatzisarantis, Alberts, Anggono, Batailler et al, 2016), but, as outlined above, many observational studies demonstrate predictable changes in behaviour and decision-making over time that are compatible with the motivational account (Danziger et al, 2011; Sievertsen et al, 2016; Dai et al, 2015). Within the context of nursing, research which directly contrasts these opposing accounts of fatigue finds motivational factors (perceived reward, perceived control) but not indicators of remaining resource (energy expenditure, work demands) to be consistently related to subjectively experienced fatigue over the working day (Johnston, Allan, Powell, Jones, Farquharson et al, 2018). However, this work looks only at the subjective fatigue reported by nurses and not at any potentially clinically relevant consequences of that fatigue.

Both resource and motivational models would predict that decision fatigue should arise as a result of progressive increases in uninterrupted ‘time on task' and consequently, that fatigue effects would be apparent in situations where consecutive decisions are made without a break. Large numbers of consecutive decisions are made in frontline healthcare services where health professionals must make appropriate diagnostic and treatment decisions about a series of patients in turn. Consequently, any systematic changes in decision processes within this context would have clear implications for service provision (Pignatiello, Martin & Hickman Jr, 2018). Furthermore, as the most important predictors of patient outcomes in any clinical context are likely to be fixed (e.g. severity of health condition), identifying new and potentially modifiable theoretical determinants of these outcomes is important.

The present paper investigates the presence and extent of decision fatigue effects in the healthcare context, specifically testing whether the number of decisions made by health professionals since a break is, as predicted by theory, associated with a predictable shift towards more conservative (and therefore more expensive and less efficient) decisions. The study focuses on nurses working for the NHS 24 telephone helpline, an NHS Scotland wide service in which nurses assess callers' reported symptoms, make decisions about the most appropriate course of action to take, and direct callers onto primary or secondary care services where required. NHS 24 nurses deal with large numbers of cases and make many decisions each day. Importantly for the current research, unlike the judges in Danziger et al's study, nurses in the present study had no control over, or advance knowledge of, the content of incoming calls and limited control over the timing of their breaks, enabling a more robust test of the decision fatigue hypothesis. Using data from ~4,000 real clinical decisions made by 150 nurses, the likelihood of different decisions occurring is modelled from the beginning of a shift, up to and following breaks during each shift. In line with theoretical accounts of decision fatigue, it is expected that nurses will become increasingly likely to make ‘safer’ and ‘easier’ (i.e. more conservative) treatment and management decisions the more decisions they have made since their last break.

The present study tests two hypotheses. The **decision fatigue hypothesis** predicts that nurses will become increasingly likely to make conservative decisions the more uninterrupted time they have spent ‘on task’ within each work shift. If this hypothesis is correct, nurses should make increasingly conservative decisions the more consecutive decisions they have made and/or the more time that has passed *since their last break* (or in the case of the period prior to the first break of day, since they started their shift). A critical prediction of this hypothesis is that any shift in decision making will occur as a function of time/decisions since last break rather than time elapsed/decisions made in total over the working day as breaks represent the theorised opportunity to replenish motivational and/or cognitive resources. To confirm that any effect detected relates specifically to time/decisions *since break*, a second hypothesis -the **general work hypothesis** -is also tested to determine whether decision making changes predictably over the working day as whole irrespective of opportunities to replenish motivational and/or cognitive resources (i.e. breaks). If this general hypothesis is correct, nurses should become increasingly likely to make conservative decisions the more consecutive decisions they have made and/or the more time that has passed in total *since the start of their shift* (regardless of breaks or time spent 'off-task').

Each hypothesis is tested in our models with both number of decisions and time elapsed as predictors. This results in four planned analyses. Specifically, the likelihood that nurses would direct callers to another health professional within 12 hours (the most conservative decision) is modelled in relation to (1) the number of consecutive decisions made/calls taken since the last break (or start of shift if prior to first break), (2) time since last break (or start of shift if prior to first break), (3) decisions made/calls taken in total since the start of shift regardless of breaks, and (4) total time spent at work since the start of shift regardless of breaks.

METHODS

Design and setting

In a within-person, repeated measures study, data were collected on the timing and number of calls and decisions made by nurses assessing callers to the NHS 24 telephone service. NHS 24 is a nurse-led telephone (and now online) advice service operating across Scotland and designed to provide >5 million members of the public with 24 hour access, 365 days a year, to health services and information. Data for the present study were collected during a comprehensive evaluation of the possible determinants and consequences of stress in nurses working for the NHS 24 service between 2008 and 2010. The original parent study included physiological, behavioural and cognitive measures collected in real time over two full working shifts in addition to information about the calls received by nurses during the measurement period. The study protocol (Allan, Farquharson, Choudhary, Johnston, Jones & Johnston, 2009) gives full details of these measures. Only methodological information of relevance to the present study is presented here. The study was reviewed and ethically approved by the NHS North of Scotland Research Ethics Committee (05/S0801/136).

Participants and recruitment

All 465 nurses working in the four main NHS 24 call centres nationally or in any of the 11 associated integrated local call centres were contacted with study information and invited to take part in the study. Those interested in participating (n=171 / 37% of the national workforce) returned a signed consent form and arranged suitable shifts for participation. Four participants were excluded (as they were taking medication that would interfere with heart rate recordings taken in the main study), two participants withdrew, it was not possible to schedule data collection with thirteen further participants and data was not available for an additional two participants. This resulted in a final sample of 150 participants (*M* age = 44 years, *SD* = 7.5). Most participants were female (*n* = 142, representative of the gender split in this workforce) and were employed in seven different call centres across Scotland. Participants worked an average of 22.6 hours per week (*SD* = 10.4), had been qualified for an average of 21 years (*SD* = 8.3) and had been employed by NHS 24 for an average of 3.5 years (*SD* = 2.6).

Procedure

Participating nurses were asked to identify two ‘typical’ shifts from their next month’s rota where they would be available for participation and where they would not be engaging in any non-standard activities (e.g. training, away days etc). Data were collected on all calls received by each of the 150 participating nurses over these two full working shifts. Call timing (time of day at which call was taken) and duration (length of call in minutes/seconds) were automatically recorded, and call outcomes (ambulance call-out, GP referral, self-care, information provided, etc. see Table 1) were recorded by the nurse. Most calls to the service are incoming (i.e. a standard call received from a member of the public who has dialled the service or been routed from their GPs number). However, during times of peak demand, urgent calls are prioritised and less urgent calls are queued and returned by nurses later, resulting in outgoing calls. Outgoing calls were excluded from the present analysis as in these cases, nurses know in advance that the call is likely to be non-urgent. Decision making within the service is supported by computerized decision algorithms which highlight additional questions that nurses may wish to ask /conditions that should be considered in response to particular symptoms but in each case, the final decision on treatment / management is made by an individual nurse.

Data Coding

Call outcomes - decisions taken by the nurse on which service the patient is referred to and with what level of urgency - were classified as either conservative (i.e. clinically safest and cognitively easier decisions) or not. All decisions where the patient was advised to urgently seek, or was directly referred to primary or secondary care within 12 hours via an urgent as opposed to routine pathway were conceptualized as the conservative option: in these cases, callers would be assessed by at least two health professionals (the NHS 24 nurse and a primary/secondary care practitioner/first responder) within the same day. As patients in these cases are retained within the healthcare system and are assessed via phone and then again face to face the same day, this was deemed the safest option clinically. Such decisions are also cognitively 'easier' as nurses do not need to offer detailed information or instructions to the patient, can resolve any uncertainty they feel about the best course of action and can handover final responsibility for treatment and management decisions to another health professional. These calls were compared to all other calls where outcomes reflected less conservative courses of action (where callers were not retained continuously in the healthcare system but were advised to seek primary or secondary care 'within 36 hours', or 'at their leisure').

Breaks from work were classified as any continuous period of 15 minutes or more between consecutive calls as this reflects the minimum standard break length within the NHS 24 service. Outside of official breaks, nurses are required to remain at their stations so that they are 'available for call' and consequently during these times are unlikely to be truly 'off-task'. The position of each call within the sequence of calls received since (i) start of shift; and (ii) the last break was computed as the predictor of interest.

Analysis

The final dataset had a two-level structure with triage decisions made during incoming calls to the service (level-1; *k* = 3,948) nested within individual nurses (level-2; *n* = 150). Nurses' decision making (1 = conservative; 0 = less conservative; as defined above) exhibited meaningful and significant clustering within nurses (ICC = 0.079, SE = 0.017, $p < .001$) and were therefore analysed using two-level mixed-effects logistic regression models. All models included a random intercept, and a fixed effect of shift (first of the two participation shifts = 0; second shift = 1). Since calls at certain times of day may be more likely to involve serious conditions (warranting more urgent responses), all analyses also included time of day (entered as a series of hour of day dummy variables). As participating nurses worked in either one of the larger, main call centres (n=3) or in a smaller, regional call centre (n=4), call centre size was also controlled for in analyses.

To test hypothesis 1 (the decision fatigue hypothesis) two models were estimated with the following fixed effects added: Model (i) number of decisions i.e. calls since last break; and Model (ii) time elapsed in hours since the last break. To test hypothesis 2 (the general work hypothesis) a further two models were estimated, with the following fixed effects added: Model (iii) number of decisions since the start of the shift; and Model (iv) time elapsed in hours since the start of the shift. All analyses were carried out in Stata 15. Statistical significance was set at $\alpha = .05$, corrected for multiple comparisons

(Bonferroni corrected α = .0125).

RESULTS

The participating nurses did not significantly differ from the rest of the NHS 24 workforce in terms of years qualified ($t_{(373)}$ =-0.817, p=0.41), years of employment ($t_{(271)}$ =-0.005, p=0.99), or number of hours worked per week ($t_{(430)}$ =1.14, p=0.25).

During data collection, participating nurses dealt with 5,325 calls in total (mean number of calls per nurse = 35.51; *SD* = 11.72). Of these, 95 calls (1.8%) were coded as ‘refused triage’ meaning that either the call was disconnected before a decision was made, or no decision could be agreed between nurse and patient. As no decision was made during these ‘refused triage’ calls, decisions in these cases were recorded as missing and were not included in the analyses. A further 1,282 calls (24.1%) were outgoing calls and were also excluded from the analyses as nurses in these cases had advance knowledge that the call content was non-urgent. The remaining 3,948 calls were standard incoming calls and were included in the analyses. During these incoming calls, 3,075 (77.9%) of the decisions made were classified as conservative and 873 (22.1%) as not (see Table 1 for a breakdown of call outcomes).

Participating nurses’ shifts were on average 7.09 hours long (SD 1.73) and involved an average of 13.78 incoming calls (SD= 6.82) each lasting an average of 15.04 mins (SD = 6.08). There were 662 observed breaks lasting ≥ 15 mins (mean = 2.30 breaks per shift; *SD* = 1.47. Median break length was

25 minutes (IQR 19-35). The average time from the end of a break (or from the start of shift) to the end of the last call taken prior to the next break (or end of shift) was 2.14 hours (SD=1.12). Nurses took an average of 4.35 incoming calls (SD=3.61) between breaks.

[Table 1 here]

Table 2 presents the fixed effect regression coefficients from all four models where each model controls for time of day, shift (first or second), and size of call centre.

Model i (decisions since break) and ii (time since break) test the **decision fatigue hypothesis**: whether nurses make more conservative decisions the more consecutive decisions they have made and/or the more time that has passed *since their last break*. The Model i results show that for every additional call taken since their last break, the odds of nurses making a conservative decision increased by 5.5% (p = .001, 95% CI: 2.2%, 8.8%). The results for Model ii show a similar effect with time elapsed. The odds of nurses making a conservative decision increase by 20.5% for every hour that passes since the last break (p < .001, 95% CI: 9.1%, 33.2%). This translates to an increase in odds of 49.0% from the first call after one break to the final call taken before the next break (i.e. an average of 2.14 hours later).

Models iii (decisions since start of shift) and iv (time since start of shift), test the **general work hypothesis**: whether nurses simply become more likely to make more conservative decisions with more effort exerted during the whole shift. These models found no effect on decision making of number of calls (decisions) since the start of their shift (p = .529) nor time elapsed since start of shift (p = .766).

[Table 2 here]

DISCUSSION

The present analysis of ~4,000 clinical decisions made by nurses working for the telephone based NHS 24 service, revealed evidence of a predictable, mental-fatigue related bias in clinical decision making. Specifically, nurses made progressively more conservative and therefore more expensive and less efficient decisions as the time and the number of decisions made since their last rest break increased. For every call taken since last break, the odds of nurses recommending a treatment option that involved callers seeing another primary or secondary care professional within 12 hours increased by 5.5%: an increase in odds, on average, of 20.5% an hour or 49.0% from just after one break to just before the next. To convert this into relative probabilities: relative to the first person to call in after a nurse's break, the second caller will be 1.3% more likely to be retained within the healthcare system and seen the same day by another health professional, but the final caller before the next break will be 8.8% more likely to be seen the same day (i.e. a modelled probability of 75.4% immediately after a break, increasing to 82.0% before the next break). This effect appears to be related specifically to the number of decisions made / time that has elapsed *since a nurse's last break* and not to an accumulation of general fatigue as decisions were unaffected by the total number of calls taken or time at work over the shift as a whole.

Theoretical and clinical implications

These results demonstrate that clinical decision makers are not immune to the cognitive biases demonstrated in a range of other settings including law, education and marketing (e.g. Danziger et al, 2011; Sievertsen et al, 2016; Levav et al, 2010). Decision fatigue, i.e. the tendency to become increasingly likely to go for the 'safe', 'default', or 'easy' option as the number of decisions made increases, has long been exploited in the commercial sector. Economic studies, for example, explicitly recommend that high mark-up options be offered to customers late in a series of decisions to increase the likelihood of them being accepted (Levav et al, 2010).

From a theoretical standpoint, the present findings cannot determine whether the observed effects arise as the result of depletion of some general cognitive resource or from a progressive shift in motivation away from current task, but either way, they demonstrate that the effect is tied to the length of continuous episodes of work (i.e. without a break) within a work period rather than to the total or cumulative amount of work over the whole work period.

Within the clinical context, decision fatigue serves to bias decision making in a conservative direction. This is optimal from a patient safety point of view as retaining patients within the healthcare system will maximize the chances that any detectable health conditions are recognised and treated quickly. However, an increased tendency to refer patients to primary or secondary care services within a short time frame may also increase the number of unnecessary investigations carried out, increase patient anxiety, skew patient expectations of care, and make less efficient use of limited resources. Referring large numbers of patients to primary and secondary care undermines one of the core aims of medical telephone helplines. NHS 24 was established by the Scottish Government in 2001 with a vision to "…..reduce the ever increasing burden on existing services" (NHS 24, 2004). Our analysis suggests that health professionals may become increasingly unable to fulfill this vision as time since break increases. Furthermore, it implies that at times when services are under the highest levels of demand, decision making may be least efficient, since at these times, staff may be less likely to take the breaks required to combat decision fatigue.

Importantly, our analysis suggests that it would not be necessary to reduce total workload or shift length in order to reduce the effects of decision fatigue in health professionals. Rather, it suggests that strategic scheduling of (frequent, short) breaks would be the best way to ensure that decision making remains efficient throughout shifts. This may be particularly relevant for those who consciously recognise cognitive changes occurring as previous analyses from the same dataset (Allan, Farquharson, Johnston, Jones, Choudhary & Johnston, 2014) indicate that nurses who report noticing that they are making frequent cognitive failures (slips of attention and memory) are more likely in general to refer callers on to other services.

Much empirical data suggests that breaks from work are restorative, in that they function to reduce, or even reverse, fatigue-related changes in decision making and performance. A study of job performance over four weeks (Binnewies, Sonnetag & Mojza, 2010) found that when people had a chance to fully recover from work demands during the weekend they reported better performance of their core work tasks, were more likely to be proactive and show initiative, and more likely to help others on their return to work. Similarly, Dai et al (2015) demonstrated that while health professionals' compliance with hand hygiene guidelines declined systematically over the course of a 12-hour shift, workers with longer breaks between shifts showed reduced depletion effects. While these studies look at 'breaks' in terms of days off work, recent studies suggest that breaks in the day of 20-30 minutes may be sufficient to completely remove cognitive depletion effects (Sievertsen et al 2016). Similarly, there is some evidence to suggest that even breaks of very short durations (3 minutes) are sufficient to mitigate depletion-related declines in productivity (Dababneh, Swanson & Shell, 2001).

Future Directions

Future research may be usefully focused on identifying optimal patterns of breaks within the working shifts of healthcare professionals. Nursing shifts are typically longer (8-12 hours) than in other professions (Stimpfel, Sloane & Aiken, 2012) and it is possible that multiple short breaks spaced across the working shift (in addition to core meal and rest breaks) would improve rather than reduce service efficiency. Sievertsen et al (2016) conclude in their study of cognitive test performance over the day that the beneficial effect that resulted from a 20-30 minute break was larger than the initial depletion effect, indicating that frequent breaks over the day may actually improve overall performance. Future studies could investigate varying lengths of break, possibly using an experimental design. Clearly, in a demanding and often short staffed NHS setting, the logistical reality of providing staff with frequent breaks is extremely challenging, but the present analysis suggests this is worth exploring. It is estimated that primary care appointments cost the NHS an average of £120 each (NHS Information Services Division, 2012) so it is possible that frequent, short breaks, if they can safely reduce the number of patients being referred onto other services, could be cost effective.

For further development of theory, it is important to investigate whether decision fatigue effects are indeed the result of progressive shifts in motivation away from the current task. If so, then strategic incentives or scheduled changes between different tasks may mitigate the effects.

Finally, the present study focused on telephone based nurses who are largely sedentary during working hours. Future studies should investigate whether decision fatigue is enhanced or ameliorated in physically active, ward-based nurses, that is, whether physical and mental fatigue effects interact.

Strengths and weaknesses

The present study utilises existing data on the timing and outcome of ~4,000 real clinical decisions and the analytical approach allows important theoretical predictions about changes in this clinical decision making to be tested within people over time. As the data replicate the decision fatigue phenomenon observed in other professional groups (judges, GPs), it is likely that the results are generalizable to other occupational settings. In terms of limitations, the present study is observational in nature: it was not possible to experimentally manipulate the timing and frequency of breaks. In addition, as data on call content was not available, it was not possible to determine whether the observed shift towards more conservative decisions was clinically less 'appropriate'. While similar studies indicate that clinicians' decision making does become less appropriate over time (Linder et al, 2014), this could not be tested directly in the present study. Finally, breaks were identified as any period of >15 minutes between calls. While all such periods reflect a break from active work, this method of classification is likely to include both officially designated breaks where nurses are completely 'off-task' and periods of inactivity at the workstation while still 'available for call'. The opportunities to rest and recuperate from work may be reduced in the latter case and consequently, the reported results may underestimate the magnitude of any effect of breaks on decision making.

In conclusion, every consecutive decision that occurs, or hour that passes since a break, produces a predictable and measurable change in nurses' decision making that may function to gradually reduce service efficiency over the working day. Future research should focus on identifying an optimal pattern of breaks to minimize these effects.

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Table 1. Descriptive data on calls

Decision taken by nurse	Frequency (n)
Referral within 12 hours (conservative) - Total	3075
Ambulance sent	390
Urgently attend accident & emergency	277
Urgently attend GP surgery	2382
Urgently speak to GP	17
Other[a]	9
Referral outside 12 hour window (less conservative)- Total	873
Attend GP surgery	320
Speak to GP	3
Information provided	176
Self-care advised	237
Other[b]	137
Refused Triage	95
Total calls handled	4043

[a] Other conservative referrals included to pharmacist, dentist, midwife, primary care emergency centre

[b] Other less conservative referrals included to pharmacist, dentist, midwife, health visitor, public health nurse, police, optician, breathing space (mental health) or poison information service.

Table 2. Mixed effects logistic regressions predicting likelihood of nurses making conservative decisions from (i) number of decisions (calls) since last break, (ii) hours since last break, (iii) number of decisions (calls) since start of shift and (iv) hours since start of shift. Time was entered as a series of dummy hour of day variables and is included in all analyses shown. Complete tables (showing time variables in full) can be found in Supplementary Table S1.

	Odds Ratio	S.E	*p*	95% CI	
				Lower	Upper
Model i					
Decisions Since Break					
Intercept	3.135	0.649	< .001	2.089	4.703
Shift[a]	0.938	0.076	.430	0.801	1.090
Center Type[b]	1.891	0.353	.001	1.311	2.728
Decisions (calls) since break[c]	1.055	0.017	.001	1.022	1.088
McKelvey & Zavoina Pseudo R^2	0.065				
Model ii					
Time Since Break					
Intercept	3.067	0.635	< .001	2.044	4.603
Shift[a]	0.938	0.0766	.425	0.800	1.098
Center Type	1.825	0.344	<.001	1.289	2.668
Time (hrs) since break[c]	1.205	0.061	<.001	1.091	1.332
McKelvey & Zavoina Pseudo R^2	0.066				
Model iii					
Decisions Since Starting					
Intercept	3.410	0.739	< .001	2.230	5.215
Shift[a]	0.933	0.753	.390	0.796	1.093
Center Type	1.836	0.344	.001	1.272	2.651

Decisions (calls) since start of shift	1.006	0.009	.529	0.988	1.023
McKelvey & Zavoina Pseudo R^2	0.060				

Model iv

Time Since Starting

Intercept	3.685	0.841	< .001	2.356	5.765
Shift[a]	0.936	0.076	.412	0.799	1.097
Center Type	1.830	0.343	<.001	1.267	2.643
Time (hrs) since start of shift	0.992	0.026	.766	0.942	1.045
McKelvey & Zavoina Pseudo R^2	0.060				

[a] Shift coded as 0 = shift one, 1 = shift two; [b] center type coded as 0 = three large centers, 1 = four small centers; [c] Since last break, or start of shift if in first call period.