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FACTORS THAT PROMOTE PERCEIVED USEFULNESS OF AND CLINICAL OUTCOMES FROM SIGN-OUTS AT THE NATIONAL UNIVERSITY HOSPITAL

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Abstract- IMPORTANCE OF THE STUDY. Currently, there is a paucity of evidence in the literature to show that handoff strategies improve the quality of handoff outcomes. Studies that show the usefulness and outcomes obtained from sign-outs may motivate junior clinicians, who have limited time to perform their clinical responsibilities, to support sign-out improvement efforts. **OBJECTIVE.** To test a research model that embeds the Technology Acceptance Model and the Theory of Planned Behavior to explore factors that enhance the perceived (a) usefulness of and (b) clinical outcomes from sign-outs among junior medical officers. **DESIGN, SETTING, AND PARTICIPANTS.** A retrospective study was conducted in the Division of General Medicine in November 2012. 17 residents volunteered to participate in a theoretically validated survey. **MEASURES AND ANALYSES.** The predictor variables were Perceived Ease of Sign-outs, Perceived Benefits from Sign-outs, Attitudes towards Sign-outs, Social Norms to Sign-out, and Perceived Behavior Control over Sign-outs. Partial Least Squares with bootstrapping to 1000 cases was utilized to analyze the data from a small sample. **RESULTS.** The results showed that perceived benefits from sign-outs enhanced the perceived usefulness of sign-outs. Perceived ease of sign-outs enhanced attitudes towards sign-outs, which was significantly related to perceptions of positive clinical outcomes from sign-outs. Neither the social pressure to sign-out nor the provision of conditions to facilitate sign-outs had any significant relationships to perceived usefulness of or clinical outcomes derived from sign-outs. **CONCLUSION AND RELEVANCE.** A two-prong approach involving minimal effort and hard evidence from clinical outcomes may be required to motivate adoption of sign-outs by busy residents.

Key Words: attitudes, acceptance, usefulness, sign-outs.

I. Background

Clinician sign-out or handover of care is the process of transferring patient information and responsibility of care from one provider to another¹. Sign-outs among junior medical officers or house-staff traditionally occur through verbal communication or by passing written sign-out documents between the departing and incoming on-call house-staff at the end of the work shift.² Communication failures during sign-

outs have led to suboptimal patient care³, inefficiencies and redundancies in work⁴, and other preventable harms⁵. Such failures may be attributed to the lack of formal teaching on sign-outs in medical school and residency programs⁶ since sign-out sheets are not considered official hospital records⁷. With Accreditation Council for Graduate Medical Education (ACGME) 80-hour duty-hour restrictions established in 2003 and 2011 for teaching hospitals, it can be expected that more sign-outs will occur between house-staff who provide primary inpatient care during night coverage. Currently, there is a paucity of evidence in the literature that handoff strategies improve the quality of handoff outcomes⁸. Thus, getting novice clinicians to accept the importance of sign-outs, given limited time that could be used on learning and performing complex clinical procedures, will require systematic and compelling evidence.

The objective of this study is to test a theory of sign-out effectiveness using the Technology Acceptance Model (TAM) coupled with the Theory of Planned Behavior (TPB). Together, our theory explains the factors that enhance the perceived (a) usefulness of and (b) clinical outcomes of sign-outs among junior medical officers. TAM^{9,10} is a theory that describes how users accept and adopt information technology in the workplace. TAM theorizes that since new technologies are complex and obtaining positive outcomes from their adoption involves an element of uncertainty. An individual's intention to adopt a system is determined by two beliefs: perceived usefulness, defined as the extent to which a person believes that using the system would enhance his/her job performance and perceived ease of use, defined as the extent to which a person believes that using the system will be free of effort^{9,11}. Vankatesh and Davis¹² report numerous empirical studies that have found TAM consistently explaining about 40% of the variance in usage intentions and behaviors; although perceived ease of use exhibited a less consistent effect on intention across studies. Hence, they sought to extend the original TAM model to explain antecedent factors that may explain how individuals view the perceived usefulness of the technology. They found that cognitive

In that survey, 38% of the 133 interns, residents, and registrars from and 70% of the services represented (Medicine, Surgery, and Orthopedics Surgery) reported that handovers were unstructured and did not support a high standard of care. Handovers were perceived to be largely uninformative (61%), unstructured (38%), performed in an environment with many distractions (31%), poorly organized (22%), rife with absenteeism (18%), and in which information received was irrelevant and unnecessary (12%). Overall, 39% of junior residents were dissatisfied with the existing handover system and felt unsafe in caring for patients during night cover.

A committee was formed and a 2.5-day hospital-level and hospital-wide Rapid Improvement Event (RIE) with participation and support from various departments and all levels was conducted to create a standardized process for shift-to-shift resident handovers. Heads of Departments and medical chiefs agreed that the new handover protocol was reasonable, doable and feasible. Participants from the RIE returned to their respective departments to provide information and answer questions on the new protocol. Some steps to create a collaborative atmosphere to foster good handover included providing coffee during the handover. Yet, a frequent question that arose among the residents was, 'show us the value' of sign-outs.

A retrospective study was conducted in the Division of General Medicine in November 2012 to understand how junior medical doctors perceive the usefulness of sign-outs and their perceptions of the clinical outcomes directly connected to sign-outs. 17 residents volunteered to participate in a theoretically validated survey.

B. Measures

The two outcome measures (details in Appendix 1) were Perceived Usefulness of Sign-outs, measured by four 7-point Likert-scaled items ($\alpha = 0.93$ with an eigenvalue of 2.98, explaining 74.49% of variance) and Perceived Clinical Outcomes from Sign-outs, measured by eight 7-point Likert-scaled items ($\alpha = 0.91$ with an eigenvalue of 5.21, explaining 65.15% of variance).

The predictor variables (details Appendix 1) were Perceived Benefits from Sign-outs, measured by six 7-point Likert-scaled items ($\alpha = 0.82$ with an eigenvalue of 3.42, explaining 56.96% of variance); Perceived Ease of Sign-outs, measured by three 7-point Likert-scaled items ($\alpha = 0.71$ with an eigenvalue of 1.95, explaining 64.93% of variance); Attitudes towards Sign-outs, measured by seven 7-point Likert-scaled items ($\alpha = 0.93$ with an eigenvalue of 5.0, explaining 71.46% of variance); Social Norms to Sign-out, measured by two 7-point Likert-scaled items ($\alpha = 0.79$ with an eigenvalue of 1.65, explaining 82.61% of variance); and Perceived Behavioral Control over Sign-outs, measured by three 7-point Likert-scaled items ($\alpha = 0.77$ with an eigenvalue of 2.08, explaining 69.29% of variance). All the measures were shown to be reliable and robust for further analysis (see Table 1).

C. Analyses

instrumental processes from a technology (e.g. job relevance, result demonstrability, and output quality) were significantly related to its perceived usefulness. Since perceived usefulness is a fundamental driver of usage intentions, an understanding of its determinants enable firms to design organizational interventions to increase user acceptance and usage of new systems.

TPB is a theory from social psychology that links beliefs and behaviors^{13,14}. According to TPB, a person's performance on a specific behavior is determined by her *intention* to enact that behavior. These intentions are influenced by the person's attitude, subjective or social norms, and perceived behavioral control from external agencies. Thus, if a person has a positive attitude toward the said behavior, if they think significant others would want them to perform the behavior, and if there exist resources and opportunities to facilitate the behavior, the individual will be motivated to enact it.

We apply TAM and TPB in our study to explore factors that enhance the (a) perceived usefulness of and (b) perceived clinical outcomes from sign-outs among junior medical officers. TAM provides the motivating framework for the model while TPB explains the mechanism of action. In our research model (Figure 1) TAM predicts that *perceived benefits* of formal sign-outs influence users' *perceived usefulness* of the sign-out protocol. TPB predicts that perceived usefulness and ease of use of the sign-out protocol will influence users' attitudes toward mandatory sign-out practices. Thus, we hypothesize that:

H1: Perceived benefits from sign-outs enhance the perceived usefulness of sign-outs.

H2a: Perceived usefulness of sign-outs enhances attitudes about sign-outs.

H2b: Perceived ease of sign-outs enhances attitudes about sign-outs.

In Figure 1, TPB predicts that positive attitudes about sign-outs enhance the belief that the sign-out will lead to positive consequences. We also predict that if senior doctors support the practice of formal sign-out, junior doctors will carry a stronger belief that sign-outs will lead to positive consequences for patient care. Finally, we predict that the provision of facilitating conditions for junior doctors to engage in sign-outs will lead to positive consequences in clinical outcomes. Thus, we hypothesize that:

H3: Attitudes about sign-outs enhance perceived clinical outcomes.

H4: Social norms to sign-out enhance perceived clinical outcomes.

H5: Perceived behavioral control over sign-outs enhances perceived clinical outcomes.

II. METHODS

A. Setting, Design, and Participants

The setting for this study is in a tertiary academic hospital in Singapore with 1100 inpatient beds. Prior to November 2011, sign-outs were ad hoc and operator dependent. Clinical data was transmitted in an informal way. In analyzing eight sentinel events that occurred at the hospital between 2008 and 2010, handover was identified as a root cause of risk for clinical outcomes and patient safety. Hence, a workgroup was

Due to the sample size, Partial Least Squares with bootstrap to 1000 cases was utilized to increase the stability of the coefficients in the path model.

III. RESULTS

Figure 2 shows the significant paths in the research model, providing support to Hypothesis 1, which predicted that perceived benefits from sign-outs enhances the perceived usefulness of sign-outs. The data did not provide support for Hypothesis 2a, which predicted that the perceived usefulness of sign-outs would enhance the respondents' attitudes about sign-outs. Nevertheless, our data provided support for Hypothesis 2b, which predicted that the perceived ease of sign-outs enhances respondents' attitudes about sign-outs. The positive attitudes towards sign-outs were also statistically significantly related to positive perceptions of clinical outcomes directly connected to sign-outs, providing support for Hypothesis 3. Finally, our data did not provide support for Hypotheses 4 or 5, which respectively predicted that social norms to sign-out and perceived behavioral control over sign-outs would enhance perceptions of positive clinical outcomes that could be derived from sign-outs.

Discussion & Implication of Results

The results suggest that extrinsic facilitators and motivators such as supervisor expectations to perform sign-outs (social norms) or protected time and location, collegial environment with coffee machines (perceived behavioral control) did not matter. Instead, perceptions of minimal effort (ease of sign-out) mattered in changing attitudes towards sign-outs. Although the perceived usefulness of sign-outs is heightened when adopters cognitively understand the benefits from sign-outs, however, such positive perceptions were insufficient to motivate acceptance of a new protocol as attitudes were not changed, suggesting that hard evidence from scientific studies of clinical outcomes are needed to convince adoption. Adopter attitudes appear to be more sensitive to a rational assessment of perceived (minimal) effort than perceived usefulness to clinical performance from sign-outs.

Organizations must pay attention to adopter attitudes toward a new protocol. Rapid Improvement Events need to be planned with the systematic collection of data in mind. Adopters have to be convinced of the benefits with evidence to make a protocol effective. The appeal to social norms and enhancing feelings of empowerment did not suffice. Only when scientific evidence for a protocol's effectiveness is presented to stakeholders are the attitudes positively influenced. Perceptions toward sign-out benefits and changed attitudes may be fostered by constant messaging, didactics, role play, and self-reflection exercises.

The small sample size limits the opportunity to test feedback loops between the Technology Acceptance Model with Theory of Planned Behavior; where perceived clinical outcomes may influence other perceived benefits of sign-outs. This limitation provides an opportunity for a future study on feedback loops. Future research may test if perceived usefulness of sign-outs motivates attendance of and participation in sign-outs. The empirical findings are site and

time specific, limiting the generalizability of the results. Thus, a future research study should test the research model in multi-sites with larger sample sizes that include longitudinal data with multi-sources of data. Finally, the survey data is perceptual and may therefore be vulnerable to common method variance bias. A future research would be to obtain actual clinical outcomes to examine if objective data would improve junior medical officers' perception of the usefulness of sign-outs to obviate the need for social pressure and behavioral control mechanisms.

IV. CONCLUSION

Sign-outs matter to junior doctors-in-training to increase their perceptions of safety when covering inpatient care in the night. The sign-out protocol is likely to be especially important and probably most successfully accepted early in the training process. Additional ways to improve adoption include continual 'selling' techniques to increase perceived usefulness and ease of use.

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Appendix 1: Description of the Measures

1. Perceived Usefulness of Sign-outs: the extent to which the new handover process enhanced:
 - a. clinical productivity
 - b. job performance
 - c. job responsibility
 - d. interactions with team members
2. Perceived Clinical Outcomes: the extent to which:
 - a. accuracy in clinical assessment and diagnosis is improved
 - b. incidences of delays in clinical assessment have decreased
 - c. incidences of medication errors have decreased
 - d. incidences of duplication orders have decreased
 - e. incidences of medical errors have decreased
 - f. incidences of patient re-admission have decreased
 - g. incidences of patient complaints have decreased
 - h. length of stay are reduced
3. Perceived Benefits from Sign-outs: the extent to which the handover process
 - a. provided opportunities to clarify and resolve questions about patient care
 - b. improved continuity of care
 - c. increased speed in making clinical decisions
 - d. enhanced prioritization of clinical work amongst different patients
 - e. establishes the kinds of information to handover
 - f. creates less likelihood to overlook patients whose conditions may potentially deteriorate at night.
4. Perceived Ease of Sign-outs: the extent to which the handover process was:
 - a. easy to learn
 - b. easy to use
 - c. easy to be skillful at
5. Attitudes toward Sign-outs: compared with the previous handover, respondents' indicated their level of...for the handover procedure.
 - a. Enthusiasm
 - b. Excitement
 - c. Positiveness
 - d. Satisfaction
 - e. Desire
 - f. Importance
 - g. Liking
6. Social Norms to Sign-out: the extent to which
 - a. People who are important to me want me to use the new handover procedure
 - b. People at work would look down on me if I use the new handover procedure (reversed)
7. Perceived Behavioral Control over Sign-outs: the extent to which the respondents have the necessary...to perform the handover procedure.
 - a. knowledge
 - b. resources
 - c. work unit support

Table 1: Descriptive Statistics

Variable	Mean	S.D.	1	2	3	4	5	6	7
1.Perceived Clinical Outcomes	4.61	1.02	(.91)						
2.Perceived Usefulness	5.41	.94	.60*	(.93)					
3.Perceived Benefits	5.57	.75	.60*	.61**	(.82)				
4.Perceived Ease of Use	5.29	.78	.78**	.33	.54*	(.71)			
5.Attitude	5.13	.82	.64**	.55*	.62**	.71**	(.93)		
6.Social Norms	5.59	1.21	.07	.30	.05	.01	.14	(.79)	
7.Perceived Behavioral Control	5.25	1.04	.20	.30	-.04	.19	.24	.87**	(.77)

**p < .01; * p < .05 (Pearson correlation, 2-tail test)
(values in parenthesis refers to Cronbach's alpha for the construct)

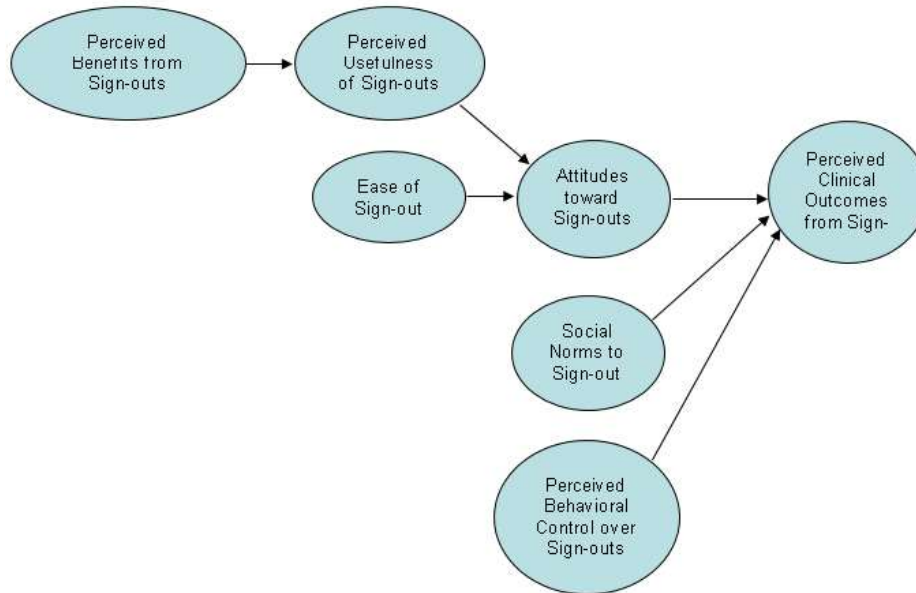


Figure 1: The Research Model

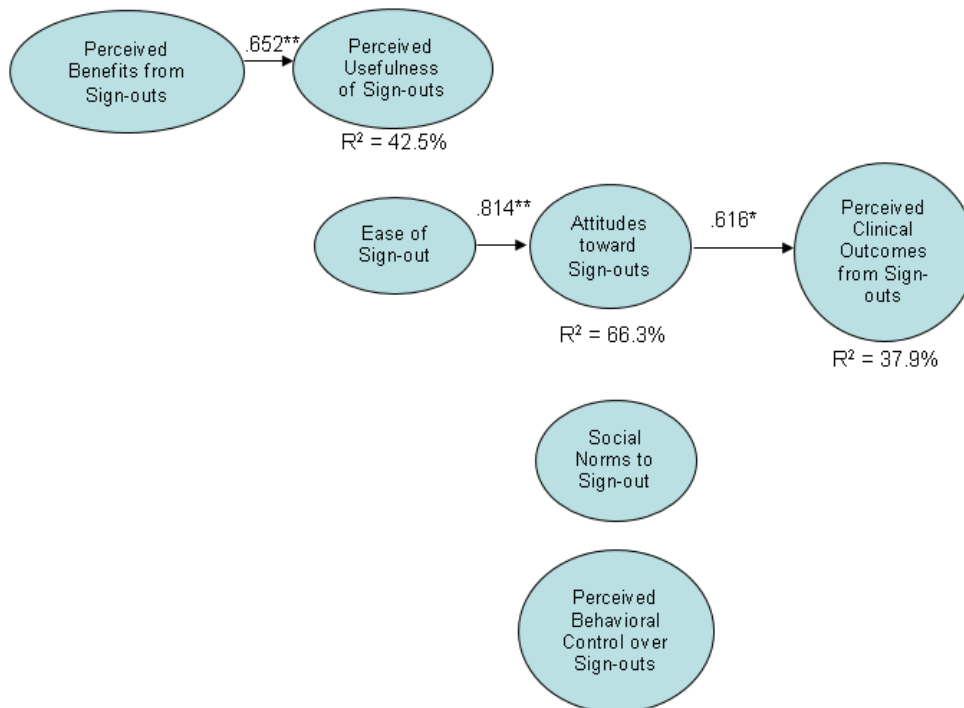


Figure 2: Results of the Study