Refereed paper

The cognitive impact of research synopses on physicians: a prospective observational analysis of evidence-based summaries sent by email

Ruiqing Wang BA
Faculty of Medicine, McGill University, Montreal, Canada

Gillian Bartlett PhD
Associate Professor

Roland Grad MDCM MSc CCFP
Associate Professor

Pierre Pluye MD PhD
Associate Professor

Department of Family Medicine, McGill University, Montreal, Canada

ABSTRACT

Background Effective information transfer in primary care is becoming more difficult as the volume of medical information expands. Emailed research synopses are expected to raise awareness and thereby permit more effective information retrieval.

Objective To identify key factors that influence physicians' self-reported cognitive impact of emailed research synopses.

Method In this prospective observational study, research synopses sent by email between 8 September 2006 and 30 May 2007 were analysed. Seven characteristics of synopses (number of characters, research design, study setting, number of types of patient populations studied, number of comparisons, number of outcomes, and number of results) were analysed. Each synopsis was classified as either positive or negative based on physician-reported impacts. Logistic regression analysis was used to evaluate the association between a negative impact and the synopsis' characteristics.

Results A total of 1960 Canadian physicians submitted 159 442 ratings on 193 synopses. Each synopsis was assessed on average by 826.1 physicians. On average there were 28.3 negative ratings per research synopsis, 146.3 neutral, and 656.2 positive. Out of the seven characteristics analysed, only the number of comparisons (odds ratio (OR) = 0.47, 95% confidence interval (CI) = 0.23–0.93) and the number of results (OR = 0.64, 95% CI = 0.44–0.93) had a statistically significant influence on physician ratings. An increase in the number of comparisons ($P = 0.03$) or the number of results ($P = 0.02$) decreased the likelihood of a negative impact.

Conclusions Characteristics of the synopses appear to influence cognitive impact, and there might be lexical patterns specific to these factors. Further research is recommended in order to understand the mechanism for the influence of these characteristics.

Keywords: biomedical research, cognition, electronic mail, humans, observation, prospective studies

Introduction

Since the 1990s, 'evidence-based' (i.e. research-based) decision making has become a powerful social movement in many areas, specifically in medicine and public health where physicians are taught to rely on high-quality evidence. While the values of critical appraisal, one fundamental aspect of evidence-based medicine, are well known, physicians do not have time to screen, organise and appraise new scientific literature. Slawson and Shaughnessy (1997) proposed that the usefulness of medical information is proportional to both the relevance and validity of the presented information, but inversely proportional to the effort required to obtain it.[1] Research-based synopses delivered by email are increasingly popular and may overcome this issue.[2] Synopses read by email have been shown to raise awareness of new developments, contribute to continuing medical education and improve professional practice.[3]

While concerns have been expressed about the comprehensiveness and accuracy of medical journal abstracts,[4] studies that systematically assess email-delivered research synopses are only now emerging.[5] Previously, most studies examined the characteristics of research-based information that influenced research utilisation, notably with respect to printed educational materials and compliance with guidelines. In accordance with a systematic literature review on the association between knowledge attributes of clinical practice guidelines and physician behaviours, the attributes combining characteristics of information, individual behaviours and organisational routines may account for less than 20% of the variance.[6] This low result has been challenged by studies that globally examined research utilisation. For instance, according to cross-sectional survey data for 4421 registered nurses, variation in research utilisation was mainly explained by individual characteristics.[7] Significant individual and organisational factors associated with research utilisation were as follows: time spent on the internet and lower levels of emotional exhaustion; facilitation; nurse-to-nurse collaboration; a higher context (i.e. of nursing culture, leadership, and evaluation), and perceived ability to control policy; and hospital size. However, characteristics of research synopses that may influence clinicians have not been examined despite the fact that a positive cognitive impact on physicians should facilitate their utilisation.

In the social sciences, literature on research utilisation started appearing in the 1970s. More recently, the development of knowledge translation activities in health sciences has become increasingly popular; however, actual research on knowledge translation is underdeveloped.[8] Theoretical frameworks are needed,[9] and only a few empirical studies have scrutinised knowledge translation processes and outcomes.[10] Four problems hinder this development: (1) difficulties in identifying research-based information units for evaluation; (2) the lack of studies going beyond basic notions on the utilisation of information; (3) the use of questionnaires with unknown validity; and (4) the absence of consensus on basic concepts.[8–11]

The 'Information Assessment Method' (IAM) addresses three of these problems and a research synopsis constitutes a well-defined information unit. IAM is based on a generic conceptual framework derived from information science, and evidence of its validity is supported by seven years of research and development.[12] IAM has been used to evaluate three types of electronic knowledge resources: email, clinical information retrieval technology and clinical decision support systems. Using qualitative, quantitative and mixed methods studies, our previous work supports the feasibility, content and construct validity of the IAM checklist combined with a computerised ecological momentary assessment technique for efficiently evaluating information items.

Using these validated tools, the factors that influence physician perception of research synopses can be evaluated. The present exploratory study examines factors that influence physicians' self-reported evaluation of research synopses.

Method

This study is a secondary analysis of data collected prospectively in a study of the cognitive impact of research synopses on physicians.[13] The study protocol was approved by the McGill University Faculty of Medicine Institutional Review Board. Synopses of original research were first delivered via email to 12 800 members of the Canadian Medical Association (CMA) in 2005. These research synopses were part of InfoPOEM®, developed by Wiley InterScience. InfoPOEMs® are one-page research synopses relevant to primary care physicians. They could address a question that clinicians might face in their daily practice, or measure outcomes that are relevant to patient care, e.g. quality of life. This study evaluates physicians' self-assessed cognitive impact of evidence-based summaries sent out via daily emails.

In this study, all CMA members who received these evidence-based summaries via email as of September 2006 were eligible to participate. On 15 September and 3 October 2006, the CMA emailed an invitation to participate to all addresses on their list. After completing a demographic questionnaire and providing informed consent online, CMA members who read research synopses could begin rating them by clicking

a link in the top left corner of the email page containing each synopsis. This link connected the reader to the validated ten-item IAM checklist.[12] The reader could then report one or more items of impact ('check all that apply'), with one exception. When 'no impact' was selected, no other item of impact could be chosen. Each rating by one physician of one research synopsis was a self-report of cognitive impact comprising a single item or a combination of items of impact. A participant was defined as a practising family physician or specialist physician who submitted at least one rating of one research synopsis between 8 September 2006 and 30 May 2007. Reports of impact were collected by the CMA, and forwarded weekly to our research team. For each rated research synopsis, participants certified by the College of Family Physicians of Canada earned 0.1 Mainpro M1 credit.

Definition of variables and statistical analysis

Dependent variable (outcome)

For each synopsis, the proportion of negative ratings out of all ratings submitted was determined. Negative assessments included four items of the ten-item assessment checklist: 'I was frustrated as there was too much information', 'I was frustrated as there was not enough information or nothing useful', 'I disagree with this information', and 'I think this information is potentially harmful'. The 90th percentile for the distribution of the proportions was used as the cut-off to characterise the research synopses as negative. In previous work, findings from interviews with physicians who completed the impact assessment questionnaire revealed that 'no impact' was perceived as 'this information has no relevance' or 'no use is planned for this information'. Therefore, we did not include this item as a negative impact item.

Independent variable (potential factors)

In line with our literature review, three characteristics of information that may influence cognitive impact were operationalised into seven variables as follows. In all cases, the information for each variable was taken from the original research synopsis, not the original study.

- *Relevance*:
  1 study setting, classified as inpatient, outpatient, emergency department, population-based or unknown
- *Complexity*:
  2 length of the synopses defined as the total number of characters excluding references (this variable

was divided by 150 to approximate the length of one sentence or 30 words)
  3 number of types of patient populations included in the study
  4 number of comparisons made in the study
  5 number of outcomes evaluated
  6 number of results reported
- *Truthfulness*:
  7 research design, categorised as observational versus experimental.

The following variables – number of comparisons, outcomes, and results derive from a thematic analysis of the content of synopses using the PECODR (Patient-Population-Problem, Exposure-Intervention, Comparison, Outcome, Duration and Results) method.[14] For each research synopsis, relevant sentences, segments and words were assigned to six themes: patient/population/problem, exposure/intervention, comparison, outcome, duration and result. These themes derive from prior work conducted with abstracts of evidence-based medicine journals (see Appendix for detailed definitions).[14]

Categorical variables were described using frequencies and percentages. Continuous variables were described using means and standard deviations. Bivariate comparisons were made using chi-square statistics and Student's t tests. Logistic regression analyses were performed to determine the impact of the characteristics of research synopses on perceived negative impact. The crude odds ratio (OR), 95% confidence interval (CI) as well as P value were reported for each characteristic.

This study was approved by the McGill Faculty of Medicine ethics review board.

Results

From 1960 Canadian physicians, 159 442 ratings were collected regarding 193 research synopses. All but one of the194 research synopses emailed during the study period were eligible for rating, as ratings on the research synopsis delivered 12 April 2007 were missing. Each research synopsis was assessed on average by 826.1 physicians (standard deviation (SD) = 170.4) with a range of 168–1056. Each physician assessed an average of 81.3 research synopses (SD = 63.5) with a range of 1–193. Per research synopsis, there was on average 28.3 negative ratings (SD = 27.5), with a range of 1–151; 146.3 neutral ratings (SD = 105.2) with a range of 10–456; 656.2 positive ratings (SD = 181.9) with a range of 73–969. There were 5469 negative ratings, i.e. 3.4% of all ratings. Table 1 summarises the types of ratings and average number of ratings per participant.

Table 1 Ratings of 193 research synopses submitted by 1960 Canadian physicians

IAM item	Number (%)
Positive	154 870 (97.14)
My practice was (will be) improved	25 687 (16.1)
I learned something new	79 613 (49.9)
I recalled something (because of this research synopsis)	13 621 (8.5)
It confirmed I did (will do) the right thing	28 814 (18.1)
I was reassured	21 918 (13.8)
No impact[a]	28 230 (17.7)
Negative	5469 (3.4)
I was frustrated as there was too much information	218 (0.14)
I was frustrated as there was not enough information or nothing useful	3739 (2.4)
I disagree with this information	989 (0.6)
I think this information is potentially harmful	906 (0.6)

[a] This item was a neutral assessment, but was regrouped with positive assessments for purposes of analysis

Table 2 Characteristics of positive and negatively perceived research synopses

Characteristic	Positive impact $n = 173$	Negative impact $n = 20$	Total $n = 193$
	n (%)	n (%)	n (%)
Setting			
Inpatient	31 (17.9)	2 (10.0)	33 (17.1)
Outpatient	88 (50.9)	11 (55.0)	99 (51.3)
Emergency department	10 (5.8)	2 (10.0)	12 (6.2)
Population-based	17 (9.8)	2 (10.0)	19 (9.8)
Unknown	27 (15.6)	3 (15.0)	30 (15.5)
Observational design	51 (29.5)	8 (40.0)	59 (30.6)
	Mean (SD)	Mean (SD)	Mean (SD)
Text characters[a]	2145.3 (477.2)	1922.4 (468.2)	2122.2 (479.9)
Comparisons made[a]	1.3 (1.2)	0.8 (0.6)	1.3 (1.2)
Outcomes measured[a]	3.2 (1.8)	2.6 (1.4)	3.1 (1.8)
Results reported[a]	3.1 (1.5)	2.4 (1.1)	3.0 (1.5)

SD: standard deviation
[a] Statistically significant, $P < 0.0001$

Amongst 193 research synopses, only three (2%) had more than one patient population. Therefore, no further analysis was done to examine the effect of this variable.

Taking the 90th percentile (7.3%) for proportion of negative impact ratings as our cut-off, 20 research synopses (10.4%) were rated as negative. The remaining 173 (89.6%) were rated as positive (see Table 2). Research synopses with positive and negative ratings

were comparable at baseline except for the number of comparisons, which was higher in the group of synopses rated as positive. Out of 173 research synopses rated as positive, 54 (31.2%) were derived from studies conducted in an emergency department, population based or unknown, whereas seven (35%) of 20 negative research synopses had similar settings. In total, 61 (31.6%) of all research synopses were derived from studies conducted in an emergency department, population based or unknown setting.

Using logistic regression, characteristics of 193 research synopses were analysed to assess the risk of a perceived negative impact. Table 3 presents the effect of each of the variables reported as odds ratios (ORs) and corresponding 95% CIs. As summarised in Table 3, two variables decreased the risk of a negative assessment: (1) an increase in the number of comparisons and (2) an increase in the number of results reported in a research synopsis.

Discussion

Results obtained from our study indicate that among the extracted elements of research synopses, an increase in both the number of comparisons made and the number of results reported is associated with positive perception of research synopses among Canadian physicians. Our results can be interpreted in line with three of four characteristics of research-based information that may influence research utilisation according to the literature: relevance, truthfulness, complexity of decision making, and balance between 'advantage–

risk'.[4,11] Given that research-based information is less likely to be rated negatively by practising physicians when the number of comparisons and results reported is greater, the complexity of research-based information is an important factor.

Relevance comes first as irrelevant information is not used.[1] For example, family physicians may consider some research-based information as potentially useful for practice ('just-in case'), but this information is not relevant for any specific current patient, and so it is not used. In line with a rationalist 'evidence-based medicine' perspective, truthfulness, the 'best evidence' on one topic can correspond to the most convincing information for physicians. For example, guideline recommendations supported by a higher level of evidence should be more influential as compared to weaker evidence.[15,16] In contrast to this rationalist perspective, building on the literature on 'actor network theory' and 'diffusion of innovation', Denis *et al* emphasise the socio-political nature of research utilisation, the role of values in legitimating choices for using research, the ill-defined nature of many innovative research findings, and the unexpected dangers of using new findings (hidden risks).[17] Thus, *the complexity of decision making* may influence research utilisation, e.g. evidence on decision making in the context of acute care might be more influential as compared to evidence to inform decision making in the context of complex chronic disease. In addition, *the balance of 'advantages–risks'* may also play a role in research utilisation, e.g. evidence on interventions with 'high number needed to treat (NNT) and low risk' might be more influential as compared to evidence regarding interventions with 'low NNT but high risk'.

Table 3 Logistic regression analysis of research synopses and risk of a perceived negative impact

	Odds ratio	95% Confidence interval	P
Observational study design	1.6	0.61–4.13	0.34
Setting			
Emergency department, population, or unknown versus outpatient	1.04	0.38–2.84	0.94
Inpatient versus outpatient	0.52	0.11–2.46	0.41
Per 150 text characters	0.85	0.73–1.00	0.05
Comparisons made	0.47	0.23–0.93	0.03
Outcomes measured	0.77	0.54–1.09	0.14
Results reported	0.64	0.44–0.93	0.02

Our results can be alternatively interpreted in accordance with the critical appraisal skills of physicians. Today's physicians are trained to be critical toward information received in the form of research, and should be more attuned to its shortcomings than the general population. In this study, physicians received only synopses of actual research papers as email alerts. As such, it is likely they did not have access to the full-text of information to critically appraise the original studies. Furthermore, some studies used multiple comparison populations, or presented numerous outcomes. These synopses may be more difficult to fully understand in a condensed format. As a result, these studies might be less likely to be critically appraised. Simpler synopses, such as those involving only one comparison with fewer results, are more easily understood. In these cases, physicians are more likely to critically appraise the evidence presented.

There are several limitations to this study. First, participants included both specialist and generalist physicians. Since the research synopses are sent out daily to any physician member of the CMA, they are not tailored to any physician's particular specialty or field of interest. As the target audience of these evidence-based summaries is primary care physicians, synopses that received more negative comments may be more sub-specialised. The number of each category of specialist physicians was too low to analyse the patterns of negative impact by specialty of the physician. We did not consider elements that may influence the perceived impact of research synopses such as physician experience (years in practice), expertise and research exposure.

Given the varied responses each synopsis received, it would be interesting to form focus groups to further explore each negatively rated research synopsis, thus formulating possible explanations to physicians' negative response, be it the formulation of that specific synopsis, or a too sub-specialised subject, or improbable result, for instance. Conclusions drawn from these meetings could be used in future review of original research as candidates to be summarised into synopses.

This study represents a first attempt to explore characteristics of research information that may influence physicians' research utilisation. The present exploratory study justifies further investigation of the potentially influential characteristics of research-based information. For instance, software enabling mixed methods data analysis and visualisation of text mining over the past two decades is increasingly popular, and may permit the evaluation of a larger volume of research synopses in both an inductive and deductive manner. They combine functionalities to assist thematic qualitative data analysis, and analysis of textual statistics to identify potentially important data patterns.[18]

Conclusion

The promising but exploratory findings presented in this paper bring light to more efficient data management and resource allocation in this new era of information explosion. A better understanding and potential prediction of community response will not only aid synopsis writers and magazine editors to execute an optimal selection but also provide a mechanism to target specific synopses to the most pertinent individuals. Ultimately, this information will help to improve our understanding of how physicians optimise information retrieval and utilisation.

REFERENCES

1 Slawson DC and Shaughnessy AF. Obtaining useful information from expert based sources. *British Medical Journal* 1997;314:947–9.

2 Smith R. A POEM a week for the BMJ. *British Medical Journal* 2002;325:983.

3 Haynes RB. Of studies, syntheses, synopses, and systems: the '4S' evolution of services for finding current best evidence. *ACP Journal Club* 2001;134:A11–A13.

4 Estrada CA, Bloch RM, Antonacci D *et al*. Reporting and concordance of methodologic criteria between abstracts and articles in diagnostic test studies. *Journal of General Internal Medicine* 2000;15:183–7.

5 Tamblyn R, Huang A, Taylor L *et al*. A randomized trial of the effectiveness of on-demand versus computer-triggered drug decision support in primary care. *Journal of the American Medical Informatics Association* 2008; 15:430–8.

6 Grol R and Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *The Lancet* 2003;362:1225–30.

7 Estabrooks CA, Midodzi WK, Cummings GG and Wallin L. Predicting research use in nursing organizations: a multilevel analysis. *Nursing Research* 2007; 56(4 suppl.):S7–23.

8 Graham ID, Logan J, Harrison MB *et al*. Lost in knowledge translation: time for a map? *Journal of Continuing Education in the Health Professions* 2006;26:13–24.

9 Grimshaw JM, Thomas RE, Maclennan G *et al*. Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technology Assessment* 2004;8(6):iii–72.

10 Estabrooks CA, Floyd JA, Scott-Findlay S, O'Leary KA and Gushta M. Individual determinants of research utilization: a systematic review. *Journal of Advanced Nursing* 2003;43:506–20.

11 Rich R. Measuring knowledge utilization: processes and outcomes. *Knowledge and Policy* 1997;10:11–24.

12 Pluye P, Grad RM, Repchinsky C *et al*. IAM: a comprehensive and systematic information assessment method for electronic knowledge resources. In: Dwivedi A (ed) *Handbook of Research on IT Management and Clinical Data Administration in Healthcare.* Hershey: IGI Publishing, 2009.

13 Grad RM, Pluye P, Mercer J *et al*. Impact of research-based synopses delivered as daily e-mail: a prospective observational study. *Journal of the American Medical Informatics Association* 2008;15:240–5.

14 Dawes M, Pluye P, Shea L *et al*. The identification of clinically important elements within medical journal abstracts: Patient-Population-Problem, Exposure-Intervention, Comparison, Outcome, Duration and Results (PECODR). *Informatics in Primary Care* 2007;15: 9–16.

15 Haynes RB. Of studies, syntheses, synopses, summaries, and systems: the '5S' evolution of information services for evidence-based health care decisions. *ACP Journal Club* 2006;145(3):A8.

16 Guyatt GH, Oxman AD, Vist GE *et al*. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *British Medical Journal* 2008;336:924–6.

17 Denis JL, Hebert Y, Langley A, Lozeau D and Trottier LH. Explaining diffusion patterns for complex health care innovations. *Health Care Management Review* 2002; 27:60–73.

18 Kendall JE and Kendall KE. Information delivery systems: an exploration of Web pull and push technologies. *Communications of the AIS* 1999;1:2–42.

ETHICAL APPROVAL

This study was approved by the McGill Faculty of Medicine ethics review board.

CONFLICTS OF INTEREST

None of the authors have any financial relationship with InfoPOEM® and their publisher (John Wiley and Sons) or any conflict of interest to report.

ADDRESS FOR CORRESPONDENCE

Gillian Bartlett, 515–517 Pine Avenue West, Montreal, Quebec, Canada H2W 1S4. Email: gillian.bartlett@ mcgill.ca

Appendix 1: Definition of the six PECODR themes[14]

P1 = Patient/population
1. All the inhabitants of a given country or area considered together; the number of inhabitants of a given country or area
2. (In sampling) The whole collection of units from which a sample may be drawn; not necessarily a population of persons, the units may be institutions, records, or events. The sample is intended to give results that are representative of the whole population

P2 = Problem – health-related problems:
1. disease
2. symptoms
3. risk
4. negative life event (e.g. bereavement, stress)
5. diagnostic issue
6. potentially harmful drug interaction
7. vaccine issues
8. treatment issue
9. drug marketing issue
10. office management issue

E1 = Exposure
1. Proximity and/or contact with a source of a disease in such a manner that effective transmission of the agent or harmful effects of the agent may occur
2. The amount of a factor to which a group or individual was exposed; sometimes contrasted with dose, the amount that enters or interacts with the organism
3. Exposures may of course be beneficial rather than harmful, e.g. exposure to immunising agents
4. The process by which an agent comes into contact with a person or animal in such a way that the person or animal may develop the relevant outcome, such as a disease

E2 = Intervention
Intentional change in some aspect of the status of the subjects, e.g. introducing of a preventive or therapeutic regimen, or designed to test a hypothesised relationship

C1 = Comparison: comparative exposure
Comparison group: any group to which the index group is compared. Usually synonymous with control group. Use of this term is preferably restricted to randomly allocated groups = comparing, compared, placebo, standard, versus, than

C2 = Comparison: comparative intervention
All the possible results that may stem from exposure to a causal factor, or from preventive or therapeutic interventions; all identified changes in health status arising as a consequence of the handling of a health problem

O = Outcome
= end-point, mortality, death, incidence, outcome, cause, adverse, admission

D1 = Duration: period of exposure
= throughout week (shortened form of week), long-term

D2 = Duration: period of intervention

R = Result: direction of outcome
= cast doubt, challenge, chance, closely, frequent, gradient, replicate, superiority, strongly, fewer, better, likely, decrease, correlated, differ, confidence interval, increase, significant, difference, odds ratio, occur, associated, greater, higher, ruling, highest, lowest