

8-5-2011

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Vishvesh Joshi

*Illinois State University, vrjoshi@ilstu.edu*

James R. Wolf

*Illinois State University, jrwolf@ilstu.edu*

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## Recommended Citation

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# DO INDIAN PHYSICIANS DEROGATE PEERS WHO USE COMPUTER-BASED DIAGNOSTIC AIDS?

**Vishvesh Joshi**

Illinois State University  
vrjoshi@ilstu.edu

**James R. Wolf**

School of Information Technology  
Illinois State University  
jrwolf@ilstu.edu

## ABSTRACT

Several studies suggest that physicians are reluctant to adopt computer-based diagnostic decision aids, in part, due to the widespread psychological bias that patients and peers have against physicians who use them. This bias has been well documented among Western patients and physicians. However, to date, no one has examined this bias in a non-Western setting. This work examines the attitudes of Indian physicians towards other physicians who use computer-based diagnostic aids. To accomplish this, we administered a series of experiments and a follow-up survey. The participants were physicians from three Indian medical centers. In the survey, the majority of physicians were positive about the usefulness of diagnostic aids, especially for use in the diagnosis of difficult illnesses. However, when asked to imagine how patients might react to learning their physician used a computer-based diagnostic aid, our participant responses were more negative. Similarly, in the experiments, physicians rated the diagnostic ability of physicians who used a diagnostic aid significantly lower than the ability of physicians who did not.

## Keywords

Guides, instructions, length, conference publications.

## INTRODUCTION

Each year, 98,000 people die in US and Canadian hospitals due to errors in diagnosis (Ayres, 2007). An autopsy study found one in five hospital medical intensive care units (MICU) deaths were misdiagnosed (Tai et al., 2009). The same study suggests that in 44% of these cases, knowledge of the actual condition would have resulted in altered treatment. The sad thing is that the technology exists to dramatically reduce medical misdiagnoses, possibly eliminating many of these deaths. In recent years, several technology and medical-related firms have developed highly accurate computer-based diagnostic decision aids. Studies have shown that these decision aids increase physicians' diagnostic accuracy, reduce error and save money (Arkes, Shaffer and Meadow, 2007).

However, despite the many possible benefits of computer-based diagnostic support systems, physicians have been slow to adopt diagnostic decision aids and fail to use them when they are available. As a result, these powerful, potentially lifesaving tools remain grossly underutilized. DesRoches et al. (2008) suggests that only 4% of physicians have access to even rudimentary diagnostic decision support systems.

Arkes et al. (2007) suggests several reasons that physicians may be reluctant to use diagnostic decision aids. They note that many physicians view using medical decision aids as "cookbook medicine" in which doctors simply enter the symptoms and the computer produces the diagnostic results. Arkes and associates also note that doctors are trained to diagnose patients without the use of any kind of decision aid and may be reluctant to adopt new technologies and procedures. In addition, early incarnations of computer-based decision aids were not as accurate or user friendly as recent systems. Physicians may be reluctant to use diagnostic support systems because they are unfamiliar with recent research on medical decision aids or are hesitant to trust the results because of earlier research findings. Promberger and Baron (2006) found that participants did not trust computer generated diagnoses.

Perhaps the most important reason for the underutilization of medical decision aids is the general public's strong physiological bias that patients have against physicians who use medical decision aids. Several studies suggest that physicians are reluctant to adopt computer-based diagnostic decision aids, in part, due to the fear of losing the respect of patients and colleagues (Arkes, Shaffer, & Meadow, 2007; Pezzo & Pezzo, 2006; Kaplan, 2000; Cruikshank, 1984). As Arkes et al. (2007) note, patients want their physicians to be extremely knowledgeable, if not omniscient; as a result, physicians may be reluctant

to adopt diagnostic decision aids for fear of appearing less capable. Echoing this notion, one Indian physician we interviewed for this research stated, "A doctor who uses a computer to make his diagnosis is no doctor at all."

While several studies have examined western physician and patient attitudes the use of computer-based diagnostic aids. This is the first work to examine these attitudes among physicians from a non-western country. In this work, we will examine Indian physician attitudes toward other physicians who use diagnostic decision aids. We will examine these attitudes using both survey and experiment data.

## **BIAS AGAINST PHYSICIANS WHO USE COMPUTER-BASED DIAGNOSTIC DECISION AIDS**

Over the past 30 years, several technology and medical-related firms have developed computer-based decision aids (Arkes et al., 2007). Extant literature suggests that these diagnostic decision aids offer a way to decrease various types of physician errors, foster the implementation of evidence-based medicine, and reduce inappropriate admissions and costs. In a recent reviews of 100 studies involving computer-based diagnostic support systems, the overwhelming majority of which showed that diagnostic decision aid predictions were superior to the unaided diagnostician.

Diagnostic decision aids have been developed to reduce many types of diagnostic errors, they also reduce costs and promote the use of evidence-based medicine (Balas, 2001; Sim, Gorman, & Greenes 2001; Pozen, D'Agostino, & Mitchell, 1980). Previous research suggests that physicians who use computer based diagnostic support systems perform better than physicians who do not use them (Corey & Merenstein, 1987; de Dombal & McAdam, 1997 and Friedman, Elstein, & Wolf, 1999). De Dombal and McAdam (1997) suggest that general practice physicians who used computer-based diagnostic decision aids have more than two times the diagnostic ability of the physicians who do not use a diagnostic decision aid.

However, Arkes et al. (2007) found that participants derogated the diagnostic ability of physicians who used a computer-based decision aid. In addition, the study also found that physicians who used a computer-based decision aid were rated as less thorough and less professional than physicians who did not use a decision aid. Given these findings, a physician who values his or her reputation may be understandably reluctant to use a computer-based decision aid if its use facilitates negative patient attitudes.

In addition, Pezzo and Pezzo (2006) found that physicians who used a decision aid were not only judged less positively following a positive health outcome, but also less negatively following a negative outcome. These results suggest that, in situations where the results are typically positive such as most visits to the doctor, physicians may be reluctant to adopt diagnostic decision aids because they would receive less credit when the patient recovers.

As Arkes et al. (2007) notes, we expect physicians to be omniscient oracles of medical knowledge. Latham and Whyte (1994) suggest that people trust those who make decisions based on intuition more than those who make decisions via more overtly analytical methods. Arkes and associates suggest that we often associate admirable qualities like insight and creativity with intuitive thinking, but quantitative analysis seems tedious and opaque to a most people (Arkes et al., 2007).

A pair of studies examining the persuasiveness of expert advice supports this hypothesis (Whyte & Latham, 1997; Latham & Whyte, 1994). In each study, two types of experts gave recommendations to groups of managers. The advice was given to the managers either by an unaided expert or by an expert who had performed statistical analysis to support their recommendation. Even though the advice given was identical, the recommendations made by unaided experts were more likely to be supported by the managers than the recommendations based on analysis. Arkes and associates hypothesized that medical patients, like managers in the Whyte and Latham studies, might be more trusting of intuition-based physician diagnoses than those based on more statistical methods. They note that, in both scenarios, the person who bases their judgment on intuition is rewarded, and the person who relies on more accurate statistical methods is demeaned.

Several research studies have explored the reasons that people trust intuition more than they trust analysis (Dawes, 1979; Meehl, 1986; Yates, Veinott & Patalano, 2003). Hogarth (2001) suggests that many people believe that important intuitions are performed without conscious awareness and therefore cannot be expressed in statistical terms. Another reason that people are hesitant to trust statistical models is that we want our physician to see us as individuals, not as a number. If a diagnostic aid lumps us with all the other people whose data contributes to the base rates or likelihood ratios, we feel minimized or even disregarded (Dawes, 1979). Beyond that there is a strong belief that we are not only unique, but that we are each special, above average. A natural extension of this belief is that statistically based diagnostic tools might work for others, but won't work in "my case."

As Arkes et al. (2007) notes, patients are going to reject the physician who uses a technological aid that offends us or makes us feel degraded and embrace the physician who appears to appreciate our individuality, even though the physician who embraces our individuality may not be as accurate a diagnostician as physician who uses a diagnostic aid.

While India has become a major global player in the computer software industry, computer adoption is uneven throughout the country. Even its urban areas have lower computer and Internet adoption rates than the United States and other Western countries (Shih & Venkatesh, 2003). In areas like online shopping, India lags even further behind (Adapa, 2008). India represents a distinctly non-Western culture (Shih & Venkatesh, 2003). India has Power Distance (PDI) ranking of 77 (Hofstede, 2007). The world average is 56.5. For comparison, the United States has a PDI ranking of 40. India's high PDI indicates a high level of inequality of power and wealth within the society. According to Hofstede (2007), "This condition is not necessarily subverted upon the population, but rather accepted by the population as a cultural norm."

A country's PDI captures how people of different statuses interact with one another. A country's PDI has been shown to affect physician-patient relationships (Deschepper et al., 2008). In countries with high power distance, doctors typically have high status. The gap in status between doctors and their patients might make patients less likely to challenge the opinions of their physicians and may facilitate a "doctor-knows-best" environment (Deschepper et al., 2008).

Previous work has shown that patients in countries with lower gaps in status between doctors and patients, like the US (Arkes et al., 2007) and the United Kingdom (Cruikshank, 1984), disparage physicians who use computer based diagnostic aids. As such, it is likely that countries, with larger status gaps between doctors and patients, like India, would be as likely, or more, to disparage physicians who use computer based diagnostic aids. Further, as computer adoption is lower in India than in the United States and other Western countries, its citizens would have less exposure to computer technology and may be less familiar with the benefits of computer based decision aids.

Given the above, we anticipate that Indian physicians, like the patients and medical students in Arkes et al. (2001) will rate the diagnostic ability of physicians who use computer based diagnostic aids as lower than the diagnostic ability of physicians who do not use aids. Further, as Arkes and associates found, we expect that the Indian physicians disparagement of physicians who use computer based diagnostic aids will produce a "negative halo effect," which will result in the physician receiving lower marks on several scales (i.e. wait time, thoroughness, professionalism, and overall satisfaction) unrelated to their use of a computer based diagnostic aid.

## **METHOD**

In 2008, we decided to examine the attitudes of Indian physicians towards their peers who used diagnostic decision aids. To accomplish this, we administered an experiment followed by a survey to physicians from three different hospitals in India as participants. Eighty-nine physicians from the three Indian medical centers (Maharaja Yashwant Rao Hospital and Research Center Indore, Shri Arbindo Institute of Medical Science Indore, and Peoples Medical College, Bhopal) participated in the experiment. The participants were randomly assigned to one of the three experimental groups: no-aid (31), aid (28), special aid (29). This research was approved by the authors' University's Institutional Review Board.

### **The Experiment**

The experiment used three short scenarios that described and interaction between the doctor and patient followed by small questionnaire containing dependent variable using 7-point Likert-scale. All the data was collected on paper but recorded on computer for further analysis.

#### *Procedure*

Each participant was asked to read a 4-page scenario in which they were asked to play the role of a patient. In the scenario, after 5 days with particularly bad throat you visit your primary health care physician who provides diagnosis. In the diagnosis process the doctor used no decision aid, unspecified decision aid, or a prestigious decision aid. After reading the scenario the participants have to rate the following five criteria: thoroughness of examination, length of wait, diagnostic ability of the physician, professionalism of the physician and overall satisfaction with the examination. Participants were asked to respond to each question separately using five different Likert-type scales; each scale ranged from 1-7. The more negative evaluations corresponded to the left side of the scale that is 1, 2, 3 and the more positive evaluations with the right that is 5, 6, and 7. Each point on the scale was given both numeric value and a descriptive label.

Data Analysis

To test for psychological bias, we conducted quantitative analysis of the data mentioned above. In each experiment we first performed a multivariate analysis of variance (MANOVA) with five dependent variables (i.e., thoroughness of examination, evaluation of length of wait, diagnostic ability, professionalism, and overall satisfaction) and one independent variable, the three experimental conditions (i.e., no-aid, aid, prestigious-aid and search engine). Additionally after completing the MANOVA tests, to examine differences in specific items, we performed Kruskal-Wallis equality-of-populations rank tests.

In situations with multiple dependent variables, a multivariate test (i.e., MANOVA) is preferable to multiple ANOVAs or ordinary least square (OLS) regressions with dummy variables because multiple ANOVA/OLS ignore the intercorrelations between the independent variable. The MANOVA test uses also more information about the data than ANOVA does. Since MANOVA takes the intercorrelations between the independent variable into account, it can provide a more powerful statistical test. Finally, repeated univariate procedures (i.e., ANOVA tests) can dramatically increase TYPE I ERRORS.

Scenario	Thoroughness of Examination	Appropriate Length Of Wait	Physician's Diagnostic Ability	Professionalism of the Physician	Overall Satisfaction
No-Aid	5.193548	3.967742	4.935484	5.354839	5.064516
Aid	3.925926	2.962963	3.111111	3.962963	3.444444
Prestigious Aid	3.774194	3.645161	3.322581	4.290323	3.645161
Total	4.314607	3.550562	3.820225	4.561798	4.078652

Table 1: Average Responses from Indian Physicians

Results

The multivariate test of differences between groups (aid, no aid or prestigious aid) using the Wilks Lambda criteria was statistically significant  $F(10, 164) = 3.91, p = 0.0001$ . Follow-up multivariate comparisons showed that the non-aid group was significantly different from both the generic aid group ( $F(5, 82) = 5.88, p = 0.0001$ ) and the prestigious aid group ( $F(5, 82) = 5.31, p = 0.0003$ ). However, the generic aid and the prestigious aid group were not significantly different ( $F(5, 82) = 1.15, p = 0.3422$ ). Each of the F-ratio transformations of the Wilks criteria were exact.

Further, it was determined that the diagnostic ability of the physician who used the diagnostic decision aid was rated significantly lower than the physician who did not use a diagnostic decision aid ( $\chi^2(2) = 23.301, p = 0.0001$ ). In addition, the physician participants also rated the physician who used the diagnostic decision aid lower on acceptability of wait time ( $\chi^2(2) = 7.186, p = 0.0275$ ), thoroughness of examination ( $\chi^2(2) = 12.989, p = 0.0015$ ), professionalism ( $\chi^2(2) = 14.187, p = 0.0008$ ), and overall satisfaction ( $\chi^2(2) = 16.724, p = 0.0002$ ).

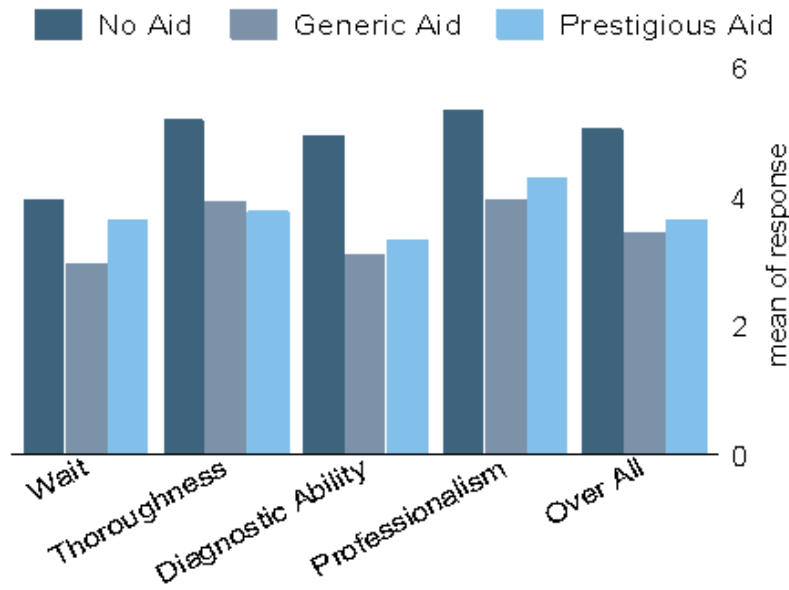


Figure 1. Results from Indian Physicians

**The Survey**

*Procedure*

We administered the survey to 111 physicians in India; 21 from Maharaja Yashwant Rao Hospital and Research Center Indore, 50 from Shri Arbindo Institute of Medical Science Indore, 40 from Peoples Medical College, Bhopal. The participants were asked to complete a paper-based survey.

*Results*

Questions	Yes	No
Do you use any type of computer-based diagnosis decision aid?	49 (44%)	62 (56%)
Do you ever use Google or another search engine to diagnosis a patient?	70 (63%)	41 (37%)
If you learned that one of your colleagues was using a computer-based diagnosis decision aid to diagnose patients, would this affect your opinion of the diagnostic ability of the physician?	28 (25%)	83 (75%)
If you learned that one of your colleagues was using Google or another Internet search engine to diagnose patients would this affect your opinion of the diagnostic ability of the physician?	25 (23%)	86 (77%)

Table 2: Yes/No Questions

Table 2, reports the participant answers for the first four questions on the survey. A surprising large number of the physicians (44%) reported the use of a computer diagnosis decision aid in their treatment of patients. Of those indicating that they had used an aid, 39% reported that they only use diagnostic aids for difficult cases, and 6% reported that they use diagnostic aids for both difficult and routine cases (Table 2).

Question	Difficult Diagnoses	All Diagnoses	Do not use	Not Available	No Comments
If you do use any type of computer medical diagnosis decision aid, do you use it for all diagnosis or just the difficult ones?	43 (39%)	7 (6%)	9 (8%)	7 (6%)	45 (41%)

**Table 3: Diagnosis Decision Aid Usage**

Question	Harmful	Helpful
Are computer medical diagnosis decision aids helpful/harmful?	16 (14%)	95 (86%)

**Table 4: Harmful/Helpful Question**

Of those who reported that they did not use a computer diagnosis decision aid in their treatment of patients, the most common reasons given for non-use were confidence in their own diagnostic ability, or that use of a diagnostic aid was either not required or not appropriate. When asked directly (Table 5), 70% reported that they had a positive impression of computer medical diagnosis aids and only a very small percent (6%) reported a negative impression. Further, when asked whether diagnosis decision aid were harmful or helpful (Table 4), 86% physicians said helpful and 14% said harmful.

A high percentage of our participating physicians (63%) reported that they had used Google or another search engine to help them diagnose difficult illness (Table 5). Of these, 58% reported that they only used a search engine for cases that were especially difficult (Table 5).

Questions	Positive	Negative	No Response	Skeptical
What is your overall impression of computer-based diagnosis decision aids?	77 (70%)	7 (6%)	17 (15%)	10 (9%)
If you have ever used Google or another search engine to help diagnose an illness, was it helpful?	64 (58%)	38 (34%)	4 (3%)	5 (5%)

**Table 5: Computer Medical Diagnosis Decision Aids**

Only 25% of physicians reported that discovering that one of their colleagues was using computer medical diagnosis decision aid to diagnose patients would that affect their opinion of the colleague’s diagnostic ability (Table 1). Of these, 56% reported that the change would be positive. Less than half (44%) reported that discovering that one of their colleagues was using computer medical diagnosis decision aid to diagnose patients would negatively affect their opinion of the colleague’s diagnostic ability.

Seventy-seven percent of physicians reported that discovering that one of their colleagues was using Google or another search engine to help diagnose patients would that not affect their opinion of the colleague’s diagnostic ability (Table 2). Of the 23% who reported that it would affect their opinion of the colleague’s diagnostic ability, 68% reported that their change in opinion would be positive. Only 32% reported that it would negatively affect their opinion of the colleague’s diagnostic ability

Question	Would be more positive	Would be more negative	Would not be affected
If you learned that one of your colleagues was using a computer medical diagnosis decision aid to diagnose patients, would it affect your opinion of the diagnostic ability of the physician?	14 (13%)	11 (10%)	86 (77%)
If you learned that one of your colleagues was using Google or another search engine to diagnose patients would this affect your opinion of the diagnostic ability of the physician?	17 (16%)	8 (7%)	85 (77%)

**Table 6: Use of DSS by Colleagues**

When asked about a hypothetical situation of a patient discovering that their physician was using a computer medical diagnosis decision aid to help diagnose patients, 48% of physicians predicted that the reaction would be positive, 19% believed the reaction would be negative. Finally, when asked about a hypothetical situation of a patient discovering that their physician was using a Google or another Internet search engine to help diagnose patients, only 35% of physicians predicted that the reaction would be positive, 16% believed the reaction would be negative.



Question	Positive (Their Opinion will be favorable)	Negative (Their opinion will not be favorable)	No Response	Don't Know	Both
How do you believe that patients would react if they discovered that their physician was using a computer medical diagnosis decision aid to diagnose their illness?	48 (44%)	19 (17%)	16 (14%)	15 (14%)	13 (12%)
Would their opinion of the diagnostic ability of the physician be more or less favorable if they discovered that their physician was using a computer medical diagnosis decision aid to diagnose their illness?	52 (47%)	17 (15%)	26 (23%)	16 (15%)	-

**Table 7: Patients thoughts on Using DSS**

**CONCLUSION**

Medow, Arkes and Shaffer (2010) found that physicians recognize the superior diagnostic ability of computer-based diagnostic aids. However, Promberger and Baron (2006) found that patients do not trust computer-generated diagnoses. Our results mirror these two incongruent findings. When surveyed about their personal view of computer-based diagnostic aids and those who use them, our physician participants were overwhelmingly positive. When asked about their personal view of Internet search engines and physicians who use them in the diagnosis of patients, our physician participants were also positive. However, when asked to imagine how patients might react to learning their physician used a computer-based diagnostic aid or an Internet search engine during diagnosis, our participant responses were more negative.

In our experiment, the physicians were asked to imagine themselves as patients. As with the survey, the data suggest that participants, in their roles as patients, had a negative reaction to the use of a computer-based decision aid. Physicians who used the diagnostic decision aid were rated significantly lower than the physician who did not use a diagnostic decision aid. In addition, due to a “negative halo effect” the physician participants also rated the physicians who used the diagnostic decision aid lower on acceptability of wait time, thoroughness of examination, professionalism, and overall satisfaction. Our results suggest that, as patients, participating physicians were less positive about the use of computer-based diagnostic aids than they were as medical doctors.

This is consistent with the theory that physicians are reluctant to use computer-based diagnostic aids, in part, because they are worried about how others may react. As Arkes et al. (2007) notes, patients want their doctors to be all-knowing Oracles of medical knowledge. In high power distance countries, like India, doctors enjoy even greater status than they do in Western countries. As a result, patient expectations might be even higher and the reputational risks of using a computer-based diagnostic aid even more pronounced. Further, as computer adoption is lower in India than in the US or other Western countries, it is likely that patients would be even less trusting of computer-generated diagnoses.

This bias against computer-based diagnoses, and statistically based decision making in general, jeopardizes patients' health and safety. Given the estimated 11,000 unique illnesses and the 4000 different medications, it is impossible for anyone physician to know it all. As Joseph Britto, co-creator of the Isabel diagnostic aid, explains, "Only in fiction do men beat machines" (Ayers, 2007).

When the physicians were surveyed, an abnormally high number claimed to use computer based diagnostic aids. We do not know whether this is the result of the sample we surveyed or a problem with our instrument. From the survey responses, it appears that there was a wide array of interpretations of this question. Some physicians appear to have interpreted computer diagnosis decision aid to include any use of the computer, including the use of an Internet search engine. Whereas others

appeared to have interpreted computer diagnosis decision aid to include only commercial diagnostic decision support systems. This represents a major limitation of this work.

However, despite its limitations, this work contributes to the medical decision making literature by demonstrating that Indian physicians do derogate other physicians who use computer-based diagnostic aids. This is consistent with work by Arkes et al. (2007) which found that American medical students and patients rated the diagnostic ability of physicians who used a diagnostic decision aid significantly lower than the diagnostic ability of physicians who did not use a diagnostic decision aid. Now that this bias has been documented in both Western and non-Western countries, future work may want to explore the antecedents of this bias and possible remedies. For example, it may be fruitful to investigate whether greater exposure to computers or greater exposure to computer-based decision aids (e.g., tax preparation software or turn-by-turn navigation systems) reduce this bias? Further, it might be fruitful to investigate whether this bias can be mitigated by education?

In addition, future research may want to explore whether, after greater exposure to computers, greater exposure to computer-based decision aids or education on the benefits of computer-based decision aids, patients would grow to derogate those physicians who do not use computer-based diagnostic aids.

## ACKNOWLEDGMENTS

The authors would like to thank Caterpillar Inc, and Illinois State University's Center for Mathematics, Science, and Technology (CeMaST) for their generous support of this research.

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