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Overconfidence and hygiene non-compliance in hospitals

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Structured Abstract

Context

Among measures to fight hospital acquired infections, an emerging epidemic in many countries around the world, adoption of appropriate hand hygiene practices by healthcare workers is considered a priority. Despite their simplicity and effectiveness, healthcare workers' compliance is poor, with most empirical studies finding compliance rates well below 50% in many countries. Management strategies to increase compliance are often based on the notion that non-compliance is a moral hazard problem, characterized by asymmetric information between hospital management and healthcare workers. In this study, we provide empirical evidence that an individual behavioral characteristic, known as overconfidence, induces many healthcare workers to overestimate their hand hygiene compliance and hence to underperform unknowingly and unintentionally.

Methods

We develop a theoretical model in which measures aimed at overcoming a moral hazard-induced compliance-deficit are shown to be suboptimal or even counterproductive in the presence of overconfidence. In a second step we present results of an experiment with 155 medical students. We elicited general overconfidence by using an incentivized setting and collected additional questionnaire data that contained self-reported levels of hand hygiene from the participants.

Findings

We find substantial overconfidence in hand hygiene compliance among the participants, both in terms of over-placement (particpants believe to comply more often than others) and over-estimation (the assumed individual compliance rates are much higher than actual performance found by studies in hospital settings (Pittet, *2000)). Further results indicate that overconfidence (and under-confidence) might lead to an overestimation of time pressure and a potential negative impact on hand hygiene compliance in stressful situations.*

Conclusion

To conclude, this study provides evidence that overconfidence is a potentially important factor leading to lower than desired hygiene compliance in hospital settings. This factor should not be overlooked when designing measures to increase compliance. Specific measures to address overconfidence in compliance behavior should be explored and tested in future studies.

Keywords: hospital acquired infections, hand hygiene, overconfidence, moral hazard, WHO guidelines

Classification codes: I12, I18, C91

Declarations of interest: none

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I. Introduction

"*No problem in judgement and decision making is more prevalent and more potentially catastrophic than overconfidence*" (Plous, 1993, p. 217).

Hospital acquired infections (HAIs) pose a major, often preventable, threat to hospital patients admitted for reasons other than this infection. Many types of HAIs display antimicrobial resistance, which complicates an effective treatment and poses an increasingly serious threat to global public health (WHO, 2018). HAIs prolong hospital stays, decrease patients' long-term survival and are estimated to cause significant costs to national healthcare systems, e.g. $6.65 billion in the US (Scott, 2009) and £930 million in the UK (Plowman, 2000). At any time in 2005, more than 1.4 million patients were thought to be affected worldwide (Pittet et al., 2006). In high-income countries, 5-15% of hospitalized patients are estimated to have HAIs, with even higher prevalence rates in intensive care units (Pittet et al., 2006).

Among measures to fight against HAIs, adoption of appropriate hand hygiene practices by healthcare workers is considered a priority, championed inter alia by the World Health Organization's pertinent guidelines. Although evidence shows clearly that hand hygiene reduces the transmission of infections (Larson, 1999), healthcare workers' compliance with hand hygiene rules has often persisted below 50% (see Pittet (2000) for an overview). Doctors seem to perform even worse than nurses (Stevens et al., 2013, Wetzker et al., 2016). In response measures to improve hand hygiene compliance have become a major management focus in hospitals during the last decade (Naikoba and Hayward (2001) for an overview of such measures).

Despite growing efforts to improve healthcare workers' compliance with hand hygiene rules, compliance rates remain low. This raises the question how measures should be designed to increase compliance effectively. While previous research has explicitly or implicitly assumed such measures must overcome a moral hazard problem, we postulate that this view neglects a second potentially important source of non-compliance, namely the influence of overconfidence. To fill this gap, the present study investigates the role of overconfidence in hand hygiene compliance first in a theoretical model and then in an experimental study.

Management strategies to increase compliance are often based on the notion that non-compliance is a moral hazard problem, a form of hidden action amid asymmetric information between hospital management and healthcare workers. In this view, healthcare workers' often high marginal opportunity costs of time induce them to cheat, in anticipation that non-compliance may be hard to detect and those responsible for a nosocomial infection unlikely to face punishment. If in reality moral hazard is not the only or major source of non-compliance, measures aiming to reduce moral hazard might fail to increase compliance.

This conjecture is supported by empirical research that shows interventions to improve hand hygiene compliance often have very limited or only short term effects on compliance (Naikoba and Hayward, 2001). Interventions that have been found to be most effective used reminders (e.g. McGuckin et al., 2004; Khatib et al., 1999) and performance feedback (e.g. Mayer et al., 1986; Van de Mortel and Heyman, 1995; Tibbals et al., 1996). Performance feedback is primarily meant to give workers the feeling of being observed. But in addition, feedback can help workers assess their own performance correctly. This in turn may help reduce undesired behavior resulting from an incorrect assessment of own performance, for example an overestimation of own compliance, as predicted by Tversky and Kahnemann's (1974) theory of overconfidence.

There already exists evidence that health workers tend to overestimate their own performance. Studies show that health workers in general and doctors in particular consistently overestimate the actual rate of hygiene compliance (e.g. O'Boyle et al., 2001). Additional evidence exists that doctors are on average overconfident with potentially serious consequences for example in committing diagnostic errors, admitting and disclosing errors (e.g. Brezis et al., 2016; Berner and Graber, 2008). Additional evidence exists that doctors tend to exhibit overconfidence and miscalibration in the assessment of treatments (e.g. Baumann et al., 1991; Alexander and Christakis, 2008). This may lead to diagnostic errors and failure of admitting and disclosing errors (Brezis et al., 2016; Berner and Graber, 2008), thus undermining the reliability and quality of care (Kovacs et al., 2020).

To address the problem of overconfidence in the setting of non-compliance to hand hygiene rules, we first develop a theoretical model in which measures aimed at overcoming a moral hazard-induced compliance-deficit are shown to be suboptimal or even counterproductive in the presence of overconfidence. In a second step we present results of an experiment with 155 medical students. We elicited general overconfidence by using an incentivized setting and collected additional questionnaire data that contained self-reported levels of hand hygiene from themselves and other sub-groups. Prior literature has shown that self-reported levels are positively correlated with the observed level of compliance (O'Boyle et al., 2001). Our experiment was conducted among medical students, i.e. future doctors, as there exists evidence that doctors in particular consistently overestimate the actual rate of hygiene compliance (e.g. O'Boyle et al., 2001) and are on average overconfident (e.g. Brezis et al., 2016; Berner and Graber, 2008). This is especially the case for junior doctors who are often reluctant to consult their supervisors when faced with uncommon circumstances (Swank, 2010). We find substantial overconfidence in compliance among medical students in the sense that they indicated to comply more often than others (fellow students, doctors and medical staff). In addition, the assumed individual compliance rates are much higher (on average 70%) than actual performance found by studies in hospital settings (Pittet, 2000). We further find that participants who correctly assessed their own performance believed that the drop in hygiene compliance during stressful situations is less severe than those individuals who under- or over-estimated their performance.

We develop the theoretical model in Section 2. In Section 3, we develop an experimental survey study with medical students at the University of Kiel and report the empirical findings in Section 4. We discuss these findings in Section 5 and conclude in Section 6.

II. Hygiene non-compliance under moral hazard and overconfidence in a hospital setting – a model of the policy dilemma

To understand local policy and management choices addressing non-compliance with rules of hand hygiene, such as the WHO rules, we assume there is a positive monotonic functional relationship between the rate of hand hygiene, r, and the probability of *not* transmitting an infection, P, by health care workers in a given hospital setting. In the graphical representation of our model, Figure 1, we assume there is a linear one-to-one mapping of r into P, represented by the diagonal from the lower left corner (the origin) into the upper right corner (where r=P=1).

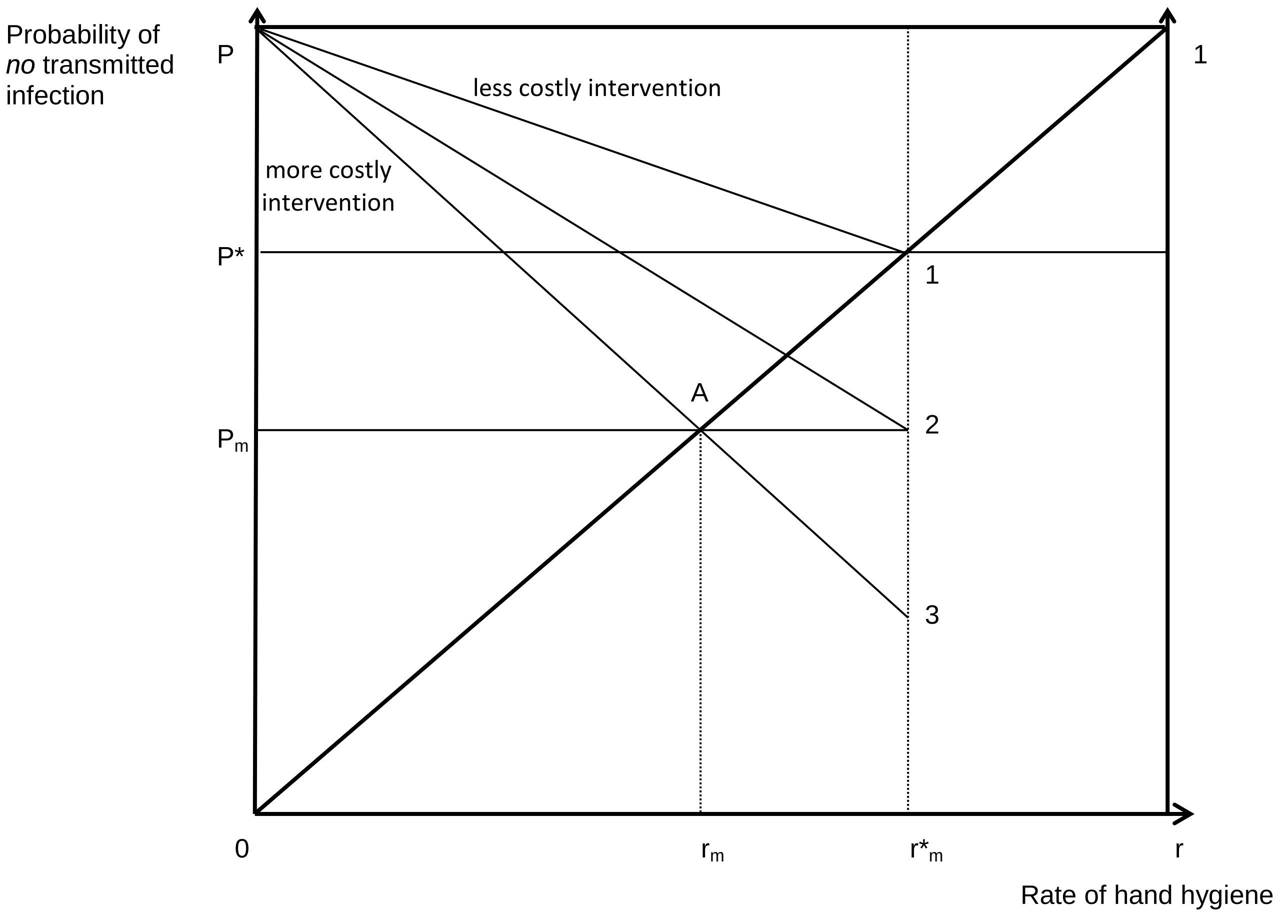


Figure 1: Graphical representation of the model

Taking account health care workers' opportunity cost of time in hand hygiene, we define the minimum acceptable probability of no transmitted infection (or shorter: probability of no infection) as P* < 1. The size of P* will depend primarily on the adverse health consequences to those infected in the absence of health care workers' full compliance with the established hand hygiene rules. The economic value of these consequences, in turn, will depend on people's willingness to pay for avoiding these infections and therefore also – indirectly – on the availability and effectiveness of treatments for the diseases that may be transmitted in the hospital setting. An infectious disease that can be fully cured is less serious and carries lower costs to the infected than one that will result in the victim's death, for example.

P* implies that an optimal rate of hand hygiene, r* < 1, can be defined as a function of P*, such that r* = f(P*). However, the actual P may fall short of P* as P itself is a function of the real rate of hand hygiene, r, and for simplicity, we assume a linear relationship, such that P = r for all $r \in [0, 1]$.

We next define $P_m = (1\text{-}m)\, r^*$ as the reduced probability of no infection in the presence of a moral hazard that – if unaddressed by management – reduces effort by the factor m, with $0 < m < 1$, and leads to the reduced rate of hand hygiene $r_m=(1\text{-}m)\, r^*$. It reflects health workers' belief that cheating – if done in moderation – will not be detected, nor have a significant impact on P if only one worker cheats. This may seem plausible if each patient has contact with multiple health workers along treatment pathways designed to exploit gains from medical specialization, which is a defining characteristic of modern hospitals. In the graph, r_m is mapped via point A into P_m.

The established economic theory of moral hazard – primarily concerned with financial incentives set by a principal to elicit unobserved effort from an agent – has shown that in the case of risk-averse agents, incentives must be balanced against agents' demand for some form of insurance against bad outcomes that are only partially influenced by agents' actions. This seems especially relevant for hospital settings where even the most careful hand hygiene cannot fully guarantee suppression of nosocomial infections, which occur as a stochastic process. The need for insurance generally implies that optimal incentives alone cannot bring about the level of effort that would be optimal in the absence of asymmetric information.

To yield more specific implications for the management of moral hazard in a hospital setting, the principal-agent theory would have to be adapted in several ways. Unlike established models of moral hazard that yield incentive-compatible reward or wage functions linking agents' rewards or wages to the principal's profit, an appropriate model for hospitals would have to specify incentives that are consistent with medical ethics; see for example Phipps-Taylor and Shortell (2016). These ethics are supposed to guide health workers' decision making and financial incentives for specific tasks might be seen as interfering with ethics in undesirable ways, especially since hand hygiene is only one of several means to a more comprehensive end, the curing of patients. Moreover, additional ethical considerations may prevent the hospital from wishing to place a monetary value on the cures produced so that no basis for a conventional incentive-compatible wage function would exist. For a related discussion on the use of theoretical perspectives on patient care, see Grol et al. (2007).

For the purpose of this study, we take as given that improving compliance in hand hygiene by means of financial or non-financial incentives would be costly to the hospital and would not necessarily achieve the same rate of hand hygiene that could be implemented if health workers' behavior were fully observable. Additional or alternative measures, aimed at improving the direct observability of agents' actions, thereby reducing or eliminating the asymmetric distribution of information, would also be costly and generally have limited technical feasibility in hospital settings.

Against this background, a hospital management that does not observe the individual rate of hand hygiene directly – and suspects a moral hazard problem – may responds with a variety of administrative and control measures to an observed increase in infections that exceeds the frequency implied by P*, including some form of penalty for health care workers caught not cleansing their hands. These measures may entail a variety of pecuniary and non-pecuniary costs, such as surveillance costs and loss of trust between health care workers and management. We further assume the hospital management is able to design these measures in such a way that they do not implement hand hygiene rates exceeding r* or that they cease to be enforced once the observed P exceeds P*.

More specifically, the new rate of hand hygiene $\tilde{r}$ that the administrative response implements is, for simplicity, assumed to be determined by a monotonic function of P, which we call the intervention function, such that $\tilde{r} = (1 - P)/c$ for all $\tilde{r} \leq r^*$, where c can be thought of as a measure of the total costs per unit of intended hand hygiene rate increase, i.e. a marginal cost. In the presence of moral hazard with size m, these measures will result in the new rate of hand hygiene $\tilde{r}_m = (1 - P_m)/c \;\; \forall \;\; \tilde{r} \leq r^*$ and $\tilde{r}_m = r^* \;\; \forall \;\; (1 - P_m)/c > r^*$, respectively. Thus, $\tilde{r}_m$ cannot exceed r* because the administrative measures would no longer be active as soon as P exceeds P*. The slope of the intervention function is inversely related to c as long as $(1 - P_m)/c \leq r^*$.

To illustrate the effects of an administrative intervention, we analyze three limiting cases, shown in Figure 1, for the following levels of c:

1. c is just low enough to implement the elimination of any shortfall from P* (represented by the intervention function connecting the upper left corner with point 1 in the graph),

2. c is just low enough to implement the complete elimination of the assumed moral hazard (represented by the intervention function connecting the upper left corner with point 2 in the graph), and

3. c is just high enough to rule out any reduction of the assumed moral hazard (represented by the intervention function connecting the upper left corner with point 3 in the graph),

In case 1, the moral hazard-induced deviation in the hand hygiene rate will be completely eliminated and the optimal rate r* implemented. The same would hold for any intervention function with costs even lower than c in case 1.

In case 2, the moral hazard-induced deviation in the hand hygiene rate will be completely eliminated and the optimal rate r* implemented. Similarly, any intervention function with costs between the costs assumed in cases 1 and 2 would also implement r*. But a smaller moral hazard problem than implied by m would be eliminated only partially.

In case 3, the moral hazard-induced deviation in the hand hygiene rate will remain unchanged at r_m, since the intervention function now maps P_m back to r_m. In a similar vein, any intervention function with costs between those assumed in cases 2 and 3 would eliminate the moral hazard-induced deviation in the hand hygiene rate only partially and fail to implement r*. On the other hand, if c were even higher than in case 3, the intervention function would not be activated since there would be no sufficient gain in the hand hygiene rate to justify the costs of addressing a moral hazard of size m.

To study the overconfidence problem, we augment the model by defining $P_x = (1-x)\ r^*$ as the probability of no infection in the presence of overconfidence, driven by a wedge whose absolute size is proportional to r, with $0 < x < 1$, between the rate r* at which health care workers think they are cleansing their hands and their real rate of hand hygiene, r_x.

In Figure 2, the reduced rate of hand hygiene induced by overconfidence is represented by the hyphenated positively sloped line connecting the origin to the label "overconfidence r." This line represents the overconfidence-induced shortfall in the real rate of hand hygiene, such that for each r intended by an overconfident health care worker, the real r_x is found by first mapping the intended combination of r and P on the 45°-line (horizontally) into the "overconfidence-line" and then from there back into the space of r.

For example, an overconfident worker intending to cleanse his or her hands at the optimal rate r* will really do so at rate r_x found via points 1 and B in the graph. P_x is then found by mapping r_x via point A into P. The overconfidence-line itself does not represent a functional relationship between r and P. This functional relationship remains unchanged.

The graph represents a situation where the overconfidence problem is observationally equivalent to a moral hazard of size m, such that $P_m=P_x$. As before, the hospital management does not observe the real rate of hand hygiene directly and suspects a moral hazard problem whenever it observes infections above the frequency implied by P*. We continue to assume the administrative measures address only the suspected moral hazard, aiming to implement a new rate of hand hygiene $\tilde{r}$ that, for simplicity, is assumed to be a linear function of P, the intervention function, such that $\tilde{r} = (1 - P)/c$, where c can be thought of as a measure of the total costs per unit of intended hand hygiene rate increase, i.e. a marginal cost.

In the case of moral hazard, these measures would result in the new rate of hand hygiene $\tilde{r}_m = (1 - P_m)/c$, as before, but in the case of overconfidence, the new hand hygiene rate will only be $\tilde{r}_x = (1 - x)(1 - P_x)/c$ since health care workers' response itself will be subject to – unobserved and uncorrected – overconfidence so that the real rate will again fall short of the intended rate by the factor (1-x).

To illustrate the differential effects of an administrative intervention contingent on whether P has been induced by moral hazard and overconfidence, we again look at the same three limiting cases for different levels of c, as before:

1. c is just low enough to implement the elimination of any moral hazard-induced shortfall from P* (represented by the intervention function connecting the upper left corner with point 1 in the graph),

2. c is just low enough to implement the complete elimination of the assumed moral hazard (represented by the intervention function connecting the upper left corner with point 2 in the graph), and

3. c is just high enough to rule out any reduction of moral hazard (represented by the intervention function connecting the upper left corner with point 3 in the graph).

In case 1, a moral hazard-induced deviation in the hand hygiene rate would be completely eliminated and the optimal rate r* implemented. But if the same P is caused by overconfidence instead of moral hazard, the intervention would leave the real rate of hand hygiene unchanged, resulting in the same probability of no infection as before.

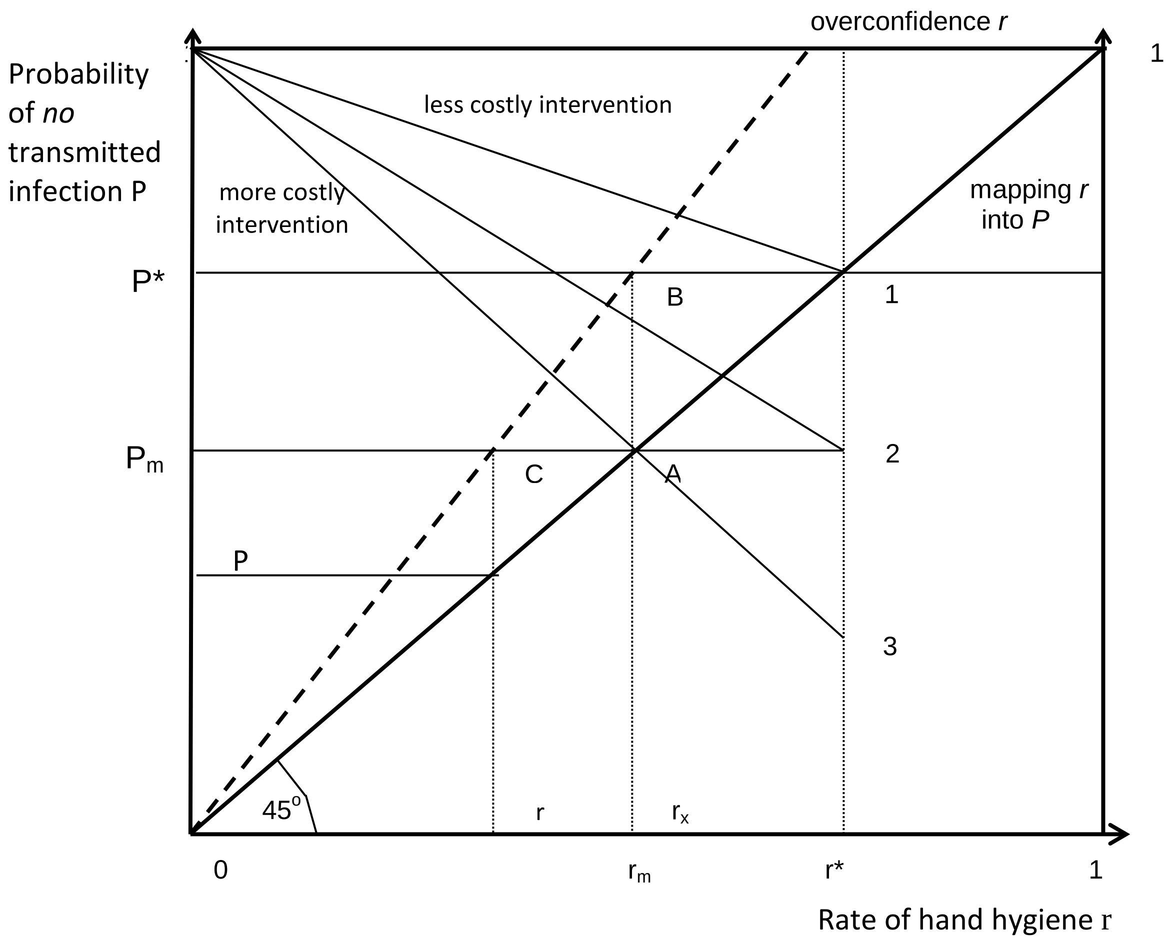


Figure 2: Model including Moral Hazard and Over-confidence (dashed line)

In case 2, a moral hazard-induced deviation in the hand hygiene rate would again be completely eliminated and the optimal rate r* implemented. And again, if the same P is caused by overconfidence instead of moral hazard, the intervention would leave the real rate of hand hygiene unchanged, resulting in the same probability of no infection as before.

In case 3, a moral hazard-induced deviation in the hand hygiene rate would remain unchanged at r_m, since the intervention function maps P_m back to r_m. But if the same observed P, at P_m in the graph, were caused by overconfidence instead of moral hazard, the moral hazard-motivated intervention would now cause the real rate of hand hygiene to fall even further, to r_{x2} in the graph, found via points A and C, resulting in an even lower probability of no infection than before, at P_{x2}. The rate r_{x2} is reached because overconfidence remaps r_m via points A and C into r_{x2}.

Within our model, the administration has no way to eliminate or even reduce an overconfidence problem by measures addressing the perceived moral hazard problem, given that the administrative measures do not implement a higher rate of hand hygiene than r*, the optimal rate given health care workers' opportunity cost of time.

Moreover, the model suggests that policies or administrative interventions aimed at eliminating a moral hazard-induced shortfall from the optimal hand hygiene rate may not only be ineffective, but even counterproductive if the observed shortfall is actually induced by an observationally equivalent overconfidence problem. Our model thus provides a compelling rationale for an empirical study of the impact of moral hazard and overconfidence on hospital hygiene.

Before turning to our empirical study, we note that the intervention function in our analytical model might be specified differently. In particular, it might be questioned why the intervention function is specified for values of P above P* when the hospital management is assumed to activate the intervention function only if the observed P falls short of P*. To illustrate the robustness of our conclusions, the Appendix provides an alternative version of our model in which the intervention function induces only incremental increases in the rate of hand hygiene.

III. Experimental design

To examine empirically whether and to what extent overconfidence and moral hazard may play a role in hand hygiene compliance, we conducted an experimental survey study with 155 medical students asking for their hand hygiene behavior in hospitals.

Subject pool

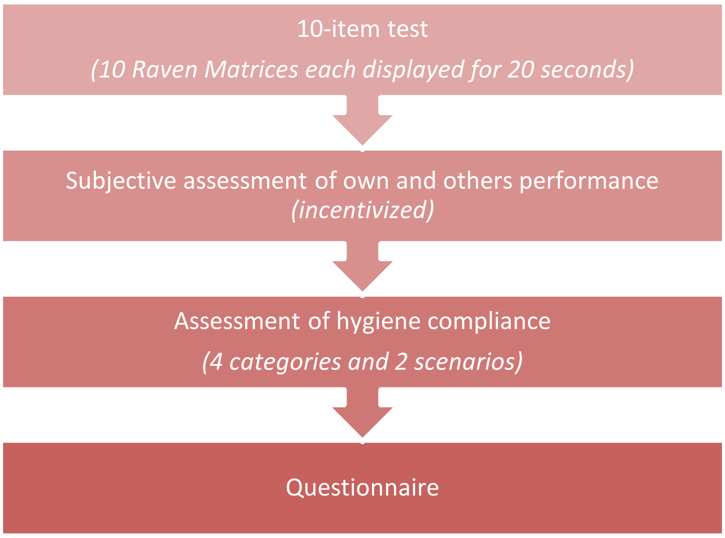
The study was carried out in June 2017 with medical students at the University of Kiel. In total, 155 students (5th-10th semester) took part, of which 104 were women. The average age was 24 years (SD = 3.37). The experiment was conducted during regular lecture time. Students were free to participate and all students present at the time agreed to take part in the study. As common in economic experiments the study was monetarily incentivized. Students had the possibility to earn between €0 and €4 depending on their answers. Average payoff was €1.52. Three sessions were conducted in total and each session lasted about 15 minutes.

Experimental Procedure

The experiment was paper based and was conducted in the lecture room. At the beginning of the experiment students were informed that the evaluation of the study would be anonymous and that inferences of data records on persons and inferences within result reports on individual questionnaires would not be possible. Each student was given a code which was written on each page as well as attached to each questionnaire. Students were also informed that they would have the opportunity to earn up to 4 € in the study and that the payment would be made anonymously at the end of the study. The payoff was conducted using the codes so that no names were elicited at any point.

During the experiment students had to first conduct a test, where they had to find the correct answer for 10-items. Afterwards they were asked to guess their own performance and the performance of others in the test. These guesses were monetarily incentivized and were used afterwards to construct our general overconfidence measure. After collecting the answers and guesses of the test, students were asked to fill out a questionnaire. It was pointed out to the students that most questions had no right or wrong answer and that they should respond intuitively to the questions. In the questionnaire we asked students to assess hygiene compliance in 4 categories (own, medical staff, doctors, fellow students) and in 2 scenarios (during a “normal” and a “busy” work day). We furthermore elicited risk attitudes, attitudes towards the risk of nosocomial infections, the detection probability of transmitting microorganisms and behavioral responses to these probabilities as well as some demographic variables such as gender, age, and semester. We now describe the main variables of interest in more depth. The entire questionnaire can be found in the appendix.

Figure 3: Overview of the Experimental Survey Study



Methods

Overconfidence – To measure general overconfidence students were asked to solve a 10-item test. For each item they had to solve a Raven Matrix, i.e. identify the missing element that completes a pattern. For each item they had 20 seconds time to find the correct answer. Afterwards they were asked how many items they had solved correctly (*guess own*) and how sure they were that their assessment was correct. They were furthermore asked how many items they thought the other participants had answered correctly (*guess others*). As typically done in economic experiments, the assessment of own performance and the performance of others was incentivized. Participants received €2 for each correct assessment payed out at the end of the study. The answers to the questions were used to construct several overconfidence measures.

1. Over-placement measures how participants placed themselves with regard to the other participants. Therefore, we take the difference between *guess own* and *guess others*. If a participant indicated to have scored higher (lower) than other participants, over-placement will be positive (negative). If *guess own* and *guess others* coincided the participant placed

herself as good as the others and the score will be zero. This measure reflects the beliefs of the participants and does not take the actual performance into account.

2. Over-placement corrected takes the actual performance and the placement guess into account. Participants were divided into i) correct assessment of own placement, ii) over-confident which implies that they thought they would be better compared to others but were actually not iii) under-confident which is the case when participants underestimated their own performance in comparison to the performance of others.

3. Over-estimation measures the difference between the participant's *own guess* and her actual performance. A participant is assumed to be over-confident (under-confident) if her guess was higher (lower) than her actual performance, i.e. over-estimation>0 (<0).

Moral hazard – we explored the role of moral hazard in hand hygiene compliance by asking participants about the probability that i) patients or ii) health care worker responsible for transmitting health care-associated pathogens would be detected[1] and, furthermore, whether they believe that the probability of being detected influences iii) their own or iv) other doctors' behavior. Without moral hazard, the detection probability of non-compliance should not play a role in health workers' hand hygiene behavior. In the presence of moral hazard, a higher detection probability should induce a higher rate of hygiene compliance. Interventions to increase compliance should hence involve more checks, controls and documentation of individual behavior.

Hygiene compliance – In order to assess hygiene compliance rates students were asked to assess hygiene compliance in 4 categories (own, medical staff, doctors, fellow students) and in 2 scenarios (during a "normal" and a "busy" work day). First students were requested to imagine a normal day in an hospital and to estimate, in how many percent of cases the "five moments for hand hygiene" (see Appendix 3 for details**Fehler! Verweisquelle konnte nicht gefunden werden.**) are on average complied with by a) themselves, b) medical staff, c) doctors, and d) their fellow students. After several other questions and on a different page, they were asked to do the same assessment for a particularly busy day.

We use these estimated compliance rates to measure overconfidence in hygiene compliance. Given that we do not know the true hygiene compliance rate we can only measure over-

[1] "If insufficient hygiene was the reason for the transmission [of health care-associated pathogens]; how likely do you think it is that one can trace back which employee was responsible for the transmission?" Answer on a scale from 0 (very unlikely) to 5 (very likely)

placement, i.e. measure how participants placed themselves with regard to the other categories. *Over-placement HC* therefore measures the difference between own estimated hygiene compliance and estimated compliance of others (categories b-d). If a participant indicated to comply more often than others *over-placement HC* will be positive. As before this measure reflects the beliefs of the participants and does not take the actual performance into account.

IV. Results

Moral Hazard

To assess the role of moral hazard in hand hygiene compliance, participants were asked whether they believe that the probability of being detected influences their own or other doctors' behavior. The likelihood that the detection probability of transmitting a pathogens influences compliance behavior was rated by the participants as moderate for their own behavior (mean=2.70, SD=1.55) and for that of other doctors (mean=2.97, SD=1.29, measured on a scale from 0–very unlikely to 5-very likely). In both cases the mean is statistically significantly higher than zero (Wilcoxon signrank test, $p<0.001$) which would be the benchmark for no moral hazard. The likelihood of being influenced by the detection probability is slightly higher for other doctors than for participants' own behavior (Wilcoxon signrank test: $z = -2.545$, $p > |z| = 0.0109$). This can be interpreted as a form of overconfidence in the sense that on average participants believed to be less likely to be influenced than others.

On average, participants indicated that the identification probability of the responsible i) patient or ii) health care worker for transmitting pathogens is low (mean patient=1.79, SD=1.18 and mean worker=1.19, SD=1.16 on a scale from 0–very unlikely to 5-very likely). The identification probability has been rated significantly higher for patients than for health care workers (Wilcoxon signrank test: $z = 5.752$, $p > |z| = 0.0000$).[2]

[2] The detection probability and likelihood of being influenced by that probability is positively correlated (correlation coefficient= 0.166, p=0.039). This indicates that those participants who indicated that the probability of being detected is higher also indicated to be more likely influenced by that probability on average.

In a next step, we assess whether the stated detection probability is related to hand hygiene compliance rates. A positive relationship between detection probability and stated compliance rate would be a further indication of moral hazard in the hygiene context. We find, however, that the stated detection probability is uncorrelated with the assessment of own hygiene compliance (see **Table 1**), i.e. that the subjective probability to be detected does not directly influence the assessment of hygiene compliance of our participants.

Table 1: OLS regression with own hygiene compliance as dependent variable and detection probability as independent variable

	Hygiene compliance	Hygiene compliance	Hygiene compliance
Detection probability	-0.624	-0.406	-0.673
	(2.65)	(3.03)	(2.62)
Female		-4.269	-3.618
		(3.78)	(3.59)
Age		0.097	0.085
		(0.60)	(0.62)
Semester		-1.326	-1.365
		(2.00)	(1.83)
Risk taking			1.524*
			(0.42)
Fear of own infection			0.700***
			(0.07)
constant	71.274***	80.047***	70.986***
	(4.82)	(2.83)	(1.90)
No. of Obs.	155	148	148
Adj. R2	-0.005	-0.008	0.005
Prob>F	0.836	-0.008	0.005

* p<0.10, ** p<0.05, *** p<0.010

Overconfidence

Subjective Assessment of Hand Hygiene Compliance

When asked about their compliance with the hand hygiene rules on a normal day in a hospital, participants indicated that they would comply correctly in 70.53 % (SD=18.72) of the cases on average. The compliance of doctors was rated as particularly low at 52.50% (SD=21.21), followed by the medical staff with 56.27% (SD=19.36) and the fellow students with 62.53% (SD=19.68). Thus, we find that on average participants consistently rated their own compliance as higher than that of health care workers in the other categories (p<0.001 for all categories) indicating overconfidence in hand hygiene compliance. Overconfidence is least pronounced compared to fellow students where only 50% of the participants stated to comply more often and 40.6% just as often, while compared with doctors 77% stated to comply more often, respectively 80% compared to medical staff.

Further Results

10-Item Test

In the test we find that subjects in our sample tended to be rather under-confident than over-confident. When asked about own performance 38% of the subjects under-estimated their actual performance, 34% assessed it correctly and 27% over-estimated their performance. The assessment of own performance relative to other subjects performance shows a similar pattern. 41% of the subjects indicated a lower score for themselves than for their fellow students, 36% just as well and 23% indicated to have scored higher than their fellow students.

We find clear gender differences in overconfidence in our data. While the majority of male participants over-estimated their own performance (42%) and rated themselves as being better (36%) or the same (44%) as other participants, the majority of female participants under-estimated their own performance (45%) and ranked their own performance below other participants (51%). These differences are highly statistically significant (over-estimation: Mann-Whitney test z=2.901, P>|z|=0.0037; over-placement: Mann-Whitney test z=2.968, p>|z|=0.0030).

Over-placement in 10-item test correlates with over-placement in hygiene

The data indicates that over-placement in the 10-item test correlates with over-placement in hand hygiene compliance (correlation coefficient = 0.1162, p=0.0414), when the group that subjects compare themselves to is the same (here fellow students). This also holds when including further control variables (see Table 2).

Table 2: OLS regression with over-placement in hygiene compliance as dependent variable and over-placement in the 10-item test as independent

Dependent:	Over-placement in hygiene with regard to fellow students
Over-placement test	3.397**
	(1.46)
Female=1	-2.384
	(2.49)
Age	0.691**
	(0.34)
Semester	-1.671**
	(0.81)
constant	4.813
	(9.25)
No. of Obs.	144
Adj. R2	0.069
Prob>F	0.007

* p<0.10, ** p<0.05, *** p<0.010

Note: Including further control variables, does not substantively alter the coefficients.

Note that in the test comparison is only possible with fellow students, while for hygiene compliance participants were also asked about the performance of general medical staff and doctors.

Overconfidence and time pressure

The participants estimated that there is a significant drop in compliance with hand hygiene regulations under time pressure. When asked about the compliance at a particularly stressful day participants stated that the regulations are consistently followed in less than 50% of cases in all categories. In line with the assessment of a "normal" day participants estimated that doctors comply least (38.81%, SD=22.99), followed by medical staff (40.39%, SD=21.43), fellow students (42.32%, SD=21.28), and themselves (47.58%, SD=22.92). While own compliance remains statistically significantly higher (p<0.001), the differences between the categories are smaller than for those reported for a normal work day.

An interesting pattern arises when looking at the relationship between overconfidence and the difference between estimated hygiene compliance under the "normal" condition and under time pressure. It appears that those individuals who correctly assessed their own performance in the test believe that the drop in hygiene compliance is less severe than those individuals who under- or over-estimated their performance. The regression analysis shows that the difference between those who correctly estimate their performance in the test and those who over-estimate their performance is strictly significantly positive over all groups (see Table 3).

Table 3: OLS regression with difference between hygiene compliance on a normal and a busy day as dependent variable and overconfidence as independent

Dependent variable: Difference between hygiene compliance on a normal and a busy day	Own	Medical Staff	Doctors	Fellow Students
underconfident	4.066	6.204**	3.446	3.378
	(2.92)	(2.73)	(2.75)	(3.05)
correct	Reference group	Reference group	Reference group	Reference group
overconfident	10.088***	9.866***	6.747**	8.779***
	(3.19)	(2.99)	(3.01)	(3.36)
constant	18.692***	10.865***	10.692***	16.346***
	(2.12)	(1.98)	(2.00)	(2.22)
No. of Obs.	151	151	151	150
Adj. R2	0.051	0.060	0.020	0.031
Prob>F	0.008	0.004	0.083	0.035

* p<0.10, ** p<0.05, *** p<0.010

Note: Adding a battery of control variables leaves the coefficients qualitatively unchanged.

V. Discussion

Discussion Moral Hazard

Our findings indicate medical students are aware that hygiene compliance can fall short when a principal lacks means to control it. However, we also find that beliefs about the detection probability do not directly influence the assessment of hand hygiene compliance. Interventions to increase compliance by increasing the detection probability might therefore have limited effect.

As a limitation, we acknowledge that the study design is not ideal for assessing moral hazard, given that the detection probability does not vary exogenously. To assess whether an increase (decrease) in detection probability induces changes in compliance behavior, future studies could (exogenously) vary the beliefs about the detection probability while keeping everything else constant.

Discussion Overconfidence

Overall, our empirical findings indicate that there is substantial overconfidence in hand hygiene compliance among medical students. Given that 90% of the participants indicated to comply more often than or just as often as others (fellow students, doctors and medical staff) we can assume that a substantial share of participants is overconfident with regard to their actual compliance. A second indication of overconfidence is that the assumed individual compliance rates are much higher (on average 70%) than those typically indicated by studies in hospital settings which claim that compliance is lower than 50% (e.g. Pittet, 2000). This is in line with other studies that show health workers in general and doctors in particular consistently overestimate the actual rate of hygiene compliance (e.g. O'Boyle et al., 2001).

In our general overconfidence measure, which was derived from a test not related to hygiene, we do not find that the participants are overconfident in general. However, when we split the sample into women and men, we find that men are on average overconfident, while women are rather under-confident regarding their performance in the test. This gender difference in overconfidence with men being more overconfident than women is a common finding in economic experiments. Given that women are overrepresented in our sample (67% women) and together with the fact that the task was relatively complicated, this might explain our finding in the test. The literature provides supporting evidence that doctors are on average overconfident, which can lead to potentially serious consequences for example in committing diagnostic errors and or admitting and disclosing errors (e.g. Brezis et al., 2016; Berner and Graber, 2008). This can be explained by the fact that overconfidence is linked to an individual's propensity for status seeking (Anderson et al., 2012) and can also be status enhancing (Anderson et al., 2012; Kennedy et al., 2013) which is important for a prestigious profession like doctors. There also exists some evidence of gender differences in self-reported and observed hand hygiene compliance. Zimakoff et al. (1992) report that female health care workers reported higher frequencies of handwashing than their male counterparts. A study with health care workers in a critical care unit by van de Mortel et al. (2001) further found that female doctors washed their hands significantly more often after patient contact than their male counterparts (P = .0468).

We further find that overconfidence in hand hygiene compliance is positively correlated with overconfidence in the 10-item task. This indicates that there is domain generality of overconfidence. Previous findings regarding domain generality of overconfidence are inconsistent. While Glaser et al. (2005) found insignificant and even negative correlations across distinct tasks, West and Stanovich (1997) found some degree of domain generality in their study.

Our results regarding the assessment of hand hygiene compliance under time pressure might have important implications. Time pressure is a much discussed topic in the hospital setting. Health care workers are often under high time pressure, which can lead to a drop in performance (see e.g. Tsiga et al., 2013 or Evans and Kim, 2006). Beyond actual time pressure, the perception of time pressure can also impact performance. Experimental studies have shown, for example, that perceived time pressure leads to a decrease in performance (DeDonno and Semaree, 2008) and to efficiency losses (Kocher and Sutter, 2006; Sutter et al., 2003). A correct assessment of actual time constraints and adequate coping with a limited time budget therefore seem crucial in the context of hand hygiene compliance. Our results indicate that overconfidence might lead to an overestimation of time pressure and a negative impact on hand hygiene compliance in stressful situations among all types of health workers.

While we find that overconfidence contributes to poor hygiene compliance, we cannot distinguish between potential mechanisms that might be at work: 1) individuals have a biased assessment of their actual performance and overestimate their compliance, i.e. their actual performance is lower than they think it is; 2) individuals might underestimate the actual risk of transmitting microorganisms and therefore the need to comply with hygiene rules 3) individuals might think that their own transmission probability is lower than that of others and therefore need to take less precaution. Our experimental study only looks at mechanism 1) and we cannot infer about the other two mechanisms. When designing measures to reduce overconfidence in hygiene compliance, it may be important to know the relative strengths of all three mechanisms in order to design appropriately targeted interventions.

We note that our study is based on self-reported hygiene compliance by medical students. Even though self-reported levels of hand hygiene compliance have been found to be positively correlated with the observed level of compliance (O'Boyle et al., 2001), we cannot infer about the actual compliance of these students or health care workers in general. With this caveat in mind, our study identifies and provides evidence for overconfidence as a potential mechanism that depresses hygiene compliance below the desired level in hospital settings.

VI. Conclusion

Overconfidence among health workers can have a multitude of adverse consequences in the health system, including the transmission of health care-associated pathogens. Our study assesses the role of overconfidence in explaining and preventing low hand hygiene compliance observed in hospitals around the world. Our study contributes to the growing literature on hygiene compliance by highlighting the influence of health workers' often biased assessments of their compliance on actual compliance with rules on hand hygiene, such as the pertinent WHO guidelines.

Previously, low hygiene compliance has often been explained by moral hazard and measures taken by hospital management to reduce non-compliance typically attempt to overcome moral hazard, for example through increased documentation and controls. Less attention has been given to the possibility that health workers might unintentionally comply less than desired because they suffer from biased assessments of their own compliance behavior.

In an illustrative theoretical model, we demonstrate that neglecting this potential source of non-compliance may lead to suboptimal outcomes of measures typically implemented in hospitals. Our experimental survey study with medical students sheds light on the empirical role of overconfidence in self-assessed hand hygiene compliance. We find substantial overconfidence among these medical students in the sense that they indicated to comply more often than others (fellow students, doctors and medical staff). In addition, the assumed individual compliance rates are much higher (on average 70%) than actual performance found by studies in hospital settings which claim that compliance is typically around 50% (Pittet, 2000).

We further find that participants who correctly assessed their own performance believed that the drop in hygiene compliance during stressful situations is less severe than those individuals who under- or over-estimated their performance. This might have important implications. A correct assessment of actual time constraints and adequate coping with a limited time budget seem crucial in the context of hand hygiene compliance. Our results indicate that overconfidence (and under-confidence) might lead to an overestimation of time pressure and a potential negative impact on hand hygiene compliance in stressful situations.

To conclude, this study provides evidence that overconfidence is a potentially important factor leading to lower than desired hygiene compliance in hospital settings. This factor should not be overlooked when designing measures to increase compliance. Specific measures to address overconfidence in compliance behavior should be explored and tested in future studies. These studies should also provide more detail on why and when overconfidence arises.

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Appendix 1: 2nd version of the theoretical model: Intervention function induces only incremental increases in the rate of hand hygiene

The conclusions from our analytical model may be questioned on the ground that the intervention function might be specified differently. In particular, it might be questioned why the intervention function should be specified for values of P above P* when the hospital management is assumed to activate the intervention function only if the observed P falls short of P*.

To counter this potential criticism, we now introduce a second version of the model in which the administrative measures respond to an observed P < P* by implementing an *increase* in the intended rate of hand hygiene $\Delta\tilde{r}$ that, for simplicity, is again assumed to be a linear function of P, the intervention function, such that $\Delta\tilde{r} = (P^* - P)/c$, where c can again be thought of as a measure of the total costs per unit of intended hand hygiene rate increase, i.e. a marginal cost.

In the case of moral hazard, the administrative measures will result in the new rate of hand hygiene $\tilde{r}_m = r_m + (P^* - P_m)/c$, but in the case of overconfidence, the new hand hygiene rate will only be $\tilde{r}_x = (1 - x)[r_x + (P^* - P_x)/c]$ since health care workers' response will again be subject to – unobserved and uncorrected – overconfidence so that the real rate will again fall short of the intended rate by the factor (1-x).

To illustrate the differential effects of an administrative intervention contingent on whether P has been induced by moral hazard and overconfidence, we again analyze three limiting cases for the following levels of administrative cost c:

1. c is so low that the intervention implements the elimination of almost any moral hazard-induced shortfall from P* (represented by the line from point B to point 1, labelled "less costly intervention" in the graph),
2. c is just low enough to implement the complete elimination of the assumed moral hazard (represented by the intervention function connecting point B with point 2 in the graph), and

3. c is high enough to induce only a partial reduction of moral hazard (represented by the intervention function connecting point B with point 3 in the graph),

In case 1, the moral hazard-induced deviation in the hand hygiene rate would be completely eliminated and the optimal rate r* implemented. But if the same P is caused by overconfidence instead of moral hazard, the intervention would leave the real rate of hand hygiene unchanged, resulting in the same probability of no infection as before.

In case 2, the moral hazard-induced deviation in the hand hygiene rate would again be completely eliminated and the optimal rate r* implemented. But if the same P is caused by overconfidence instead of moral hazard, the intervention would again leave the real rate of hand hygiene unchanged, resulting in the same probability of no infection as before.

In case 3, the moral hazard-induced deviation in the hand hygiene rate would increase slightly to r_{m2}, and the probability of no infection would increase to P_{m2}, since the intervention function maps P_m to r_{m2}. But if the same observed P, at P_m in the graph, is caused by overconfidence instead of moral hazard, the moral hazard-motivated intervention would cause the real rate of hand hygiene to fall even further, to r_{x2} in the graph, found via points A, C and D, resulting in an even lower probability of no infection than before, at P_{x2}. The rate r_{x2} is reached because overconfidence remaps r_{m2} via points A and C into r_{x2}.

This second version of the model confirms that, since the administrative measures do not implement a higher rate of hand hygiene than r*, the administration has no way to eliminate or even reduce an overconfidence problem by measures addressing a perceived moral hazard problem. Moreover, the second version of the model also confirms that policies or administrative interventions aimed at eliminating a moral hazard-induced shortfall from the optimal hand hygiene rate may not only be ineffective, but even counterproductive if the shortfall is actually induced by an observationally equivalent overconfidence problem.

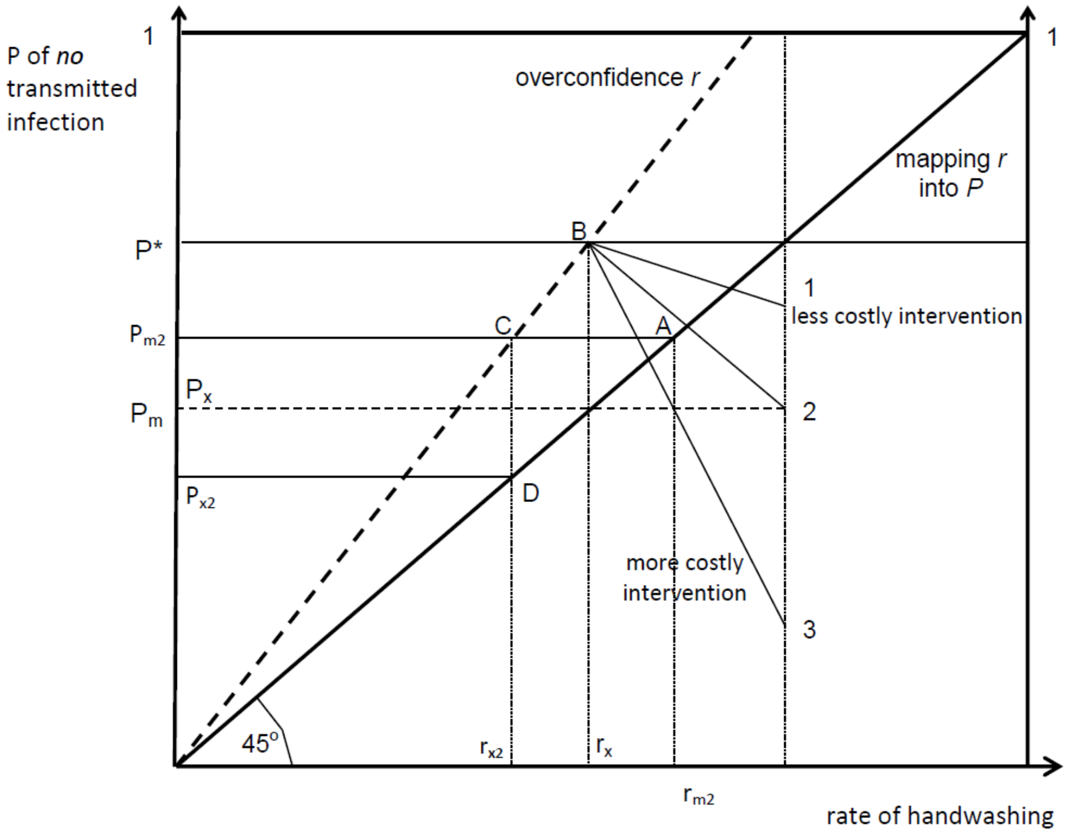


Figure 4: Model 2b

Appendix 2

Table A4: OLS regression with over-placement in hygiene compliance as dependent variable and over-placement in the cognitive reflection test as independent variable

Dependent: Over-placement in hygiene	Index (Mean of all)	Medical staff	Doctors	Fellow students
Over-placement CR	1.519	3.210*	-2.051	3.397**
	(1.24)	(1.63)	(1.85)	(1.46)
Gender (Female=1)	-3.614*	-3.091	-5.369*	-2.384
	(2.13)	(2.80)	(3.18)	(2.49)
Age	0.529*	0.073	0.823*	0.691**
	(0.29)	(0.38)	(0.43)	(0.34)
Semester	-0.502	-0.406	0.569	-1.671**
	(0.69)	(0.91)	(1.03)	(0.81)
constant	6.481	17.448*	-2.818	4.813
	(7.89)	(10.38)	(11.78)	(9.25)
No. of Obs.	144	144	144	144
Adj. R2	0.045	0.022	0.041	0.069
Prob>F	0.034	0.130	0.044	0.007

* p<0.10, ** p<0.05, *** p<0.010

Note: Including further control variables, does not substantively alter the coefficients.

The fact that the coefficient for doctors (Table 2, column 3) is reversed seems counterintuitive at first. Looking more closely into the data we find that participants that place themselves higher than others in the cognitive reflection task tend to estimate the compliance of doctors significantly higher.[3] Therefore, although these participants also estimate their own compliance as higher, the difference between own and the compliance of doctors is smaller. A possible explanation is that people who are over-confident are rather status seeking individuals; therefore they might also believe that people with higher status (doctors as compared to medical staff or students) perform relatively better.

[3] We also observe that the higher the estimation of own performance in the CR the higher the estimated compliance with hand hygiene for all groups (own, doctors, med. Staff and students), i.e. a high assessment in one domain leads to a high assessment in the other domain. Interestingly, the assessment of hygiene compliance is uncorrelated with the actual performance:

Appendix 3

Liebe Studierende,

vielen Dank, dass Sie sich bereit erklärt haben an dieser Umfrage teilzunehmen. Die Befragung und Auswertung erfolgt selbstverständlich anonym. Rückschlüsse von Datensätzen auf Personen und Rückschlüsse innerhalb von Ergebnisberichten auf einzelne Fragebögen sind nicht möglich.

Sie haben die Möglichkeit bis zu 4€ bei dieser Umfrage zu verdienen. Die Auszahlung erfolgt anonym am Ende der Veranstaltung. Bringen Sie dafür bitte Ihre Nummer mit.

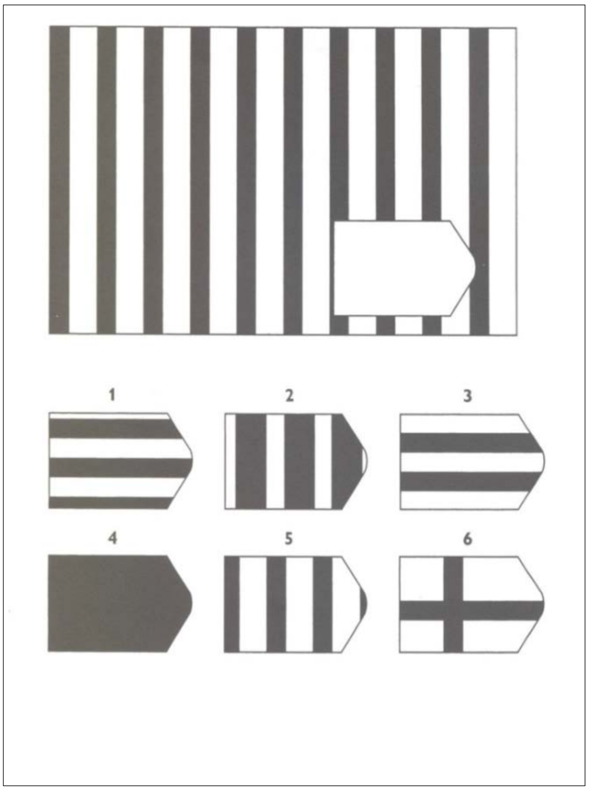
Mit freundlichen Grüßen,

Lena Detlefsen, Katharina Miranda und Michael Stolpe

Zum Anfang möchten wir Sie bitten bei 10 Bildern das fehlende Element zuzuordnen. Unten sehen Sie ein Beispiel. Die Bilder werden Ihnen gleich vom Beamer angezeigt. Sie haben pro Bild jeweils 20 Sekunden Zeit, dann kommt automatisch das nächste Bild. Die 10 Bilder steigen in ihrer Schwierigkeit von sehr leicht zu schwierig an. Tragen Sie Ihre Antwort bitte in die untenstehende Tabelle ein. Sind Sie sich bei einem Bild unsicher, geben Sie eine intuitive Antwort. Geben Sie bitte in jedem Fall eine Antwort.

Bildnummer	Welche Option ergänzt das Bild?
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Beispiel



Welche Option ergänzt das Bild? ____

1. Für wie viele der zuvor gezeigten 10 Bilder haben Sie die richtige Lösung gefunden? *Wenn Sie mit Ihrer Einschätzung richtig liegen erhalten Sie 2€ am Ende des Experiments.*

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
0	1	2	3	4	5	6	7	8	9	10

2. Wie sicher sind Sie sich, dass Ihre Antwort auf die vorherige Frage richtig ist?

   Mit ________ % Wahrscheinlichkeit habe ich mich richtig eingeschätzt.

3. Für wie viele der zuvor gezeigten 10 Bilder haben Ihre Kommilitonen im Durchschnitt die richtige Lösung gefunden? *Wenn Sie mit Ihrer Einschätzung richtig liegen erhalten Sie zusätzlich 2€ am Ende des Experiments.*

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
0	1	2	3	4	5	6	7	8	9	10

Nun möchten wir Sie zu Ihrer persönlichen Einschätzung auf verschiedenen Gebieten befragen (insgesamt 19 Fragen). Bei den meisten Fragen gibt es kein richtig oder falsch, bitte antworten Sie daher möglichst intuitiv.

---

1. Wie schätzen Sie sich persönlich ein: Sind Sie im Allgemeinen ein risikobereiter Mensch oder versuchen Sie, Risiken zu vermeiden? Bitte kreuzen Sie ein Kästchen auf der Skala an, wobei der Wert 0 bedeutet: gar nicht risikobereit und der Wert 10: sehr risikobereit. Mit den Werten dazwischen können Sie Ihre Einschätzung abstufen.

Gar nicht risikobereit *Sehr risikobereit*

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5 6 7 8 9 10

2. Stellen Sie sich nun einen ganz normalen Klinikalltag vor. Was schätzen Sie, in wieviel Prozent der Fälle werden an diesem Tag durchschnittlich die „5 Indikationen der Händehygiene" realistischer Weise korrekt eingehalten…

…von Ihnen selbst?	In _______% der Fälle
…vom medizinischen Fachpersonal?	In _______% der Fälle
…von den Ärzten?	In _______% der Fälle
…von Ihren Kommilitonen hier im Raum?	In _______% der Fälle

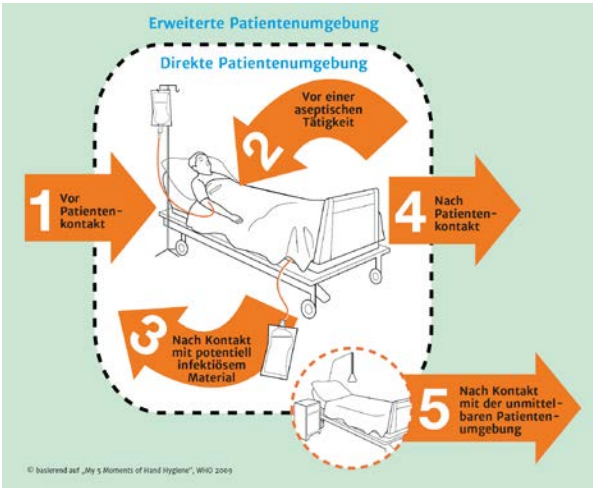


Abbildung der „5 Indikationen der Händedesinfektion“

3. Für wie wahrscheinlich halten Sie es, dass man von einem mit einem nosokomialen Erreger (Krankenhauskeim) infizierten oder besiedelten Patienten zurückverfolgen kann, von welchem Patienten genau der Keim übertragen wurde?

Sehr unwahrscheinlich *Sehr wahrscheinlich*

☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5

4. Falls unzureichende Hygiene Grund für die Übertragung war; für wie wahrscheinlich halten Sie es, dass man zurückverfolgen kann welche/r Mitarbeiter/in für die Übertragung verantwortlich gewesen ist?

Sehr unwahrscheinlich *Sehr wahrscheinlich*

☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5

5. Denken Sie, dass diese Entdeckungswahrscheinlichkeit Ihr eigenes Verhalten beeinflussen könnte?

Sehr unwahrscheinlich *Sehr wahrscheinlich*

☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5

6. Denken Sie, dass diese Entdeckungswahrscheinlichkeit das Verhalten anderer Ärzte beeinflussen könnte?

Sehr unwahrscheinlich *Sehr wahrscheinlich*

☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5

7. Für wie problematisch, im Hinblick auf die Übertragung von Erregern, halten Sie die folgenden Gegenstände im Klinikalltag? Bitte ordnen Sie diese so an, dass auf Rang 1 der Gegenstand steht, der Ihrer Meinung nach am meisten Erreger überträgt und auf Rang 5, der am wenigsten Erreger überträgt.

Stethoskop, privates Smartphone, Kugelschreiber, Tablet-PC, Armbanduhr

Rang 1: ______________________

Rang 2: ______________________

Rang 3: ______________________

Rang 4: ______________________

Rang 5: ______________________

8. Stellen Sie sich nun einen besonders stressigen Kliniktag vor, etwa weil Ihr Team nach einem großen Verkehrsunfall plötzlich doppelt so viele Patienten wie an einem durchschnittlichen Tag versorgen muss. Was schätzen Sie, in wieviel Prozent der Fälle werden an diesem Tag durchschnittlich die „5 Momente der Händehygiene" realistischer Weise korrekt eingehalten…

…von Ihnen selbst?	In _______% der Fälle
…vom medizinischen Fachpersonal?	In _______% der Fälle
…von den Ärzten?	In _______% der Fälle
…von Ihren Kommilitonen hier im Raum?	In _______% der Fälle

9. Wie viele Menschen infizieren sich mit einem nosokomialen Erreger in Deutschland pro Jahr?

_______________ Menschen pro Jahr

10. Wie viele Menschen infizieren sich mit einem nosokomialen Erreger in Kiel pro Jahr?

_______________ Menschen pro Jahr

11. Wie hoch ist die Zahl der Todesfälle durch nosokomiale Infektionen in Deutschland pro Jahr?

_______________ Menschen pro Jahr

12. Denken Sie, dass nosokomiale Infektionen ein Problem in Deutschland darstellen?

Zu vernachlässigendes Problem *Sehr großes Problem*

☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5

13. Denken Sie, dass nosokomiale Infektionen am UKSH in Kiel ein Problem darstellen?

Zu vernachlässigendes Problem *Sehr großes Problem*

☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5

14. Wie besorgt sind Sie, dass Sie sich im Klinikalltag mit einem für Sie persönlich gefährlichen Erreger infizieren?

Sehr besorgt *Gar nicht besorgt*

☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5

15. Ihr Geschlecht: ☐ Männlich ☐ Weiblich ☐ Keine Angabe

16. Alter: ____________

17. Semesteranzahl: _________________

18. Geplante spätere Fachrichtung:____

19. Haben Sie Anmerkungen, Kritik, Verbesserungsvorschläge zu diesem Fragebogen?

Vielen Dank für Ihre Teilnahme!