Intervening in interruptions: What exactly is the risk we are trying to manage?

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Intervening in interruptions: What exactly is the risk we are trying to manage?**Abstract**

Interruptions are thought to be significantly associated with medication administration errors. Researchers have tried to reduce medication errors by decreasing or eliminating interruptions. In this paper, we argue that interventions are often (perhaps unreflectively) based on one particular model of risk reduction—that of barriers placed between the source of risk and the object-to-be-protected. Well-intentioned interventions can lead to unanticipated effects because the assumptions created by the risk model are not critically examined. In this paper we review the barrier model and the assumptions it makes about risk and risk reduction/prevention, as well as the model's incompatibility with work in healthcare. We consider how these problems lead to interruptions interventions with unintended negative consequences. Then we examine possible alternatives, *viz.* organising work for high reliability, preventing safety drift, and engineering resilience into the work activity. These all approach risk in different ways, and as such, propose interruptions interventions that are vastly different from interventions based on the barrier model. The purpose of this paper is to encourage a different approach for designing interruptions interventions. Such reflection may help healthcare communities innovate beyond old, ineffective, and often counter-productive interventions to handle interruptions.

Keywords: interruption; medication errors; nurse; high reliability; drift; resilience
engineering

INTERVENING IN INTERRUPTIONS

41 **Introduction**

42 In a recent paper, Dall'Oglio et al¹ studied a set of interventions to prevent workplace
43 interruptions during medication administration. The interventions included yellow sashes
44 worn by nurses, specially marked medication preparation areas, and signs urging patients and
45 families not to interrupt nurses administering medication. This study is the latest of many
46 attempts to reduce medication errors by discouraging interruptions. The idea that workplace
47 interruptions is positively associated with medication errors is supported by other studies in
48 healthcare settings.^{2,3} Data from controlled laboratory studies supports this proposition as
49 well.⁴⁻⁶ Given the association between workplace interruptions and medication errors,
50 researchers have tried to reduce medication errors by decreasing or eliminating
51 interruptions.⁷⁻⁹

52 Like all workplace interventions meant to reduce risk, these attempts make particular
53 assumptions about the nature of work, and about the nature of the risk posed to the work. The
54 effectiveness of these interventions is therefore dependent on the appropriateness of those
55 assumptions. In this paper, we argue that interruptions interventions are generally based on
56 one particular model of risk management, which involves placing barriers between risks and
57 objects-to-be-protected. Utilising this model can lead to unintended consequences as the
58 model imports assumptions, which researchers of interruptions intervention may be unaware
59 of.

60 Interruptions research frequently only examines a limited amount of outcome
61 measures—such as interruptions rate itself.⁷⁻¹¹ In fact, many intervention studies reported
62 unintended consequences – changes to variables other than those intended to be influenced by
63 the intervention. Unintended consequences are reported to include: (a) increase in medication
64 errors (although the statistical significance of this is unknown),¹² (b) increase in staff

INTERVENING IN INTERRUPTIONS

65 interruptions,¹³ (c) low compliance rates,¹⁴ and (d) increase in dissatisfaction among other
66 healthcare practitioners.¹⁵ Unintended consequences, by their very nature, are difficult to
67 rigorously measure and analyse. However, unintended consequences are reported often
68 enough to call into question the viability of interruption interventions.

69 The purpose of this paper is to encourage an active reflection on the possible nature(s)
70 of the risk posed by interruptions that ostensibly has to be managed. We first review the
71 barrier model, its application in interruptions interventions, and arguments against the model.
72 Then we examine possible alternatives to the barrier model and their applicability to
73 interruptions interventions research. These alternatives are: (1) organising work for high
74 reliability, (2) preventing safety drift, and (3) engineering resilience into work activity. These
75 alternatives conceptualise risk in different ways; for example, as weaknesses in social
76 organisation, gradual normalisation of deviant practices, or a level of behaviour variability
77 that is inadequate for responding to conditions outside the learned routine. None of these
78 alternatives lends itself (or is even responsive) to putting a barrier in place. They therefore
79 call into question current views about the risk posed by interruptions, and the means of
80 managing that risk.

81 **Barrier Model and its Prevalence in Interruptions Interventions**

82 The barrier model suggests that safety is achievable if barricades are placed between
83 sources of risk (e.g. interruptions) and areas of vulnerability (e.g. nurses who are
84 administering medication).¹⁶ In a critical analysis of the barrier model, Hollnagel¹⁷ indicated
85 that barriers can be physical, functional, symbolic, or incorporeal in nature. The interruptions
86 literature contains many examples of all four barrier archetypes.

87 Physical barriers achieve safety by materially blocking the transportation of mass,
88 energy, or information from one place to another. In interruptions interventions research, this

INTERVENING IN INTERRUPTIONS

89 takes the form of having nurses close the door to a patient's room to create a temporary quiet
90 space where interruptions (i.e. transportation of information) are blocked.¹⁸ Another form is a
91 dedicated room for medication preparations.^{13,19}

92 Functional barriers impose one or more conditions that have to be met before an
93 action can be taken. For example, some interruptions interventions studies require a secretary
94 to vet phone calls to medication administration nurses to ensure that only urgent phone calls
95 get through.^{10,20–23}

96 Symbolic barriers use signs to convey particular meanings to someone to influence
97 their actions, such as signs and/or some form of clothing with some variance of the phrase
98 “Do Not Disturb” written on them to prevent interruptions.^{1,7,9–14,18,20–22,24–30} Interventions that
99 declare particular areas of a ward to be “No Interruptions Zone” are another example of
100 symbolic barriers.^{1,8,12,20,22,25,30–32}

101 Lastly, incorporeal barriers refer to rules and procedures that block certain actions
102 from being carried out, such as procedures stating that other nurses should not interrupt the
103 nurse who is administering medication.^{18,31}

104 Whereas the barrier model is widely used in interruptions interventions studies, its
105 effectiveness is debatable. Several researchers have argued that stopping workplace
106 interruptions from happening may not be a good idea.^{33–35} Workplace interruptions can offer
107 benefits such as: (a) allowing a healthcare practitioner to gain information, (b) directing
108 attention to patients that need immediate attention, or (c) allowing inexperienced nurses to get
109 help.

110 Through a series of observations and interviews, Klemets and Evjemo³⁶ discovered
111 that whether an interruption is wanted or unwanted depends on many factors, such as the

INTERVENING IN INTERRUPTIONS

context of the nurse being interrupted, and the content of the interruption. Likewise, Colligan and Bass's³⁷ interviews with nurses revealed that nurses considered some interruptions as so important that they should be addressed immediately. To decide if they should attend to an interruption, nurses mentally assess (a) the possible risks, (b) whether it would be more efficient to block the interruption or to attend to it immediately, (c) the context of the interruption and the task that the nurse is currently engaged in, and (d) their past experiences. To decide whether to interrupt, nurses in a further study engaged in a quick cost-benefit analysis to assess the interruptibility of their colleagues, and whether the interruption would add value.³⁴

The above studies indicate that the fundamental barrier-model assumption—that interruptions are a “threat” to “normal work” – does not hold. Interruptions can be unwanted and therefore a potential threat in one context, but wanted (or needed) and therefore not a potential threat in another context. Hence, it makes little sense to classify interruptions as always a threat and use barriers to block them. In the following sections we introduce three alternative safety models and outline their implications for interruptions research.

Organising Work for High Reliability

Organisations that continuously produce successful results despite difficult circumstances with high likelihood of failure are known as High Reliability Organisations (HRO).³⁸ Ideas from HRO research have been implemented in healthcare settings.^{39–41} These ideas have not been applied to interruptions interventions research, but that does not mean they have no relevance.

People working in HROs are said to be sensitive to daily operations, meaning they are perceptive to potential anomalies.⁴² From a HRO perspective, workplace interruptions have the potential to be a source of information that allows people in an organisation to notice

INTERVENING IN INTERRUPTIONS

136 anomalies before these anomalies get out of hand. For instance, nurses in one study revealed
137 that they had sometimes made a subtle recommendation to a colleague when they realised
138 that the colleague was about to commit an error.⁴³ Cases such as these suggest that variables
139 such as *content* of an interruption and *frequency* of interruptions can provide useful
140 information on happenings within a ward. Similarly, a nurse in another study commented on
141 how some interruptions cannot be rejected due to their importance, and that inexperienced
142 nurses may not always understand the importance of these interruptions,⁴⁴ adding weight to
143 the idea that interruptions can be a useful tool for nurses to spot potential anomalies.

144 Individuals within HROs also display a commitment to resilience.⁴² Resilience is
145 defined as the ability of an organisation to either remain in or return to a stable state of
146 operations during or after a crisis (i.e. ensuring that errors do not disable daily operations).⁴⁵
147 In terms of interruptions interventions research, resilience can be developed in nurses through
148 means such as visual timers, which allow nurses to continue to administer intravenous push
149 medications despite interruptions (i.e. remain in a stable state of operations).³² Resilience can
150 also be developed through methods such as reminder signage, which can be used to prompt
151 nurses to check important parameters after an interruptions to ensure that nurses did not miss
152 anything (i.e. return to a stable state of operations).

153 Those working in HROs have the tendency to defer to expertise rather than
154 authority.⁴² In other words, decision-making is pushed to the person who is most suited to
155 make the call, regardless of their place in the hierarchy.⁴⁶ Applying the idea of deference to
156 expertise in interruptions intervention research can mean letting nurses decide for themselves
157 how should interruptions be managed. Since the value of an interruption is dependent on
158 many factors,^{34,36,37} it can be difficult to decide how interruptions should be managed on an a
159 priori basis. Application of a HRO model suggests that we should defer to the expertise of
160 nurses instead. After all, nurses have demonstrated that they have their own interruption-

INTERVENING IN INTERRUPTIONS

161 handling strategies. One such strategy involves holding onto artefacts (e.g. syringes) that are
162 relevant to their primary task while attending to an interruption, so that they will remember to
163 return to the primary task.⁴⁷ Another strategy involves nurses placing marks on medicinal
164 products that they are about to work on, so that they will know where they stopped when they
165 were interrupted.⁴⁸

166 In sum, ideas in HRO research teach us to see interruptions as a potential source of
167 information that allows a ward (or even a hospital) to be sensitive to daily operations and spot
168 anomalies. HRO research also teach us to develop resilience in nurses by providing them
169 with useful tools which allow them to either continue their work despite interruptions, or
170 easily return to their work after an interruption. Lastly, HRO research teach us to consider
171 deferring to the expertise of nurses when it comes to interruptions management.

172 **Managing Safety Drift**

173 Safety drift proposes that individuals in complex systems will make trade-offs to
174 manage goal conflicts, which over time can lead to accidents.⁴⁹ Factors that are speculated to
175 be associated with safety drift include: (a) scarcity, (b) decrementalism, and (c) contribution
176 of the protective structure. Scarcity refers to the lack of resources such as time, while
177 decrementalism refers to reasonable small changes made over time to manage goal conflicts
178 having the potential to cause big events. Contributions of the protective structure refers to
179 policies or guidelines meant to manage risks.

180 For example, a study of drug rounds in a ward observed that several drug rounds often
181 occur simultaneously in the ward, but there was only one set of keys (i.e. scarcity) to access
182 controlled drugs.⁵⁰ The restriction of access to controlled drugs is a form of protective
183 structure. However, such restrictions created goal conflicts among nurses administering
184 medication. A trade-off to manage such conflicts can mean interrupting a colleague who is in

INTERVENING IN INTERRUPTIONS

185 the middle of medication administration. These trade-offs do not always produce a negative
 186 consequence and are generally reasonable (i.e. decrementalism), leading to their
 187 normalisation.⁴⁹ When a nurse does not see any negative consequences stemming from her
 188 interruption of a colleague for the keys, she may assume that interruptions are acceptable and
 189 see no harm in interrupting her colleagues in the future, and continue to do so until an
 190 accident happens.

191 A proposal to reduce the chance of accidents happening due to drifts is to study the
 192 information environment that healthcare practitioners use for decision making, and
 193 understand how the information environment supports and justifies the decisions made.^{51,52}
 194 Nurses have their own rationales for interrupting a colleague, and in deciding whether or not
 195 to accept an interruption. Researchers should learn these rationales and use this information
 196 to design interventions that can support nurses in making better-informed decisions. In
 197 studying nurses' decision-making process and interruptions management methods, Klemets
 198 and Evjemo³⁶ found that nurses were not always well-equipped to judge the urgency of
 199 patients' calls, leading to difficulties in deciding if they should stop their current task to
 200 attend to patients' calls. Therefore, the authors suggest that patients' calls can include some
 201 information regarding the call, allowing nurses to evaluate the urgency of the call.

202 **Engineering Resilience into a Healthcare System**

203 Resilience is defined as the ability for a system (e.g. a hospital) to adjust its
 204 functioning before, during, or after a disruption, to continue performing as required while
 205 facing continuous stresses.⁴⁵ The key concept in the definition of resilience is *adjustment*, not
 206 continued functioning, because continued functioning can be easily achieved through
 207 inefficient means such as stockpiling an absurd amount of resources—for example, having
 208 multiple empty wards in a hospital in case of an emergency. Applying resilience engineering

INTERVENING IN INTERRUPTIONS

209 concepts to interruptions research can mean seeing interruptions either as a disruption, or an
210 adjustment to handle disruptions.

211 If interruptions are seen as a disruption, a resilience engineering approach would
212 entail helping healthcare practitioners continue their primary task despite an interruption, or
213 helping healthcare practitioners to easily return to their primary task after an interruption. As
214 stated in the previous section on organising work for high reliability, developing resilience
215 can take the form of visual timers or reminder signs.³²

216 Another way of viewing interruptions in healthcare is to consider interruptions as a
217 solution to a problem – a way to adjust work. The idea of interruptions as a solution to a
218 problem is backed by some evidence in current interruptions literature and is worth exploring
219 further. For example, a recent study discovered that rate of interruptions increased with
220 doctors' seniority, indicating that interruptions were often used to seek advice from senior
221 doctors.⁵³ Interruptions can also: (a) warn healthcare practitioners of impending negative
222 events,^{35,54} (b) be used to manage operational failures,⁵⁵ (c) bring attention to higher priority
223 tasks,⁵⁶ (d) solve problems such as missing drug keys or other clinical issues,^{34,50} (e) allow
224 information sharing and coordination,^{57–59} (f) create opportunities to educate patients,³² (g)
225 allow work to proceed,³³ and (h) prevent medication errors.^{43,60,61}

226 Rather than asking how interruptions should be prevented or managed, we should be
227 asking why interruptions occur, and if these reasons for occurrences need to be acted upon.
228 For example, if healthcare practitioners are interrupting to prevent medication errors from
229 medical students,⁴³ this may indicate that students either require additional training, or that
230 the curriculum needs to be revised. Conversely, interruptions that are used to seek advice (e.g.
231 bed allocation or patient treatment plan) from senior doctors may not need to be acted upon,⁵³
232 as these interruptions may simply be how work is done in a healthcare setting.

INTERVENING IN INTERRUPTIONS

Conclusion

An association between workplace interruptions and medication errors has led to the development of interventions involving the barrier model.^{7,9,17,25} It is questionable as to whether the barrier model is a good way to approach the issue of workplace interruptions in healthcare, given that such interruptions do provide some benefits,^{33–35} and can be considered valuable in some contexts.^{34,36,37} This paper suggests various alternative safety approaches which may be useful.

Researchers who are considering incorporating high reliability principles into interruptions research can consider means of using workplace interruptions as a potential source of information that enables nurses to notice anomalies. Enhancing nurses' resilience to interruptions by allowing them to remain in a stable state of operations via means such as visual timers is another idea that is worth considering.³² Deferring to the expertise of nurses by letting them decide for themselves how should interruptions be managed is another recommendation of high reliability principles.

If one is interested in reducing the chance of accidents happening via safety drift, they can study nurses' rationale when it comes to interrupting a colleague or deciding whether or not to accept an interruption, and use this information to develop interventions that will support nurses' decision-making process. One plausible idea is to provide nurses with some information regarding an interruption, so that they can make well-educated decisions on whether or not to accept the interruption.³⁶

Researchers who want to engineer resilience into nurses' work can consider enhancing nurses' capacity to manage or recover from an interruption. Alternatively, researchers can see interruptions as a tool nurses use to solve problems, and act on these problems instead.

INTERVENING IN INTERRUPTIONS

256 Like the barrier model, the approaches examined here are not necessarily perfect, nor
257 a perfect match to the intricacies of a particular healthcare workplace. However, these
258 approaches demonstrate that there are viable alternatives to the barrier model. Adopting ideas
259 from different safety models may increase the efficacy of safety interventions. All safety
260 models have their own assumption regarding the nature of work and safety. Without
261 conscious reflection of these assumptions, we risk producing unintended consequences with
262 our interventions.

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INTERVENING IN INTERRUPTIONS

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INTERVENING IN INTERRUPTIONS

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INTERVENING IN INTERRUPTIONS

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INTERVENING IN INTERRUPTIONS

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