DRUSSA

Development Research Uptake in Sub-Saharan Africa

Handbook Series:

Essay 2: Research traditions of knowledge utilisation and its most influential models

UKaid from the British people

The Association of Commonwealth Universities

OSD Organisation Systems Design

crest Centre for Research on Evaluation, Science and Technology

Universiteit Stellenbosch University

Author

Dr Sara S Grobbelaar (ssgrobbelaar@sun.ac.za) is a Senior Researcher at the Centre for Research on Evaluation, Science and Technology (CREST), University of Stellenbosch, South Africa

Nelius Boshoff (scb@sun.ac.za) is a Senior Lecturer at the Centre for Research on Evaluation, Science and Technology (CREST), University of Stellenbosch, South Africa

*This material has been funded by UK aid from the UK government; however the views expressed do not necessarily reflect the UK government’s official policies.

Contents

INTRODUCTION

The first purpose of this essay is to bring together selected insights concerning the development of 'knowledge utilisation' as a field of study. The essay starts off with a historical account by Backer (1991) which portrays the development of the field of knowledge utilisation as a series of 'waves'. According to Backer, the field has developed from a series of scientific enclaves. The introductory section puts into context the presence of different scientific traditions and provides a historical overview of the development of knowledge utilisation both as a field of study and a political priority.

A second purpose of this essay is to provide a selective overview of the theory of knowledge utilisation through which practitioners may gain insight into the various pathways to moving knowledge into use. We aim to address the following areas:

An introduction to selected concepts for each research subtopic in the field of knowledge utilisation – key areas for focus and key research traditions;

Taxonomies (where available) of the subtopics and

A selective introduction to models of knowledge utilisation from various subtopics.

By definition, such a high-level overview this account is highly selective as each scientific discipline has its own theories of knowledge utilisation. We will focus on models that have been developed from the KU (knowledge utilisation) literature and consider discipline-specific models.

A historical account of knowledge utilisation

"Waves" of knowledge utilisation

Thomas Backer (1991) highlights three historical "waves" of knowledge utilisation that capture the main trends in the American context (as far as the study of knowledge utilisation is concerned), and which provide a background for similar developments worldwide.

The first wave: 1920-1960

According to Backer (1991) the first wave of knowledge utilisation started with the study of the diffusion of agricultural innovations. The term 'knowledge utilisation' had not yet been coined at that stage; the term frequently applied in those days was 'agricultural extension'. The origin of agricultural extension was politically motivated, and gained importance due to the establishment of the Co-operation Extension Service by the United States Department of Agriculture in 1914 as a result of increased pressures to raise the level of agricultural productivity in the aftermath of World War I (Rogers, 1988).

Research on the study of the diffusion of innovation emanated from a range of scholars who studied this phenomenon independently (Rogers, 2003). Rural sociologists laid the foundations of the research tradition at that stage, although the focus was mainly on agricultural extension. Rogers credited Ryan and Gross' study for setting the diffusion paradigm for the field of rural sociology. The tradition for diffusion research was carried forward by a number of land grant colleges in the USA (e.g. University of Wisconsin, the University of Missouri and Iowa State University, among others). Towards the 1960s, the rural sociologists of the USA went international. There was a large-scale attempt to disseminate the concepts and methods of the agricultural extension complex to Latin America, Asia and Africa. This also gave rise to a large number of diffusion studies in these countries (Rogers, 2003).

Following the Second World War, an influential report by Vanevar Bush (1945), entitled "Science the Endless Frontier", ushered in a new era where science was viewed as a very important ingredient for progress towards achieving national goals in health, defence and the economy. Government funding for research and development increased tenfold over the 1940 to 1960 period (Pielke, 2010). Pielke argues that the influence of Bush's report was also attributable to its timing, as the development of the atomic bomb, penicillin and radar had showed the crucial contribution of science to development, and made the public receptive to his message that "scientific progress is essential" for public welfare.

This view was bolstered by the rise of the information age through which an information explosion took place in almost all areas of study, including health, education and public services. The drive towards higher investment in the production of knowledge resulted in the need to test its use and wider application, and finding ways of promoting its wider application (Backer, 1991; Pielke, 2010).

The US federal government was therefore then open to supporting science as a relatively autonomous endeavour, free from political influence. The belief was that scientific endeavours into unexplored areas, as seen fit by scientists themselves, would eventually deliver benefits in terms of security and economic prosperity. An implicit social "contract" between science and society therefore emerged. This contract entailed:

> *"… a bilateral relationship from which both society and the producers of knowledge derive benefits. It emphasizes that knowledge-producing institutions prosper to the extent that their activities are consistent with the goals of society. It also certifies that society recognizes both the right of science and other producers of knowledge to a measure of independence, and the fact that independence is in the long-range interest of society." (Rich, 1979:13)*

This 'contract' remained largely unquestioned until the early 1960s, when it started to become clear that science was not providing answers to the most critical problems. Eventually, about three decades later, a revised social "contract" would come into effect, where science's accountability is more valued than its independency, and is also required to address the needs of the economy and society more explicitly (Martin, 2003).

For the interested reader

Pielke, R., (2010). In Retrospect: Science — The Endless Frontier. Nature, Vol 466, 19 August 2010.

Bush, Vannevar. "Science: The endless frontier." Transactions of the Kansas Academy of Science (1903) (1945): 231-264.

Martin, Ben R. "The changing social contract for science and the evolution of the university." Science and innovation: Rethinking the rationales for funding and governance. Edward Elgar, Cheltenham (2003): 7-29.

The second wave: 1960-1980

During the second wave, researchers in the field of knowledge utilisation started to acknowledge the adoption of innovations through the dissemination and utilisation of knowledge by individuals as well as organisations. Furthermore, funding became available for studies on methods of utilisation, and to assist researchers and potential users to increasingly apply federally sponsored research by both (Backer, 1991).

- The US government was interested in this for mainly three reasons (Backer, 1991):
- The "desire for rapid technological change to stimulate economic growth";
- The "desire to enhance the transfer of technology emerging from defence- and space-related research";
- The "desire to promote the adoption of innovations emerging from research and demonstration funding from federal health, education, and human services agencies".

The field of monitoring and evaluation also emerged as US President Lyndon Johnson's Great Society and the War on Poverty launched programmes at substantial federal expense. Naturally questions were raised regarding the effectiveness of the programmes, which led to significant federal funding being made available for research utilisation activities, and to show that the research conducted for these programmes had had practical benefit (Backer, 1991).

Dissemination activities thrived with various mechanisms being implemented, such as information clearing houses to provide assistance to researchers, scholars, consumers and policy-makers. Targeted publications and other print dissemination mechanisms were experimented with (Backer, 1991).

During the second wave a number of new fields also started to pay attention to the field of knowledge utilisation:

- ***Technology transfer*** emerged as a field in the 1970s. Since then, a huge field has emerged that is studied by economists, sociologists, anthropologists, engineers and behavioural and the quantitative management theorists. (See section on "Technology transfer as a field of study" for an overview of the key research tradi-

tions and contributions to this field of study);

- ***Knowledge utilisation*** in the social sciences also started to gain some attention. A general view developed that social science had limited success in informing policy. Work by Weiss (e.g. 1978, 1979, 1980) and others provided clarity about the state of knowledge utilisation for the social sciences. (See section on "Knowledge utilisation in the social sciences" for an overview of this subtopic).

The third wave: 1990s onwards

The third wave, from the 1990s onwards, was preceded by a brief interlude during the 1980s when the Reagan administration in the USA introduced a different funding approach. The funding preference of the federal government shifted from sponsored research to block grants, which meant a reduced need for the demonstration of the utility of federally sponsored research. During the 1990s, with the change to the Bush administration, there was a renewed interest in policies, programmes and research activities pertaining to knowledge utilisation. Dedicated programmes for the utilisation and uptake of knowledge started to flourish and enjoyed high priority in all spheres of policy and decision-making, including agriculture, defence, education, health, human services, space administration and transportation (Backer, 1991). It is during this wave that the demand for evidence-based medicine (EBM – see Section 3.5.1) intensified, with increasing demands "that clinical practice … be based on systematically reviewed and critically appraised evidence of effectiveness" (Lambert, 2006:2633).

The fourth wave – a systems approach to knowledge utilisation?

Although Backer's (1991) account ends with this period, he nevertheless highlights a few trends that could be interpreted as indicative of a probable fourth wave. He observed, for instance, already in the early 1990s, a closer association between utilisation, quality assurance, ethics and evaluation. Backer's observation comes to mind with the current fascination with knowledge translation, where knowledge is translated to suit a target audience by involving the audience in a lengthy and complex exchange relationship. Knowledge translation is a systems intervention that aims to facilitate evidence-informed health policy and practice. It follows the logic of planned action, which explains the emphasis on aspects of quality, evaluation and the ethically sound application of knowledge (NCDDR, 2007; Straus, Tetroe and Graham, 2009).

The observation that the further development of knowledge utilisation is currently being shaped by evidence-based medicine (EBM), and knowledge translation as an extension of EBM, is confirmed by other studies.

Validation of Backer's periodisation

Estabrooks et al. (2008) conducted the first comprehensive bibliometric analysis of the field of knowledge utilisation, by using author co-citation analysis. Their dataset comprised more than 5,000 articles published between 1945 and 2004 in the Web of Science online database. Their research showed that until the mid-1980s three specialised domains could be distinguished: initially, innovation diffusion; followed by technology transfer and knowledge utilisation; with the latter mainly comprising insights into knowledge uptake in the social sciences. During the mid-1980s a fourth domain started to appear, namely EBM, which rapidly expanded in the 1990s:

> *[U]ntil the late 1960s most diffusion research took place in Rural Sociology … In the next decade (1965 to '74), most diffusion publications are located in social science journals, and one library science journal. By 1979, the field of knowledge utilisation had become sufficiently cohesive to warrant a specialist journal: Knowledge: Creation, Diffusion, Utilization... This journal is the core journal in the field for the next two decades. In 1985 to 1994 the Journal of the American Medical Association enters the field of core journals, and in the next decade (1995 to 2004), three of the most prolific journals are health journals. (Estabrooks, 2009:5)*

This conclusion serves to validate Backer's developmental stages of the field of knowledge utilisation, highlighting shifts that range from innovation diffusion to technology transfer and the utilisation of social sciences research, to EBM and knowledge translation. The study by Estabrooks et al. (2009) does not explicitly mention knowledge translation but one should note that the study's analytical time frame ends with 2004, whereas the bulk of publications in knowledge translation only started to appear immediately thereafter.

A definite indication that knowledge utilisation as a field has become recognised as a field of science is that a number of journals were established. During the 1970s, both the *Journal of Technology Transfer* (in 1975) and the journal *Knowledge: Creation, Diffusion, Utilization* (in 1979) were established. The latter was later renamed *Science Communication* (Boshoff, 2014).

The categorisation of journals according to research tradition or subtopic clearly shows the shift in interest from

the rural sociologists in the 1950s to EBM in the late 1990s and early 2000s.

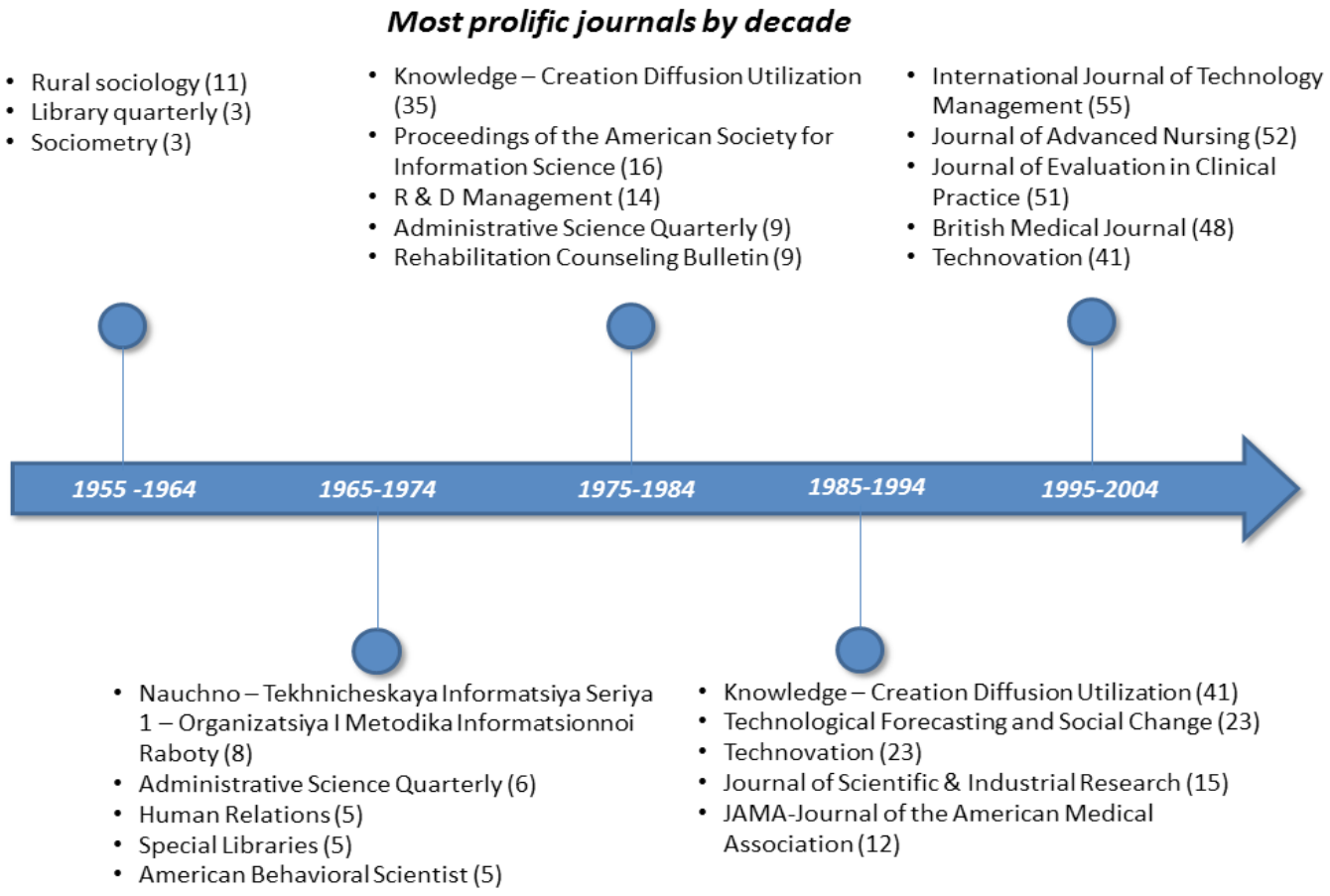


Figure 2: Most prolific journals by decade (Information extracted from Estabrooks (2008)

Areas of study in the knowledge utilisation field

From the previous section, it was concluded that the field of knowledge utilisation has evolved over the 1920s period until present day. As presented in Backer's account, four waves of knowledge utilisation have been identified:

Table 9: Backer's four waves of knowledge utilisation literature

Time period	Subtopics of knowledge utilisation
The first wave: 1920-1960	Diffusion of innovations
The second wave: 1960-1980	Technology transfer Knowledge utilisation in the social sciences
The third wave: 1990s – early 2000s	Evidence-based medicine
The fourth wave – a systems intervention to knowledge utilisation	Knowledge translation

According to Rogers (2003) a research tradition is a series of investigations on a topic where the following studies are influenced by preceding studies. The review now provides a short overview of the key concepts for each of the subtopics, and aims to identify key research traditions for each of the fields. Where available, the following overviews are provided for each of the subtopics of knowledge utilisation:

- Selected research traditions and authors in the knowledge utilisation field;
- Selected types of research studies;
- Selected models;

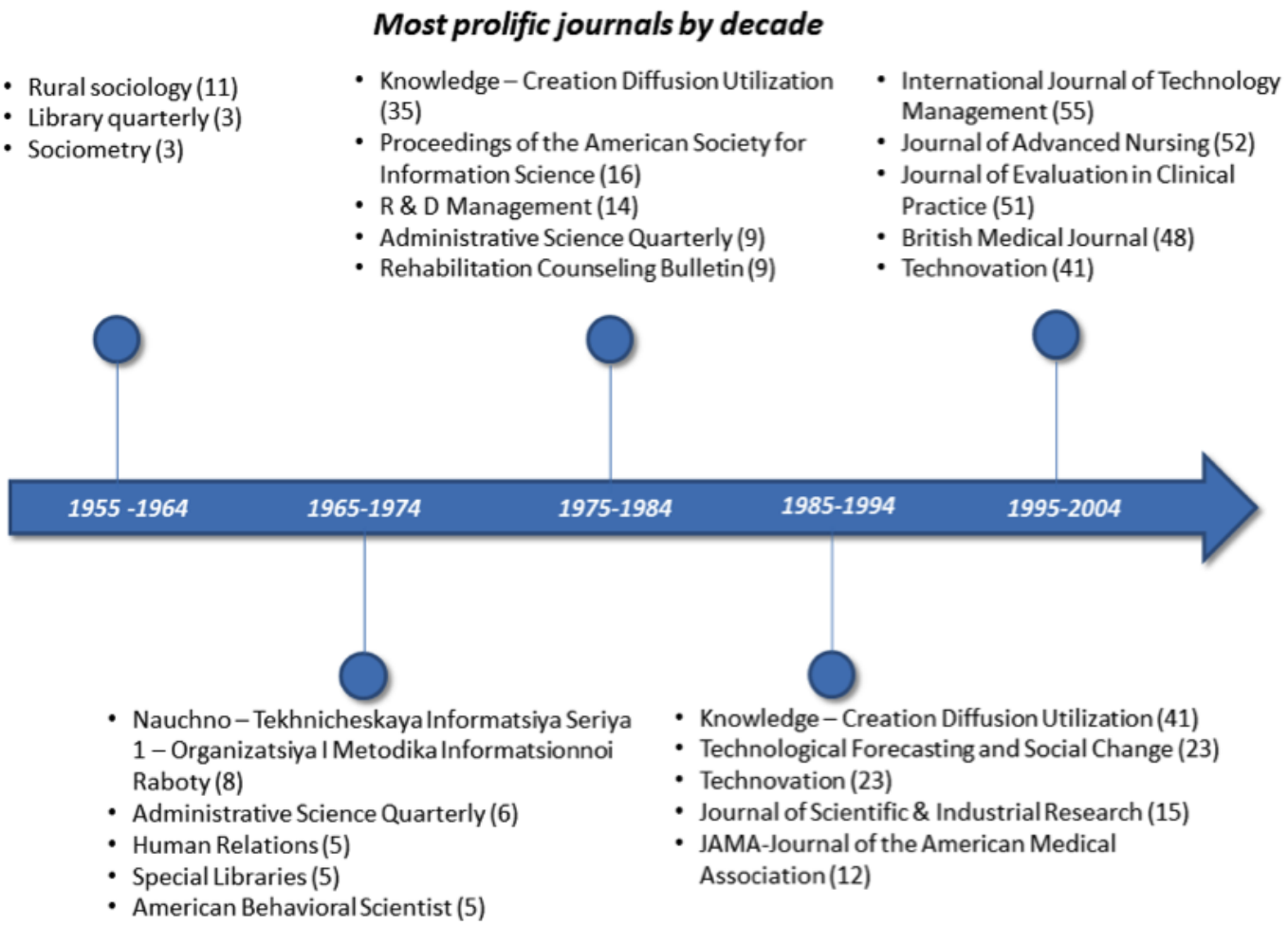
- Common criticisms of the models.

Diffusion of innovations as a field of study

Selected research traditions and authors in the field

Rogers (2003) states that although diffusion research originally started as a “series of scientific enclaves”, it later on emerged as a coherent and integrated body of scientific investigation. It has been possible to start to make a number of generalisations and to extract concepts from the wide range of studies that have been conducted in the fields of anthropology, early sociology, rural sociology (dominant until the 1960s), education, public health/medical sociology, communication, marketing, geography, general sociology, and a miscellaneous “other”. Rogers identifies the following major research traditions for the field of diffusion of innovations:

Table 10: Research traditions, innovations studies and type of findings (Redrawn from Rogers, 2003)



Selected types of study from the literature

Furthermore, Rogers identified eight key types of study for the field of diffusion of innovations:

Type 1: Earliness of knowing about innovations

The representative study that Rogers mentions is a news event study conducted by Mayers et al. (1990) of when and how people in Arizona and Phoenix in the United States had heard of the Challenger disaster.

Key findings of this study were that people could be categorised as early knowers and late knowers. The early knowers heard the news through media channels, while late knowers heard about it through other individuals. Individuals who learnt about it through other people then tended to turn to news channels to learn more about the event.

Type 2: Rate of adoption of different innovations in a social system

According to Rogers (2003), Fliegel and Kivlin (1966) investigated the rate of adoption of an innovation by questioning 229 dairy farmers in Pennsylvania on their perception of 15 attributes of 33 innovations. This data was then used to explain the rate of adoption of these innovations for the sample of dairy farmers.

A key finding of this study was that the innovations that were perceived to have the highest relative advantage, i.e. seemed most economically rewarding, were adopted more rapidly. Factors such as trialability, complexity and observability were deemed less important.

Type 3: Innovativeness

Deutschman and Borda (1962) (cited in Rogers 2003) tested the cross-cultural validity of findings by American researchers on innovativeness and the characteristics of such individuals. It was established that the findings of the studies conducted by Rogers on Ohio farmers were also valid for farmers in Columbia. The key findings were that innovators were more cosmopolitan, had a higher level of innovation and owned larger farms.

A second study of importance is Mohr's (1969) (cited in Rogers 2003) survey of directors of county departments in Ohio, Michigan and Ontario in Canada. The key findings were that the most innovative health departments had greater financial resources, were larger in size and had a director who was more committed to innovation.

Type 4: Opinion leadership

A key finding of this type of study is that opinion leaders play an important role in the success of diffusion programmes. This was found in a number of studies, such as driving the uptake of safe sex practices in gay communities in the United States. The generalizability of these findings were also tested in poor neighbourhoods in Chennai in India and in thirty-two poor villages in Zimbabwe.

Type 5: Diffusion networks

Coleman et al. (1966) (cited in Rogers 2003) studied characteristics of individuals and the determinants of that on their interaction with other individuals in a network. These issues were considered to explain the adoption of new medicines by doctors.

Key findings were that although similarity in age, religion, hometown and medical school attended were important in determining to what extent actors in the network interacted, the most important factor was professional associations between the actors, such as practising in the same clinic, hospital or office.

Type 6: Rate of adoption in different social systems

Rogers and Lawrence (1981) (cited in Rogers 2003) sought to explain the difference in adoption of innovations between systems i.e. to explain why certain villages in Korea were quicker to adopt certain innovations than others.

The key findings were that villages that were, for instance, faster at adopting contraceptives had families with relatively high exposure to mass media channels, had leaders with more connected networks in the village and had higher agent contact. Economic resources surfaced to be less important than these factors.

Type 7: Communication channel usage

Ryan and Gross's (1943) classical study of the adoption of hybrid seed suggested that individuals move through certain stages when they are in the process of adopting an innovation. Communication channel behaviour is also different at each of these stages and for various adopter categories. It was shown that early adopters seemed to be influenced by salesmen, whereas later adopters were influenced by individuals in their network, especially their neighbours, indicating that proximity also plays an important role.

Type 8: Consequences of innovation

Rogers (2003) mentions a key shortcoming of the field of diffusion studies to take on a pro-innovation bias. This assumption could be questioned if we consider a key study conducted by Sharp (1952) where they examined the impact of the diffusion of the steel axe in a tribe of aborigines in Australia.

Key findings were that the adoption of innovations may have far-reaching and unintended consequences. The stone axe was a symbol of masculinity and status for this tribe, and women and younger men had to ask older men who owned these axes for permission to use them via a customary procedure. Well-meaning missionaries who moved into the region started to distribute steel axes to tribe members as payment for work done or as gifts. This had the effect of disempowering the elders who used to be highly respected in the community,

as they then became dependent on women and younger men for access to steel axes. This caused major disruptions in this tribe and confused traditional age- and sex roles.

Table 11: Types of study in the field of diffusion of innovations (Redrawn from Rogers, 2003)

Type	Main dependent variable	Independent variable	Units of analysis	Approximate % of this type of total number of studies	Representative study
1	Earliness of knowing about an innovation by members of a social system	Characteristics of members (e.g. cosmopoliteness, communication channel behaviour)	Members of a social system	5%	Greenberg 1964
2	Rate of adoption of different innovations in a social system	Attributes of innovations (complexity, compatibility) as perceived by members of system	Innovations	1%	Fliegel and Kavlin (1966)
3	Innovativeness of members f a social system (individuals or organisations)	Characteristics of members (e.g. cosmopoliteness, communication channel behaviour); system-level variables	Members of a social system (individuals or organisations)	58%	Deutschman and Fals Borda (1962); Mohr (1969)
4	Opinion leadership in diffusing innovations	Characteristics of members (e.g. cosmopoliteness, communication channel behaviour); system-level variables; communication channel	Members of a social system (individuals or organisations)	58%	Deutschman and Fals Borda (1962); Mohr (1969)
5	Diffusion networks	Patterns in network links between two or more members of system	Dyadic network links connecting pairs of individuals	Less than 1%	Coleman et al (1966)
6	Rate of adoption of innovations in different social systems	System norms; characteristics of social system; change agent variables; types of innovation decisions	Social systems	2%	Rogers and Kinkaid (1981)
7	Communication channel use (e.g. mass media or personal)	Innovativeness and other characteristics of members of a social system; system norms; attributes of innovations	Members of a social system (or the innovation decision)	7%	Ryan and Gross (1943)
8	Consequence of innovation	Characteristics of members; nature of the social system; nature and use of innovations	Members of a social system or innovations	0.2%	Sharp (1952)

Rogers' Model of Diffusion of Innovations

Everett Rogers (2003), the leading scholar in the diffusion of innovations paradigm, uses "diffusion" to refer to the spread of innovations. An innovation is "an idea, practice or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2003:12) and "innovation diffusion" the "process by which an (1) innovation (2) is communicated through certain channels (3) over time (4) among the members of a social system" (Rogers, 2003:11). Four elements can be distinguished: the *innovation*, communication channels, time, and a social system. Each element from Roger's extensive work will subsequently be considered in more detail.

Element 1: Innovation

The notion of "new" is expressed subjectively and in relative terms – if something is perceived as new or considered for the first time by a potential adopter, regardless of how old it is, it is considered to be an innovation according to Rogers' terminology. Moreover, certain perceived attributes of innovations can accelerate their rate of adoption. Innovations that are adopted more rapidly tend to be perceived as:

Having a relative advantage, i.e. being better than the idea, practice or object that it supersedes;

Being compatible to the values, experiences and needs of potential adopters;

Lacking complexity, i.e. not being too difficult to understand and use;

Being trialable, i.e. can be experimented with on a limited basis before full-scale implementation; and

Having results that are observable or visible to others, as this may increase their decision to also adopt (Rogers, 2003:15-16).

Element 2: Communication Channels

> At its most elementary form, the process [of communication] involves (1) an innovation, (2) an individual or other unit of adoption that has knowledge of, or has experienced using, the innovation, (3) another individual or other unit that does not yet have knowledge of, or experience with, the innovation, and (4) a communication channel connecting the two units. (Rogers, 2003:18)

Thus, communication channels are structures through which the message about an innovation is conveyed among individuals. Although mass media channels also fulfil this role, transfer of knowledge about new innovations is mostly facilitated by interpersonal channels. Effective communication is more likely to occur when individuals are more homophilous, i.e. when the interacting individuals "are similar in certain attributes, such as beliefs, education, socioeconomic status, and the like" (Rogers, 2003:19). Geographical and social proximity is one determinant of homophily. However, as Rogers points out, in the diffusion of innovations the participants are usually quite heterophilous, especially in the case of directed adoption when change agents are used. These agents are often more educated or technically competent than the potential adopter. The ideal condition for rapid adoption is one where the individuals are heterophilous with regard to their technical grasp of an innovation, but homophilous in terms of socioeconomic status and education.

Element 3: Time

According to Rogers' model, the notion of time features in three ways in the diffusion of innovations. The first is expressed as chronological time, which represents the lapse of time from an individual's first awareness of a new innovation to his/her eventual adoption or rejection thereof. The second is expressed as relative time, which compares an individual's adoption to that of others in a social system, resulting in the individual being classified as an early or late adopter. The third conception of time pertains more to the innovation than the individual's behaviour, as it deals with the rate of adoption of an innovation, which is measured as the number of individuals in a social system who adopt the innovation within a certain time period (Rogers 2003). Rogers refers to these time elements as the (1) innovation-decision process, (2) innovativeness and adopter categories, and (3) rate of adoption, respectively. Each time element is discussed below.

Innovation-decision process: Rogers (2003:20) conceptualises five steps in the innovation-decision process, namely knowledge, persuasion, decision, implementation and confirmation. The innovation-decision process spans the period of time that it takes moving through the five steps, and this differs between individuals.

- ***Knowledge*** is acquired when the individual first learns about the innovation and how it functions. Three types of knowledge are essential. The first is "awareness-knowledge", which refers to information that an innovation exists. The others are "how-to knowledge", referring to knowledge about the correct (often technical) use of an innovation, and "principles-knowledge", referring to a general understanding of the principles and fundamentals underlying the working of the innovation.
- ***Persuasion*** refers to the attitude the individual develops towards the innovation, which can be either favourable or unfavourable. Innovation evaluation, i.e. selective perceptions of the advantages and disadvantages of the innovation – which are important at this stage, are generally obtained from within the individual's social network:

> This type of information, while often available from scientific evaluations of an innovation, is instead sought by most individuals from their near peers, whose subjective opinions of the innovation (based on their personal experience with adoption of the new idea) are more accessible and convincing to them. (Rogers, 2003:175-176)

- A ***decision*** is made when the individual either rejects or adopts the innovation, based on his/her knowledge and attitude. Often a decision is preceded by a small-scale trial, which can either be executed by the individual or by peers in the social network. Instances of active rejection will occur when the individual initially considered the use of the innovation but then, for various reasons (including the outcome of the trial), decides not to adopt. Passive rejection, on the other hand, signifies situations where the individual never really considered using the innovation in the first place.
- The three steps mentioned thus far all represent mental processes, such as thinking, reflecting and deciding. ***Implementation*** is a process that involves overt behaviour, as it refers to the innovation being put to use. It also covers the consequence of adopting the innovation. Moreover, during the process of adopting and implementing an innovation, re-invention of the innovation often occurs. Re-invention is "defined as the degree to which an innovation is changed or modified by a user" (Rogers, 2003:180). This tends to occur in various instances, for instance when the innovation is relatively complex and not easily comprehensible, when detailed knowledge about the innovation is lacking, when the innovation is a generic tool or concept with many

possible applications, or when the innovation must be tailored to fit the structure of the organisation of the adopting individuals. Generally, innovations that are characterised by higher degrees of re-invention during implementation also tend to display higher degrees of sustainability in the long run.

- ***Confirmation*** will be required if there are conflicting messages about the innovation once it has already been put to use. Such conflict creates a state of dissonance or internal disequilibrium, which can be reduced by discontinuance of the innovation. Two kinds of discontinuance are possible. The innovation can either be rejected in order for it to be replaced by a better development that is a logical successor (replacement discontinuance) or due of lack of performance and poor results generated by the innovation (disenchantment discontinuance). Often, however, discontinuance is impossible because of significant financial investments or other factors, meaning that some form of reinforcement is needed in order to guarantee the innovation's continued use.

Innovativeness and adopter categories: Innovativeness refers to the extent to which members of a social system are relatively quick to adopt a new innovation compared to others in the same system. Five adopter categories are used to classify members of a social system on the basis of their degree of innovativeness: Innovators, early adopters, early majority, late majority, and laggards (Rogers, 2003).

- ***Innovators*** are active information seekers, highly exposed to the mass media and risk-prone. Their key attribute is venturesomeness. However, because of this personality trait they often are the least integrated in a social network of peers, and tend to be more cosmopolitan in their social interaction. Innovators nevertheless act as gatekeepers, as they are the ones introducing new ideas into a social system, given their interconnectivity and proneness to innovation.
- ***Early adopters*** are the true opinion leaders in a social system. Compared with innovators, they are significantly more "local" in their social interaction (i.e. integrated in a social network of peers) and also enjoy great respect from their peers. They are looked up to and taken seriously by others in a social system with regard to their subjective evaluation and approval of new ideas and innovations.
- The ***early majority*** are not among the first to try out new ideas and innovations, but also not among the last. They constitute about one-third of the members of the social system to which they belong and frequently interact with others in that system. They are seldom considered to be among the opinion leaders but are followers who tend to deliberate for some time before completely adopting new ideas. They usually adopt new ideas and innovations just before the average system member.
- The ***late majority*** adopt new ideas just after the average system member. They also make up about one-third of their social system and their decision to eventually adopt is often the result of peer pressure. Their general orientation towards new ideas is that of scepticism.
- The final category, ***laggards,*** is composed of traditionalists, i.e. those do things in terms of what has worked in the past. Their interaction within the system is with the few other members who share a similar belief. Laggards are the last in the system to embrace new ideas and adopt innovations.

Rate of adoption: The rate of innovation, when presented cumulatively, tends to assume an S-shape. Initially only a few individuals (the innovators) adopt a new innovation. Thereafter, more and more individuals tend to adopt as the innovation spreads through the social system, resulting in the graph showing a steep climb. However, after a while the graph tends to level off, as there are only a few members in the system remain who have not yet adopted the innovation. The S-curve eventually reaches its asymptote and the diffusion process is complete (Rogers, 2003).

Element 4: Social System

Individuals, or whatever the set of interrelated units in diffusion research might be, are embedded within a social system. These units display a particular set of patterned arrangements, called structure, which affects any diffusion. Two sets of structure can be identified. The first is social structure, referring to the formal structure among the units, such as implied or explicit hierarchy, which ascribes a sense of regularity and stability to human behaviour, as knowledge of the social structure can be used to predict behaviour. The second is communication structure, which is an informal structure, normally "created in a system in which homophilous sets of individuals are grouped together in cliques" (Rogers, 2003:24). In ordinary language, communication structure sheds light on who is talking to whom and under what conditions. Knowledge of these two sets of structures provides valuable clues as to the behaviours of the members of a system, which, in turn, can help to understand their adoption of an innovation. In addition, any system is guided by norms, which are "the established behaviour patterns for the members of a social system" (Rogers, 2003:26).

The most innovative member of a social system, according to Rogers (2003), is often considered to be significantly deviant from the other members of a system, to the extent that he/she is never really perceived as an opinion leader. An opinion leader refers to "an individual [who] is able to influence other individuals' attitudes or overt behaviour informally in a desired way with relative frequency" (Rogers, 2003:27). A key characteristic of an opinion leader is that an individual's general orientation tends to reflect a system's norm: if

a system is very receptive to change, those regarded as opinion leaders will also be highly innovative, whereas if a system's norms are to resist change, the opinion leader's behaviour and attitude will reflect the same. More importantly, an opinion leader operates at the centre of interpersonal communication networks, which is why opinion leaders are strategically targeted by change agents (extension officers, representatives of commercial companies, etc.) in an attempt to diffuse their products and innovations among members of a social network. There is a risk, however, that, should an opinion leader significantly conform to the values and beliefs of the change agent because of persistent targeting efforts, the opinion leader will eventually lose credibility and thus also his/her central role and opinion leadership.

Furthermore, different units of a social system are involved in the decision to adopt or reject an innovation (Rogers, 2003). The most basic form, called optional innovation-decisions, is where an individual member decides to adopt an innovation, independent of the decision of any other member of the system. This contrasts with collective innovation-decisions, where consensus first needs to be reached among the units of the system, whereafter all members are obliged to adopt the collective decision. Authority-innovation-decisions are top-down decisions imposed on the members of a system by those in a position of authority. The role of the individual is decisive when distinguishing between the three types of innovation-decisions. In the case of authority decisions, the individual has no influence over the decision taken. In the case of optional and collective decisions, respectively, the individual takes complete responsibility for the decision or contributes towards the decision.

Key criticisms of the diffusion of innovations literature

Rogers (2003) identified four key shortcomings for the field of diffusion of innovations. He concludes that the original approach left an 'indelible stamp" on the way the subject was approached and studied. The four major criticisms can be summarised as:

1. ***The pro-innovation bias:*** It is assumed that innovation is a good thing, and that the goal should be for all members of the social system to adopt the innovation.
2. ***The individual blame bias:*** The focus in diffusion of innovation research is often on the individual and neglects the effect that a system may have on the behaviour of the individual.
3. ***The recall problem:*** Respondents are often asked in studies to recall when they adopted the diffusion, which may lead to inaccurate reporting.
4. ***The issue of equality:*** The diffusions of innovations may often lead to exacerbating inequalities in social systems.

> "..This book suggests that students of diffusion have been working where the ground was soft. The challenge of future research is to expand the area of digging and to search for different objectives than those of the past. Perhaps there is a need to dig deeper, in directions that theory suggests" (Rogers, 2004)

Technology transfer as a field of study

Introduction

The field of technology transfer has its roots in the research conducted by European social scientists and has gained acceptance as an area of inquiry. In the USA, the field started to attract attention in the 1920s and continued to grow until the late 1970s Researchers from various backgrounds including sociology, economics, technology, and education have contributed to this field of study (Backer, 1991; Rogers, 1995).

Bozeman lists a number of indicators to illustrate the rise of importance of this concept (Bozeman, 2000):Bozeman technology transfer

- In the United States much policy attention has been devoted to develop and pass at least eight initiatives to deal with and promote technology transfer.
- At least one academic journal, namely the Journal of Technology Transfer, is devoted to cover issues on the topic, while many professional organisations have started to include technology transfer in their mission statements.
- Technology transfer agents are acknowledged titles to describe individuals working in this field and are employed by many government and civil service institutions.

- The term “technology transfer” along with “technology diffusion” has been used in titles of hundreds of articles and books. It has been estimated that already in 1995 there were more than 10,000 documents on technology transfer.

Selected authors and research traditions in the field

Ramanathan (1994) makes a distinction between technology transfer and technology diffusion. He argues that rural sociologists such as Rogers and Shoemaker (1971) and Rogers (2003) defined technology transfer from the perspective of studying the diffusion of innovations. According to Ramanathan, using the terms technology diffusion and technology transfer interchangeably may lead to confusion.

From the technology diffusion perspective this may refer to the often passive spreading of a technology within a social system. Ramantahan argues that the distinction between diffusion and transfer is that transfer is goal oriented and can be defined as “the process of movement of technology from one entity to another” (Souder et al. 1990; Ramanathan 1994). A broader definition of technology transfer as outlined by Mittleman and Pasha (1997) who state that it is the “movement of knowledge, skill, organisation, values and capital from the point of generation to the site of adaptation and application”.

Successful transfer of technology constitutes the effective use the technology transferred and eventually assimilation of it by the receiving entity (Ramanathan, 1994). The transfer object as Bozeman’s analyses refer to it) may involve physical assets, knowledge (tacit or codified) or may even include knowledge and skills encapsulated within people, which entails relocating people to locations (Lindquist, 2003).

For the interested reader

Zhao, L.M. and Reisman, A., 1992. Toward meta research on technology-transfer. *IEEE Transactions on Engineering Management* 39 (1): 13–21.

The literature on technology transfer also focuses on the movement of technology from the university to industry, from public sector to industry, as well as from one domain to another (Philips 2002). Furthermore there is a growing body of knowledge on the transfer of technology from developed to developing countries. Attempts have been made to contrast and compare these transfer processes with those in developed countries in order to understand how they are different.

Table 12: Research traditions in the field of technology transfer (Adapted from Zhao, 1992)

	Area of research	Perspective	Key authors
Economics	Inter-Regional TT Inter-industry TT Intra-industry-TT	Macro-economics	(Arrow, 1969); (Johnson, 1970); (Dosi, 1988);
Economics	University – industry TT Public sector –private sector TT	Characteristics of objects/Nature/Phase of TT	Cohen and Levinthal (1989, 1990);
Development economics	TT in developing countries University TT in developing countries TT to developing countries	Development / catch-up/ reverse engineering	Chen (1994)
Management	Firm –level TT Inter-firm TT Intra-firm TT	Nature/Phase of TT	Extensively used
Anthropology	Cross-cultural TT Group/community/village program	Cultural change/ Institutional/Geographic	(Foster, 1962); (Service, 1971); (Merrill, 1972)

Views of technology transfer have been outlined by the various research traditions:

Some economists (Arrow, 1969; Johnson, 1970; Dosi, 1988) tend to take a macro view and consider technology transfer based on the characteristics of generic knowledge focusing mostly on production and product design (Agarwal, 1998); An alternative approach taken by economists focusing on the project level e.g. Cohen and Levinthal (1989, 1990) is from the perspective of the technology being transferred, the nature of the object as well as the phase of technology transfer.

Sociologists (Rogers, 1962; Rogers and Shoemaker, 1971) view technology transfer as a special type of communication process. Technology is considered as information, and through technology transfer information is put into use to accomplish some task (Eveland, 1986). The transfer process is the process whereby technology (or information) moves from one person or organisation to another. Therefore, technology transfer is the application of information (a technological innovation) (Gibson and Rogers, 1994).

Anthropologists (Foster, 1962; Service, 1971; Merrill, 1972) consider the technology transfer concept quite broadly in terms of how cultural change takes place and how technology affects change.

Zhao et al. (1992) provides insight into the various research traditions for the field of technology transfer. The following table is based on Zhao's analysis of the treatment of technology transfer by the various research traditions:

Selected types of study from the literature

Conceptual issues in technology transfer

The discussion on technology transfer is hampered by too many definitions and confusion in the field of how to define technology (Zhao et al., 1992, Bozeman, 2000). The definition of technology is treated differently across disciplines. This in turn affects the definition of technology transfer in general.

Firstly, a major conceptual challenge in the field of technology transfer is a historical lack of coherence in defining technology and technology transfer (Bozeman, 2000). Bozeman refers to Sahal (1981; 1982) as the only theorist who acknowledged that the transfer object, namely the technology, needs to rely on "subjectively determined but specifiable set of processes and products". Sahal says that simply focusing on the product that needs to be transferred is not sufficient in the study of the transfer and diffusion of technology. The process entails the transfer of not only the product, but also knowledge of how it is used.

In the second instance, outlining and defining the process through which technology transfer takes place is difficult as there are many concurrent processes (Bozeman, 2000).

Thirdly, it is difficult to measure the impact of technology transfer. Furthermore, the effectiveness with which the product is transferred needs to be defined. Bozeman (2000) states that developing a clear definition for effectiveness is also one of the most problematic aspects for measuring success.

Key readings

Bozeman, B. (2000). Technology transfer and public policy: a review of research and theory, *Research Policy* 29(2000): 627–655.

Chen, E. K. and Dunning, J. H. (1994). Technology transfer to developing countries. Routledge.

Sahal, D. (1981). Alternative conceptions of technology. *Research Policy* 10, 2–24.

Sahal, D. (1982). The form of technology. In: Sahal, D. Ed., *The Transfer and Utilization of Technical Knowledge*. Lexington Publishing, Lexington, MA, pp. 125–139.

Zhao, L., and Reisman, A. (1992). Toward meta research on technology transfer. Engineering Management, IEEE Transactions 39(1), 13-21.

The field of technology transfer is quite broad, as depicted in the diagram in the section above. Most relevant for the purpose of this document is the work done by a number of scholars who attempted to review the field of university technology transfer or public sector technology transfer. Agarwal (2003) outlines various types of research that treat these topics from a number of angles:

- Firm characteristics;
- University characteristics;
- Individuals' characteristics;
- Geographic proximity;

- Channels of technology transfer;
- Consequences and effectiveness of technology transfer.

Type 1: Firm characteristics

The research focusing on the characteristics of the firm mostly consider what influence the ability of the firm has to make use of externally generated knowledge. Various topics covered here include internal organisation, resource allocation, and partnerships (Agarwal, 2003).

Factors such as absorptive capacity (Cohen and Levinthal, 1990) and the degree to which universities are connected with firms outlined the importance of linkages for spillovers and engagement in research collaboration (Cockburn and Henderson, 1998). It was found that absorptive capacity is important, but so too is the recruitment of talented individuals, and rewarding researchers on their basis of effectiveness with which they engage with the public sector and private sector.

Type 2: University characteristics

A stream of research deals with the characteristics of universities that engage in technology transfer. For this type of research, topics studied covered licensing strategies, patenting incentives and policies that take equity in return for IP. Furthermore, some of these studies cover the determinants of spin-off activity in universities, resource endowment and capabilities of universities, as well as the environmental factors that impact on entrepreneurship by academics (Agarwal, 2003).

Type 3: Individual level characteristics

According to Agarwal (2003), this stream of research mostly deals with the personal characteristics of researchers and academics who engage in entrepreneurial activity. Audretsch (2000) for instance looks at how university entrepreneurs are different from normal entrepreneurs. Roche onsiders the personal attributes and characteristics of academics who exhibit academic entrepreneurship.

Type 4: Geographical proximity

This stream of research considers the impact of geography on localised spillovers. The spatial dimension is used to explain the relative success of university knowledge spillovers. In this type of study it was found that geographic proximity is required for successful technology transfer (Agarwal, 2003).

Type 5: Channels of knowledge transfer

The fifth category of study is those that consider the relative importance of the channels through which technology transfer takes place. This may include channels such as publications, patents, and consulting (Agarwal, 2003). The following channels of technology transfer are typically employed by universities:

- Publications;
- Patents;
- Consulting;
- Informal meetings;
- Recruiting;
- Licensing;
- Joint ventures;
- Research contracts;
- Personal exchange.

Type 6: Consequences and effectiveness

This category of study considers the consequences and effectiveness of technology transfer. Policy-makers and university leaders are increasingly trying to better understand how higher educational institutions can contribute regional or national competitiveness. The following studies are typical of this stream of research (Agarwal, 2003):

- Effectiveness and financial performance of university spin-off businesses;
- Economic impact studies of spin-offs on regional economies;
- Effectiveness of technology transfer studies (e.g. Bozeman, 2000),

Useful resources

Agarwal, A. (2003). University-to-industry knowledge transfer: literature review and unanswered questions. *International Journal of Management Reviews*, 3(4): 285-302

O'Shea, R., Allen, T. J., O'Gorman, C., and Roche, F. (2004). Universities and Technology Transfer: A Review of Academic Entrepreneurship Literature. Irish Journal of Management, 25(2).

Bozeman's Contingency Effectiveness Model

Bozeman (2000) focuses on the determinants of effective domestic technology transfer from universities to government laboratories and describes technology transfer with reference to five elements, namely the transfer agent, transfer medium, transfer object, transfer recipient and demand environment. The following table from Bozeman (2000) provides insight into the definitions and examples of these elements.

Table 13: Dimensions of the contingency effectiveness model

Dimension	Focus	Examples
Transfer agent	The institution or organisation seeking to transfer the technology	Government agency, university, private firm, characteristics of the setting, IT culture, organisation, personnel
Transfer medium	The vehicle, formal or informal by which the technology is transferred. The content and form of what is transferred, the transfer entity	License, copyright, CRADA, person-to-person, formal literature
Transfer object	The content and form of what is being transferred, the transfer entity	Scientific knowledge, technological device, process, know-how and specific characteristics of each
Transfer recipient	The organisation or institution receiving the transfer object	Firm, agency, organisation, consumer, informal group, institution and associated characteristics
Demand environment	Factors (market and non-market) pertaining to the need for the transfer object	Price for technology, substitutability, relation to technologies now used, subsidy, market shelters

Bozeman discusses the main findings and lessons learnt from recent scholarship on each of these five dimensions. We summarise only some of the most salient conclusions that he draws.

1) Characteristics of the transfer agent

- Etzkowitz (1994, 1998) focused on cultural changes within the new entrepreneurial university environment and shows a culture more conducive to industrially relevant work.
- Various studies (e.g. Lee, 1996) found much less enthusiasm among university faculty for business partnerships.
- Slaughter and Rhoades (1996) have focused on the effects of the cooperative paradigm on the structure of academic work, including salary distributions by field and faculty research choices. They suggest that more divisions - especially between the humanities and the natural sciences/engineering - are appearing because of these.
- In earlier studies by Bozeman and Coker (1992) they found that three types of effectiveness related to the transfer agent:

> Number of licenses related chiefly to the size of the lab; getting technologies out the door was best explained in terms of the missions of the laboratories and the composition of their R&D; market impact, measured in terms of commercialized technology, was best explained by research diversity and degree of commercial orientation of the lab. (idem: 640)

2) Characteristics of the transfer medium

- In a comprehensive study of transfer media, Roessner (1993) found that the most important category of interaction was contract research, followed by cooperative research. Few firms valued licensing and more formal

interactions.

- The verdict on science parks as a transfer medium remains ambiguous. In a recent study by Felsenstein (1994) it was found that location in a science park seems to provide no direct contribution to innovation, but does confer status and prestige, and these indirectly promote technology transfer and information flows.
- Not surprisingly, numerous studies increasingly recognise the role of human capital and training in technology transfer. Bozeman refers, among others, to work by Bessant and Rush (1995) on consultants, the study of Hicks (1993) on personnel exchange and secondment, and his own work (Bozeman et al. 1995) on informal relations among bench-level scientists.

3) Characteristics of the transfer object

- Grant and Gregory (1997) analysed the transfer of 'tacit knowledge' – an area that is receiving new attention – and found that the extent of transfer of tacit knowledge often has a major impact on the effectiveness of manufacturing technology transfer.
- An issue that has also received much attention is the extent to which transfer objects achieve commercialisation and their rate of commercial success. Various studies in the US (Roessner, 1993; Bozeman et al. 1995, Geisler and Clements, 1995) have shown that a minority of interactions are motivated by the prospect of directly realised commercial products. In addition, relatively few projects actually results in the company's commercialisation of technology transferred to the company.
- Where commercialisation is successful, Bozeman (1997) has found that projects were more likely to lead to a commercialised product if they were initiated by either the companies' R&D manager or by top managers in the company.
- Interestingly enough, Rogers and Bozeman (1997) in a study on 219 federal laboratory-industry partnerships, found that projects which involved basic research had higher costs but also a greater likelihood of yielding a commercial technology project.

4) Characteristics of the demand environment

- It is often assumed that the demand for technology is either market-push or market-pull. However, as Dalpe et al. (1002) show, the role of the public sector as the first user of technological innovations is equally important.
- In a study of technology transfer in the biomedical industry, Azzone and Maccarrone (1997) found that the critical demands for technologies and technical competencies is a major factor in determining market impact technology transfer success.

5) Characteristics of the transfer recipient

- According to Bozeman, studies that compare business and non-profit or government technology recipients have consistently found significant differences in process, barriers to effectiveness and indeed understandings of what is considered effectiveness (Kingsley and Farmer, 1997).
- There is evidence that the cooperative technology policy paradigm is taking hold - at least in the US. In their study interviewing companies' research directors and chief technical officers about sources of external technical knowledge, Roessner and Wise (1994) found that universities fared better than federal laboratories or other firms. However, with respect to sources of technical knowledge for new products and production processes, respondents rated in-house R&D as most important, with universities and government agencies being ranked well below sources such as customers, competitors, suppliers and consultants.

The following figure (copied from Bozeman) outlines variables examined in studies of university and government technology transfer. Bozeman's model basically unpacks technology transfer into "who is doing the transfer, how they are doing it, what is being transferred and to whom."

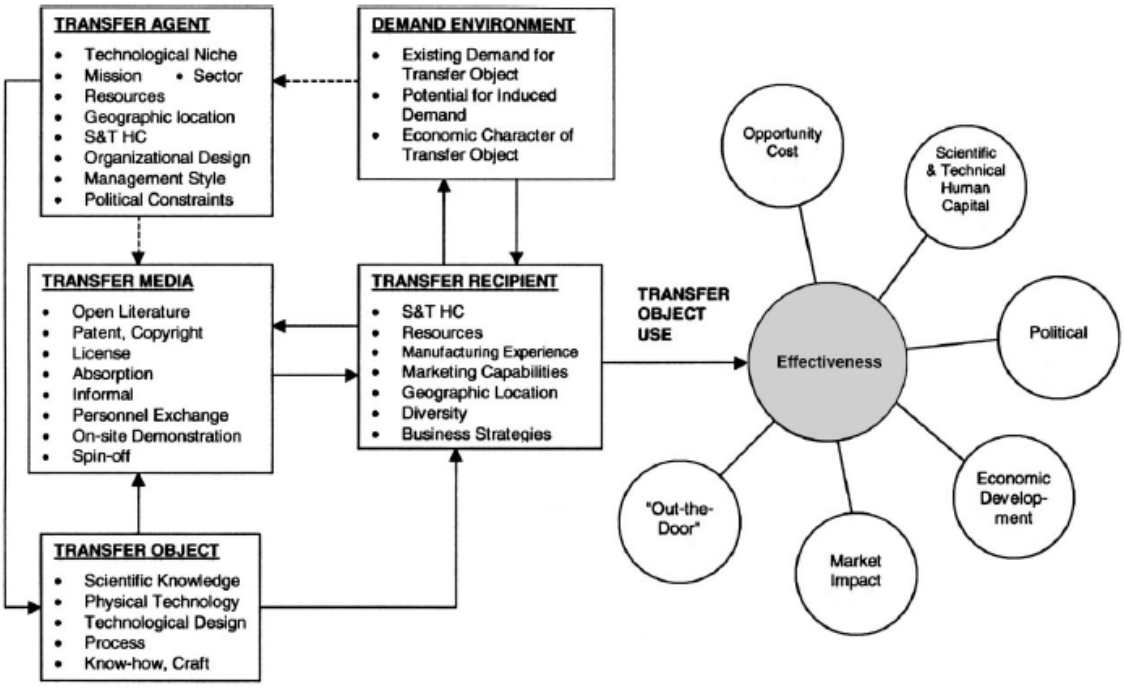


Fig. 1. Contingent Effectiveness Model of technology transfer.

Figure 3: Bozeman's contingency effectiveness model of technology transfer

In his final section, Bozeman discusses six effectiveness criteria: "Out of the door" transfer, market impact (e.g. on sales or profitability of the firm), economic development, political effects, opportunity costs, and scientific and technical human capital. The advantages and disadvantages of each of these criteria are discussed.

Table 14: Effectiveness criteria associated with the model

Effectiveness criteria	Focus	Relation to research and practice
"Out-the-Door"	Based on the fact that one organisation has received the technology provided by another, no consideration of its impact.	Extremely common in practice, uncommon as an evaluation measure (except in studies measuring degree of participation in technology transfer).
Market impact	Has the transfer resulted in a commercial impact, a product, profit or market share change?	Pervasive in both practice and research.
Economic development	Similar to Market Impact but gauges effects on a regional or national economy rather than a single firm or industry.	Pervasive in both practice and research.
Political reward	Based on the expectation of political reward e.g., increased funding flowing from participation in technology transfer.	Pervasive in practice, rarely examined in research.
Opportunity cost	Examines not only alternative uses of resources but also possible impacts on other than technology transfer missions of the transfer agent or recipient.	A concern among practitioners, rarely examined except in formal benefit–cost studies.
Scientific and technical human capital	Considers the impacts of technology transfer on the enhanced scientific and technical skills, technically social capital, and infrastructures e.g., networks, users groups, supporting scientific and technical work.	A concern among practitioners, -relevant rarely examined in research.

Useful resources

Bozeman, B., (2000). Technology transfer and public policy: a review of research and theory. Research Policy 29

(2000): 627–655.

Goktepe, D. (2005). Investigation of university industry technology transfer cases: a conceptual and methodological approach. The papers of Division of Innovation–LTH. 2007, January, Part, 2, 3-41.

Selected criticisms of the model

At the end of his review, Bozeman points out that despite hundreds of research studies on technology transfer over the recent decades, many topics are still neglected. Although we have learnt much, we still know very little about many aspects of the technology transfer process. We quote him in full:

> We still know almost nothing about technology transfer politics, including distributional outcomes of technology-based economic development. We have little understanding of many critical impacts, such as developments in scientific and technical human capital, occurring over long time periods. We know little about the impact of technology transfer activities on institutions, their designs and their full range of capabilities. (2000:650)

Bozeman continues to state that much political interest and interest of the research community well beyond the small hand full of researchers that study the field may have positive and negative implications for evaluation studies.

- On the positive side, much interest means that researchers will be careful in developing compelling arguments to support research findings.
- On the negative side, however, such interest may also result in a situation where findings may be distorted and such studies politicised.
- Furthermore, if effectiveness is defined as some short-term effectiveness it may also result in losing sight of longer-term aspects of effectiveness and impact (Bozeman, 2000).

Knowledge utilisation in the social sciences

Introduction

The debate concerning knowledge utilisation and science in the interest of society also extended beyond technology transfer to include the social sciences. In fact, in the social sciences both over-optimism and over-pessimism with regard to the utility of social science research could be observed. The greater part of the 1960s was characterised by an over-optimistic belief in the value and utility of social science research for policy. However, against a backdrop of growing evidence of the non-use of the results of social science research, a period of over-pessimism followed, where the value of social science research for policy making was seriously questioned (Wingens, 1990).

The work by Carol Weiss (e.g. Weiss, 1978, 1979, 1980) sheds significant light on the state of knowledge utilisation in the social sciences in those years. At that time the predominant line of thinking was that individual projects, specifically academic projects sponsored by government, should prove their relevance to society to the extent that the findings should be incorporated into policy documents and other structures. However, as Weiss (1978:20) points out, the state of policy research in the 1970s in the USA was faced with a paradox:

- On the one hand, millions of dollars were invested in applied social science research accompanied by a reported great interest by government officials.
- On the other hand, there was general consensus that social policy research had a negligible effect on policy decisions.

Rather than climbing on the bandwagon and attributing blame for the paradox at the usual places (policy-makers' unwillingness to accept that social policy research was not paying in terms of better decisions, a cultural gap between academics and policy-makers, etc.), Weiss argues that the main reason for the paradox lay in the interpretation of the notion of 'utilisation' in social policy research. Despite some negativism and even pessimism about the utility of science, the 1970s saw the emergence of an increased focus on accountability as a result of public expenditure on science, pushing research utilisation "into the forefront as a concern for federal program managers" (Larsen, 1989:423).

Selected models of social science in policy making

Generic models of knowledge utilisation

Over time, different models emerged from reflections on various studies of knowledge utilisation. One of the more comprehensive typologies were identified by Landry, Amara and Lamari (2001), where they distinguish between the science-push model, demand-pull model, organisational interest model, dissemination model and interaction model:

The ***science-push model*** views scientific research and its associated processes and products as the key determinant of knowledge utilisation. Researchers are considered central to the knowledge utilisation process – topics originate with them, which they then research and consider in terms of available evidence, and report on as a set of findings for potential users. Users are perceived as passive receptors of research. Studies located within this model, for instance, focus on the extent to which knowledge utilisation is determined by research types (basic/applied, quantitative/qualitative, etc.) as well as by the attributes and dimensions of the ensuing results (reliability, importance, etc.). Thus, this model explains utilisation in terms of research types and the researcher's context. The science-push model implies a simple linear model, from researcher to user; one where research advances are assumed to automatically find their way into application. This model has been criticised as it does not make explicit reference to linkages between researchers and users; it ignores the fact that research findings require some form of transformation or translation in order to become usable knowledge, and that some entity (individual or organisation) is required to facilitate the knowledge transfer.

According to the ***demand-pull model,*** knowledge utilisation is increased when the research problems are determined by users and the researchers are contractors who provide the results in return for payment. Knowledge utilisation is thus enhanced when researchers turn their scholarly attention towards investigating topics and needs as identified by users, rather than to the advancement of knowledge alone. Thus, the model explains utilisation in terms of user needs. This model is also linear – it differs from the science-push model in the sense that users are considered central to the knowledge utilisation process. Researchers are merely responding to the needs of users in order to provide them with the knowledge requested. This model has been criticised for ignoring the organisational interests of users, because utilisation can be hampered in cases where the results do not support the objectives or expectations of the contracting organisation.

The ***organisational interest model*** is an extended version of the demand-pull model and includes the organisational interest of users and other organisational factors in the explanation of utilisation. The focus is on the ways in which the organisational structures, rules and norms of the user organisation facilitate utilisation. Both the demand-pull and organisational interest models focus too much on the interest of users and, like the science-push model, ignore the interaction between researchers and users as a mode of knowledge transfer.

According to the ***dissemination model*** effective utilisation is a function of active dissemination efforts and mechanisms, and specifically the dissemination of research information packaged in a way that it meets the peculiarity of the user milieu. Thus, the model's explanatory power lies in the efforts made at utilisation and the adaptation of research products for users. The disseminated information is considered to have reached its intended audience once the audience becomes aware of the information. However, awareness and reception do not necessarily imply actual use of the research results, and the model does not provide space for the involvement of users in the selection of research information to be transferred, or in the production of research results.

The ***interaction model*** claims that knowledge utilisation "depends on various disorderly interactions occurring between researchers and users" (Landry et al., 2001:335). This model is an overarching one as it captures all the explanatory factors of the other models: research types and nature of results, needs and organisational interests of users, dissemination, and linking structures. Particularly important is the interplay of explanatory factors, and the interaction between researchers and users during the various stages of knowledge production, dissemination and utilisation. Generally, the more sustained and intense the interactions between the researchers and users are, the greater the likelihood is of utilisation. Thus, it is the linkages between researchers and users that are important in this model.

The question to be asked about these models is what they actually represent. Are they heuristic tools to classify different studies of knowledge utilisation? This is not necessarily true as Landry et al. (2001) cite elements of the same study to illustrate different models. The discussion of the models by Landry et al. also suggests some chronology in their development and use (i.e. that the one precedes the other) as can be deduced from the following quote: "The interaction model has been developed to overcome the criticisms of the previous models" (Landry, 2001:335). Again this is not necessarily the case. Huberman (1990:364), for instance, noted that, during the fifty years prior to his paper, the nature of interactions between researchers and practitioners had already constituted a primary focus within studies of knowledge utilisation. It is therefore best to say that the models as conceptualised by Landry et al. organise different foci and interests in the study of knowledge utilisation but that these are not mutually exclusive. The work by Landry et al. thus provides a

framework of "ideal types" of knowledge utilisation approaches.

Moreover, the models by Landry et al. (2001) are elaborations of earlier conceptual work by others, such as Weiss (1979) who originally distinguished between linear and interactive models. In Weiss' conception, the models were not presented as frameworks that highlight and organise aspects of various studies of knowledge utilisation, but as models trying to exemplify how (social research) knowledge is actually used in the policy domain.

Weiss' (1979) ***problem-solving model,*** a linear model, typifies situations where (1) a problem is identified, (2) a solution is not possible on the basis of existing information either because information is lacking, or no consensus could be reached among the alternatives given that crucial information is lacking; (3) research provides the missing knowledge; and (4) on the basis of the research findings, the policy-makers can reach a solution. Research, within the problem-solving model, is thus seen to provide solutions to identified problems. The need for a decision to be made in response to a problem is the actual drive behind the research. Weiss mentions two ways by which social science research can enter the policy arena. The first is where the policy-makers do not commission new research in response to the pending policy decision but consult existing research instead. The second is when new research is commissioned. Yin and Moore (1988) equated the problem-solving model to a demand-pull model, a notion that would later also feature in the classification by Landry et al. (2001).

Another linear model discussed by Weiss (1979), the ***knowledge-driven model***, is an ideal of research utilisation in the social sciences, taken directly from the natural sciences. In essence, it is a model where basic research provides new insights, which are then further refined and tested through applied research to determine their practicality. In turn, new technologies can be developed which, eventually, could also be adopted and applied. This description represented for Yin and Moore (1988) a technology-push or science-push sequence.

An ***interactive model*** is present when stakeholders participate in various consortia and other forms of interaction (face-to-face meetings) to pool their knowledge and insights to arrive at solutions for decisions or courses of action. Within this model the use of research is not central but "only one part of a complicated process that also uses experience, political insight, pressure, social technologies, and judgment" (Weiss, 1979:428).

In these earlier models by Weiss (1979) the knowledge producers and knowledge users are typically contrasted, with the flow of knowledge either one-directional (from producer to user = knowledge-driven model; or from user to producer = problem-solving model), or facilitated through some sort of interaction between the two parties. It is therefore not surprising that a new perspective emerged in which researchers and users were considered to represent two distinct communities. Caplan (1979) presented this perspective as a two-communities theory. Dunn (1980) doubted whether this represents a theory in the true sense of the word, and instead refers to it a metaphor that allows for analogies.

The two-communities metaphor

The two-communities perspective explains differences in utilisation on the basis of cultural differences between the two domains involved – the science production and policy-implementing domains respectively. The different values, language, reward systems, and social and professional affiliations of these two domains result in a so-called cultural gap, and the cultural gap can only be closed by strengthening interaction between the two communities. The cultural gap is only one of many gaps between the research and practice communities. Other gaps are the following.

Table 15: The gaps highlighted in the two-communities perspective (Source: Haddow and Klobas, 2004: 31)

Gap	Nature of gap
Knowledge gap	• Research has potential to provide practitioners with knowledge to improve their practice but the two communities do not communicate effectively.
Culture gap	• The two communities do not understand each other or respect each other's type of work.
Motivation gap	• Practitioners are not interested in research.
Relevance gap	• Two-communities value investigation of different types of problems.
Immediacy gap	• Practitioners need quick solutions while academic research can be a lengthy process.
Publication gap	• Few research publications in a particular field and practitioners do not contribute to those available.

Reading gap	• The two communities do not read each other's literature.
Terminology gap	• The two communities use different terminology so that one is not understood by the other.
Activity gap	• Practitioners do not really do research.
Education gap	• Practitioners do not have the knowledge and skills to do research.
Temporal gap	• Practitioners do not have time to read research or engage in research activities.

Awareness of potential "gaps" between the domains of the producers and users of the research can enrich a case study, as it provides a particular frame through which to view interpretations of the distance or closeness between the two communities.

Wingens (1990), however, objected to the two-communities metaphor on the basis that a viable utilisation model should not be built around the notion of two culturally different communities but around the notion of functionally differentiated social systems. A culturalistic conception of the two-communities perspective highlights the orientations and practices of individuals (i.e. scientists and policy-makers), whereas, according to a systems conception, the focus is not on individual life forms but on the structural conditions and constraints under which representatives of social systems have to act. The culturalistic conception was formulated in an attempt to account for non-use of social science research by policy-makers. Thus, a culturalistic conception of knowledge utilisation stresses the distinctiveness and separateness of the knowledge production and utilisation domains. However, as Wingens (1990) pointed out, the two domains are not that separate: policy-makers hold university degrees and have to assess research as part of their routine work; researchers, on the other hand, are familiar with the public sphere (through consultancy and other forms of engagement, among many things). He therefore proposed a systems approach that focuses on successful interaction between systems as well as successful utilisation, with the gap between the two socially different systems serving as a starting point for explanation, and not as an explanation itself as in the two-communities perspective.

Dunn's model

For Dunn (1980), as already mentioned, the value of the two-communities perspective lies in that it acts as a metaphor or constructive analogy from which one can derive diverse explanations for the use (or non-use) of social science research by policy-makers. These competing explanations, according to Dunn, can be grouped into five models. Two of the models (inquiry-contingent model and product-contingent model) cover aspects relating to the scientific community. The next two models cover aspects that relate to the policy-making community (problem-contingent model and structure-contingent model), and the last aspects relate to interaction between the two communities (process-contingent model).

- According to the ***inquiry-contingent model,*** the modes of inquiry by which knowledge is created (quality of research design and strategy, and analytical method) determine the extent of knowledge use by policy-makers.
- The ***product-contingent model,*** on the other hand, claims that the scope of knowledge used by policy-makers is a function of the characteristics of the products of social science research. In other words, the form, content, language, length, validity and reliability of the knowledge output have a direct bearing on its use or non-use.
- The nature and characteristics of the policy problem(s), according to the ***problem-contingent model,*** are key factors in determining the extent to which scientific knowledge is used to resolve the problem. For instance, the complexity of the policy problem and the levels of uncertainty and risks involved may play a role in knowledge use.
- The ***structure-contingent model*** claims that the formal structures, procedures and incentive structures of the organisation responsible for knowledge use determine the actual extent of knowledge use.
- Lastly, the ***process-contingent model*** focuses on the interaction between knowledge producers and the potential users thereof; the extent of knowledge use is considered a direct function of the nature of interaction.

What the different models by Dunn (1980), Landry et al. (2001) and Weiss (1979) reveal, apart from suggesting optimal conditions for utilisation, is the recognition that different elements (actors, actions, structures, conditions, products, etc.) can be discerned in any study of knowledge utilisation. Moreover, although these models are derived from studies of research use by policy-makers, the elements apply equally to studies outside the policy domain, such as technology transfer.

The knowledge utilisation paradigm of clinical health practitioners is inextricably linked to evidence-based medicine (EBM), a movement that has dominated the scholarly debate on clinical practice and evaluation for more than a decade (e.g. Bandopadhayay, Goldschlager and Rosenfield, 2008; Estabrooks et al., 2008; Howland, 2005). The EBM movement partly emerged as a response to physicians' reliance on a variety of knowledge sources and approaches for the treatment of common similar conditions, which is believed to have implications for the cost-effectiveness of treatment. Personal preferences of physicians, often disguised as the "art of medicine", tend to take precedence in treatment, and it is this personal preference that results in inconsistency of care (Golec, 2009). EBM therefore developed with two objectives in mind:

to ensure the quality of health care by strengthening the scientific base of clinical practice (and thus restricting opinion-based decisions) and to control costs by reducing wasteful expenditures on ineffective treatment interventions (Timmermans and Kolker, 2004).

Moreover, the intention behind EBM is to change the decision-making process, or clinical judgement of physicians, and not to introduce a new philosophy of medicine as many seem to believe.

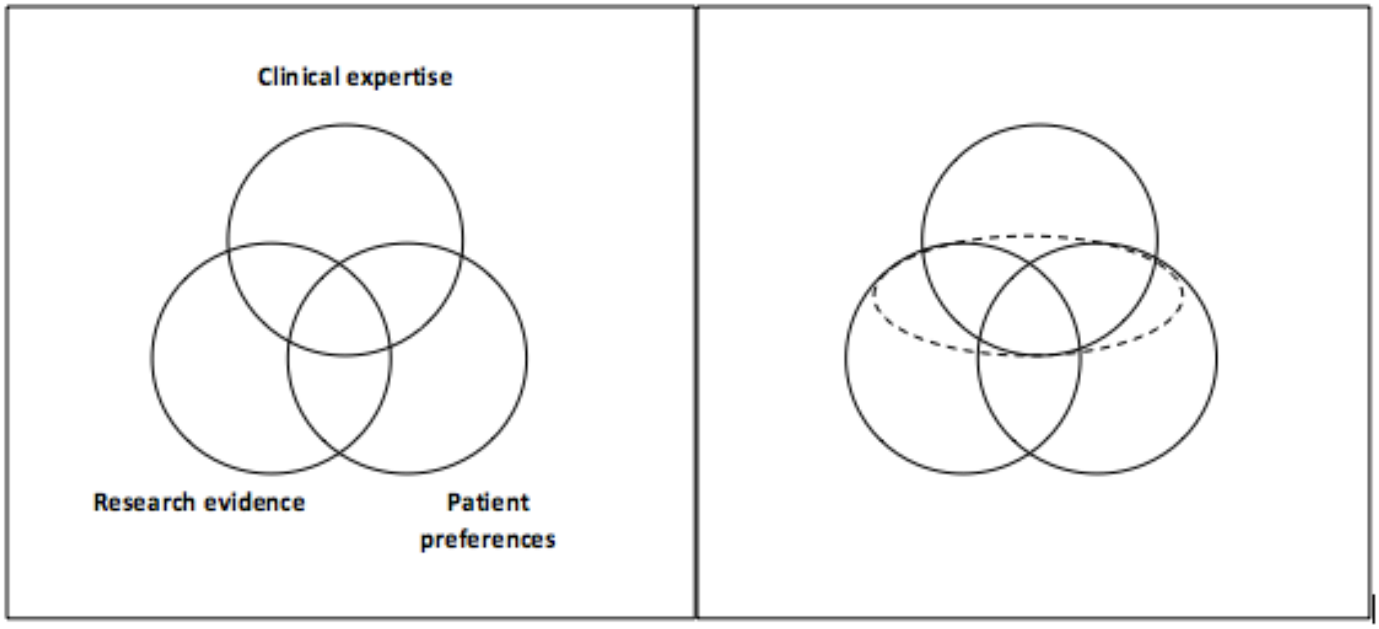
Selected questions asked and answered

Elements of EBM

Although the philosophical roots of EBM can be traced back to as early as mid-19th century Paris, one of the first and perhaps clearest attempts to demarcate the notion of EBM occurred as recently as 1996, in an editorial by David Sackett and colleagues in the British Medical Journal:

Evidence-based medicine is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research. By individual clinical expertise we mean the proficiency and judgment that individual clinicians acquire through clinical experience and clinical practice. (Sackett et al., 1996:71)

Based on this definition, EBM involves three core elements: current best evidence, clinical expertise, and individual patients. The patients not only present a set of clinical symptoms and complaints but also exhibit personal preferences. The configuration of the three core elements in the construction of EBM, however, has shifted with time, as Lambert (2006) highlights and which is also illustrated in Figure 4. The key modification is that clinical expertise, initially portrayed as equivalent to research evidence, and patient preferences in clinical decision-making have now come to assume a central position in that process (or at least in theory). Clinical expertise refers to competence that is gained through education, training and experience (APA Presidential



Task Force on Evidence-Based Practice, 2006). Haynes, Devereaux and Guyatt (2002), who are credited with the updated model in Figure 4, emphasise the rational decision-making aspects of EBM. In the rational model the patient's clinical and physical circumstances provide the first clue as to the nature of the problem and the treatment options available. These options are then weighed in terms of available research to determine the most appropriate course of action, taking the potential consequences associated with each into consideration. However, the patient's preferences and likely actions in response to treatment also need to be considered. The physician therefore relies on clinical expertise to balance the different considerations in order to reach an informed decision about the most appropriate treatment that will also be acceptable to the patient. Sackett et

al. (1996) stress the centrality of clinical expertise.

> External clinical evidence can inform, but can never replace, individual clinical expertise, and it is this expertise that decides whether the external evidence applies to the individual patient at all and, if so, how it should be integrated into a clinical decision. (Sackett et al., 1996:72)

Figure 4: Initial and updated model of EBM

Source: Lambert (2006:2636-2637)

Evidence in EBM is generally understood to be research evidence of a quantitative nature, especially evidence that has been generated by randomised controlled trials. Moreover, not all research should be used in clinical practice; only that which has been "appraised and found to be of sufficient rigour" (Bannigan and Bryar, 2002:270). This highlights the importance of critical appraisal of evidence. The principles of EBM clearly state what qualifies as proper and rigorous evidence:

- Clinical decisions should be based on the results of high-quality epidemiological studies, clinical intervention trials, and other robust research designs on human subjects.
- The prognosis of disease, and the benefits and harm of different management options, should be expressed as mathematical estimates of probability and risk.
- Randomised controlled trials are more valid and generalisable than 'anecdotal' evidence when assessing interventions.
- Secondary sources of research, especially systematic reviews and the guidelines derived from them, can summarise the relevant research evidence on a topic and provide the busy clinician with a useful short cut to the 'clinical bottom line'.
- The recommended approach to clinical problems is as follows: formulate a focused question, search the literature for relevant research evidence, appraise the evidence for its validity and usefulness, and apply the results. (Sackett et al., 2000, in Greenhalge, 2002:397).

With regard to the recommended approach in EBM (the last bullet listed above), Ely et al. (2002) investigated the obstacles that physicians typically experience when trying to answer clinical questions with evidence. These are: the amount of time needed to find information; difficulty in modifying the original question when it is vague and open to interpretation; difficulty in selecting an optimal information search strategy; failure of a seemingly appropriate resource to provide an answer; uncertainty as to when sufficient relevant evidence has been obtained so that the search can be stopped; and difficulty with integrating multiple pieces of information into a clinically useful statement. Within this context, according to Boissel et al. (2004), published scientific research acts as a primary (direct) source of information for physicians, whereas intermediaries act as a secondary (indirect) source. Examples of intermediaries are medical journalists and pharmaceutical industry marketing staff, and the products produced by these intermediaries, for instance, clinical practice guidelines, summaries and Cochrane systematic reviews1. From a physician's perspective, however, intermediaries are often preferred, simply because of a lack of time and the lack of technical ability to engage with all scientific developments in a field.

Similarly, Guyatt et al. (2000) highlighted two strategies to ensure evidence-based care. The first is to train physicians to interpret the medical literature. However, this is not the best strategy because not all practitioners have an interest in acquiring advanced skills in assessing and using the original literature, and there is also the issue of time constraints. The second and more practical strategy is to produce secondary resources, containing pre-appraised synopses, conclusions and recommendations. This also appears to be the preference of practitioners. McColl et al. (1998), for instance, conducted a questionnaire survey of general practitioners' perceptions of the route to EBM. The practitioners surveyed expressed a generally low level of awareness and use of extracting material from journals, review publications and databases relevant to EBM. This was largely attributed to a lack of personal time. Most respondents also reported an understanding of the technical terminology used in evidence-based publications, but less than one-third indicated that they would be able to explain it to others. Moreover, more than half of the survey respondents (57%) believed that the best way to shift from opinion-based practice to evidence-based practice would be by using clinical practice guidelines developed by colleagues.

Clinical practice guidelines are regarded by EBM proponents as important mechanisms to close the research-to-practice gap. In fact, the "dilemma" of EBM is that the clinical management of individual patients lies at its core, but that individually tailored treatments cannot be readily informed by the results of clinical research or randomised clinical trials as these are derived from the study of populations (Lambert, 2006). Thus, in EBM, a reliance on clinical practice guidelines is increasingly promoted as a method to bridge the gap between the

1 *Cochrane reviews are often considered as the highest standard in evidence-based health care. It involves the systematic review of controlled trials, with each review addressing a clearly formulated question (e.g. Can X alleviate the symptoms of Y?). Cochrane reviews are published in the online Cochrane Library (www.cochrane.org/cochrane-reviews).*

results of clinical research and the care of the individual (Tonelli, 2010).

Earlier examples of clinical practice guidelines, i.e. prior to the advent of EBM, were based on the opinion of experts. Nowadays, however, under influence of EBM, procedures exist for the critical appraisal and systematic grading and weighing of available clinical evidence, where only those to be found of sufficient rigour are converted into a set of practice guidelines. Thus, clinical practice guidelines, in the modern sense, are expressions of factual knowledge with an underlying science base. On the other hand, earlier examples of clinical practice guidelines, and therefore also earlier studies of such guidelines, also included expertise-based practical knowledge, given that these pre-EBM guidelines were largely opinion-based. Moreover, although consensus statements are something different from clinical practice guidelines, they are sometimes also grouped under the header of practice guidelines. Consensus statements are based on the collective opinion of a panel of experts (Bousquet et al., 2008). Thus, in the case of consensus statements, we are also dealing with opinion-based expertise, or mainly practical knowledge that has been externalised, codified and written up as recommendations.

Clinical practice guidelines have been thoroughly studied in the EBM literature and the insights derived from some of these studies, for instance, regarding the uptake of guidelines in practice, are also relevant for the purposes of the current research (e.g. the uptake of factual knowledge in practice). It is also worthwhile pointing out that clinical practice guidelines feature in two ways in the EBM movement: Firstly, under the influence of EBM, a strong scientific evidence base has been injected into clinical practice guidelines, and secondly, related to this, clinical practice guidelines have become carriers of the most preferred evidence type in EBM, which is research.

Practice guidelines as carriers of research evidence in EBM

Clinical practice guidelines are considered one of the key mechanisms in the facilitation of EBM, next to systematic reviews (primarily Cochrane reviews), professional education and continuous development. Burgers et al. (2003:15) define clinical guidelines as “documents that contain a set of individual recommendations covering one specific disease area”. Clinical practice guidelines normally have their origin in published research findings that have been synthesised (Haynes and Haines, 1998). Silagy, Stead and Lancaster (2001), for instance, investigated the extent to which clinical practice guidelines incorporate evidence from available systematic reviews of clinical research (mostly Cochrane reviews). In their example, on average, no more than 36% of recommendations in the guidelines on smoking cessation, published between 1994 and 2000, were supported by Cochrane reviews.

Davis and Taylor-Vaisey (1997 – no page number) provide a detailed account of the steps involved in the production and dissemination of clinical practice guidelines:

> First, a local group or, more often, a national body decides to develop guidelines in a clinical area in which there is a demonstrated need for such guidelines. Second, data are synthesized from research information and relevant practice patterns by searching the literature (including existing guidelines) and then weighing the strength of the evidence from the resulting trials or studies. Third, these data are further reviewed, appraised, distilled and collated as guidelines; that is, as recommendations about strategies for investigation and management. Fourth, the sponsoring organization and other interested organizations then endorse the guidelines. Fifth, [clinical practice guidelines] are disseminated, usually by traditional means such as mailing them to members or publishing them in recognized professional clinical journals. Sixth, various groups or individual practitioners may attempt to implement the guidelines more actively, through various, often multiple, strategies to assist, convince or otherwise influence physicians, patients and their caregivers. Finally, the guidelines are subjected, albeit irregularly, to re-appraisal, evaluation and reiteration of the process.

Clinical practice guidelines, once disseminated, can be modified or discontinued for a number of reasons. These include, among others, changes in current evidence on the benefits and harm of interventions, new treatments that emerge which supersede or complement existing ones, changes in the values placed on certain treatment options, etc. (Shekelle et al., 2001).

A question that arises is to what extent clinical practice guidelines are in fact being used by physicians. Grol (2001), for instance, found that guidelines are followed, on average, in 67% of decisions made by physicians but the figure differs by the kind of guideline involved (e.g. even as low as 34-36% in some cases). Timmermans and Kolker (2004) cited various studies where it was found that adherence to clinical practice guidelines in the diagnosis and treatment of asthma is relatively poor. Grilli and Lomas (1994) reported compliance rates that vary between 43% and 64%, depending on the area of clinical practice. The general perspective is that clinical practice guidelines are underutilised and associated with low compliance rates (Gagliardi et al., 2011).

A number of researchers studied the attributes of clinical practice guidelines or factors surrounding such guidelines that influence their uptake in clinical practice. Groll et al. (1998), for instance, reported a higher

compliance rate for guideline recommendations based on scientific evidence compared to those that do not incorporate scientific evidence (71% versus 57%). Moreover, recommendations that are non-controversial and compatible with current values, precisely and correctly described, specifically formulated and not demanding changes in existing routines are more likely to be adhered to than guidelines lacking these attributes. In a similar line, Foy et al. (2002) found two attributes of guidelines to be significantly associated with higher compliance rates, namely the extent to which a guideline is compatible with a user's current norms and values, and the extent to which it does not require changes to fixed routines or habits.

Burgers et al. (2003) compared the attributes of clinical practice guidelines with high compliance rates to the attributes of clinical guidelines with low compliance rates, and examined the nature of the differences between the two sets of guidelines. Specifically, 96 key recommendations were selected from 29 available clinical guidelines that were developed by the Dutch College of General Practitioners and which appeared in a scientific journal for general practitioners. Altogether 63 of these recommendations had high compliance rates and 33 had low compliance rates. A panel of general practitioners was asked to determine the extent to which twelve attributes (six potential facilitators of use and six potential barriers to use) were either present or absent in the recommendations. As it turned out, recommendations with high compliance rates were more often supported with explicit references to evidence, more often compatible with existing norms and values, less often part of a complex decision tree, and less often requiring new skills. According to Cólon-Emeric et al. (2007), physicians in nursing homes (together with other nursing staff) often express the belief that clinical practice guidelines and other protocols are not reconcilable with individualised patient care and are also inferior to professional experience. Overall, Davis and Taylor-Vaisey (1997) highlighted six categories of factors, based on their review of the literature, that can either impede or facilitate the adoption of guidelines in clinical practice. These pertain to the qualities of the guidelines (e.g. relative advantage, compatibility with existing values and beliefs), characteristics of the health care professional (e.g. demographic variables such as age and country of training), characteristics of the practice setting (e.g. beliefs of colleagues and existing organisational structures and procedures), incentives (e.g. compensation for particular procedures), regulation (e.g. accreditation for hospitals based on guideline adherence), and patient demands (e.g. patient preferences influencing compliance). The bottom line is that clinical practice guidelines, in order to be adopted:

> … should be user-friendly and based on the best evidence, without necessitating significant changes to existing practice routines. Guideline recommendations should be clear and suited to most patients. Furthermore, they should discuss patient preferences and fears experienced by patients and participants. (Dahan et al., 2007:617)

Implementation of practical guidelines

Recently, Gagliardi et al. (2011) made a first attempt at a conceptual framework to guide the adoption and implementation of practice guidelines. Specifically, they provide a taxonomy involving eight domains or clusters of elements that need to accompany guidelines in order to facilitate their use (Table 16). This approach is firmly located in the domain of knowledge translation where the focus is on developing and implementing strategies for effective research use. For that reason, for instance, apart from conveying guideline content, the guidelines should also equip potential users with appropriate strategies to identify relevant barriers of uptake, and even go a step further by including strategies to tailor guidelines for adoption in local contexts.

Table 16: Conceptual framework of implementability of practice guidelines (Source: Gagliardi et al. (2011, Tables 2 and 4))

Domain	Definition
Adaptability	The guideline is available in a variety of versions for different users or purposes.
Usability	Content is presented, organised, or formatted to enhance the ease with which the guideline can be employed (e.g. easy navigation; evidence presented in narrative or tabulated format, or both).
Validity	Evidence is summarised and presented such that its quantity and quality are apparent, and it can be easily reviewed, understood, and interpreted (e.g. total number of distinct references to evidence upon which recommendations are based; a system is used to categorise quality of evidence supporting each recommendation).
Applicability	Contextual or supplementary clinical information is provided by which to interpret and apply the recommendations for individual patients (highlighted as tips or practical issues using sub-titles or text boxes, or summarised in tables and referred to in recommendations or narrative contextualising recommendations).

Communicability	Information is included to support discussions with patients, or patient involvement in decision-making (e.g. Informational or educational resources for patients/caregivers, questions for clinicians to facilitate discussion).
Accommodation	Costs, resources, competencies and training, technical specifications, and anticipated impact required to accommodate use are identified (e.g. anticipated changes in workflow or processes during/after adoption of recommendations; direct or productivity costs incurred as a result of acquiring resources or training needed to accommodate recommendations).
Implementation	Strategies for identifying barriers of use, and selecting, planning, and applying promotional strategies are described (e.g. individual, organisational, or system barriers that are associated with adoption; instructions, tools or templates to tailor guideline/ recommendations for local context).
Evaluation	Performance measures for audit or monitoring are included (e.g. suggestions for evaluating compliance with organisation, delivery and outcomes of recommendations).

Dissemination strategies for practice guidelines

Moreover, the strategy used to disseminate clinical practice guidelines plays a decisive role in the use and knowledge of such guidelines. According to Grimshaw et al. (2001) passive dissemination of clinical practice guidelines and other educational materials is generally ineffective in bringing about change in practitioner behaviour; at best they create awareness about the desired behaviour change. (By passive dissemination is meant, for example, the mailing of the educational materials to targeted clinicians.) Stakeholder engagement as a dissemination strategy appears to be more effective. In a study that was conducted in the Netherlands (Grol, 2001), guideline materials were sent to the organisers of local continuing education and the representatives of local family physicians in two districts. In one of these districts, however, the dissemination was supplemented by outreach visits to the relevant people, to provide explanation and instruction on the use of the materials. A survey was sent to all family physicians in the two study districts. The physicians were asked whether they had been informed about the materials, whether they had the materials in their possession, whether they had read the materials and whether they had used the materials. In all four instances, respondents in the study district who also received outreach visits reported the highest knowledge of and use of the materials.

Taxonomy of knowledge for EBM

Lastly, another view of the nature of evidence used in practice is that it can involve both propositional and non-propositional knowledge. EBM largely reduces evidence to propositional knowledge (statements informed by scientific research) whereas alternative lines of research also emphasise non-propositional knowledge as evidence in clinical practice. A study by Estabrooks et al. (2005), for instance, shows that the knowledge of nurses can be categorised into four groups, namely social interactions, documents, experiential knowledge and a priori knowledge. Estabrooks et al. describe their proposed taxonomy of knowledge sources as follows:

- Social interactions are the processes of communication, information exchange and relationship formation among nurses, as well as between nurses and other health care professionals, patients and their families. Social interactions as a source of practice knowledge, according to Estabrooks et al. (2005), is the most dominant form of knowledge in the case of nurses. The investigators further distinguish between social interactions that are informal (spontaneous interactions which occur as needed) and formal (structured according to time and place, e.g. conferences, short courses, ward rounds, journal clubs, etc.).
- Experiential knowledge is the second most important knowledge source among nurses and refers to knowledge gained through observations in nursing practice, and which is normally the product of a nurse's own observations as well as those of others.
- Documents, as the next source of practice knowledge, are self-explanatory – they can be either unit-based (patient charts, bulletin boards, treatment protocols, etc.) or off-unit (books, journals, research reports, etc.). It is not uncommon for experiential knowledge and documented knowledge to directly compete, especially in instances where documentary evidence (in journals, protocols, etc.) requires a change of practice but the practitioner's experiential knowledge suggests otherwise. Often this results in the nurses' rejection of the implementation of the documentary evidence.
- Lastly, a priori knowledge, as defined by Estabrooks et al. (2005), refers to intrinsic knowledge that nurses bring with them to their unit, which includes knowledge acquired at nursing school, personal beliefs and common sense.

In the taxonomy by Estabrooks et al. (2005), documents are typical carriers of propositional knowledge. Given the diversity of documents used in practice (both research-based and non-research-based) the documents may or may not have an underlying science base. Propositions can also be articulated and transmitted

during formal and informal social interactions and, again, the formulated statements can be either with or without an underlying scientific base. Experiential knowledge and a priori knowledge, on the other hand, are illustrative of non-propositional knowledge exhibited in practice (thus practical knowledge) but, as stated elsewhere, non-propositional does not necessarily mean that these cannot ultimately be formulated as verbal rules (propositions). In instances where verbal rules can be extracted, the scientific foundation needs to be demonstrated in order for the rules to qualify as facts.

The taxonomy by Estabrooks et al. (2005) for nurses is also supported by studies conducted among general practitioners. For instances, Kitto et al. (2007) report that general practitioners express more confidence in their own judgement than in EBM mechanisms such as clinical practice guidelines. Cialdella et al. (1991) also reported personal experience to be highly valued among French general practitioners. Moreover, interactions with fellow practitioners and experts are often cited as the most frequently mentioned or most preferred information source for clinical physicians, although differences exist according to area of specialisation (Boerkamp et al., 1996; Carter and Gray, 2000; Ely et al., 1999; Falshaw & Smith, 1996).

Thinking beyond Research: Alternative Perspectives about Evidence and Practice Knowledge

The expansion of EBM beyond physicians has broadened the scholarly debate about the nature of evidence. As other health care professions joined the movement of trying to base their practice on current best evidence, EBM eventually escalated into evidence-based practice (EBP). The other professions include nursing (Boström, Wallin and Nordström, 2006; Rutledge and Bookbinder, 2002), psychology (APA Presidential Task Force on Evidence-Based Practice, 2006; Chwalisz, 2003; Ramey and Grubb, 2009; Stricker, 2003), social work (Van de Luitgaarden, 2009) and veterinary sciences (Everitt, 2008; Holmes and Ramey, 2997; Schmidt, 2007). Illustrative of the new perspectives of evidence in EBP is the threefold distinction by Chwalisz (2003), elaborated on by Stricker (2003), whereby evidence is conceptualised as being hierarchical, triangulating and dialectical. Accordingly, evidence is considered hierarchical because some evidence can be more powerful and compelling than others; it is triangulating because evidence from different sources often converge; and dialectical because of an interplay between scientific evidence and practice-based evidence. Stricker also emphasises that in the EBP debate it should not be about whether or not there is evidence for something, but rather the extent to which there is evidence for something.

Moreover, the EBM movement increasingly became criticised for the disproportionate weight assigned to research evidence, disseminated through clinical practice guidelines and other media of research synthesis, as the primary source of knowledge for practice. The traditional view of evidence in EBM – as being research based – is strongly challenged by Gabbay and Le May (2004). Their ethnographic study of practitioners in two general practices in the United Kingdom shows that primary care practitioners do not use the traditional routes of evidence into practice as proposed by EBM, such as clinical practice guidelines. In fact, the practitioners relied heavily on knowledge conveyed through networks with other practitioners and professionals, without questioning as to whether or not these views of others were rooted in research evidence. The overwhelming tacit dimension of the practitioners' knowledge base compelled the investigators to introduce the notion of "mindlines":

> … clinicians relied on what we have called "mindlines", collectively reinforced, internalised tacit guidelines, which were informed by brief reading, but mainly by their interactions with each other and with opinion leaders, patients, and pharmaceutical representatives and by other sources of largely tacit knowledge that built on their early training and their own and their colleagues' experience. (Gabbay and Le May, 2004:1014)

Thus, mindlines represent knowledge in practice and are therefore not static but dynamic, given that practitioners continuously refine their mindlines by comparing their implicit as well as explicit knowledge with that of others. Other forms of implicit knowledge, in medical practice, include "rules of thumb" (André et al., 2002; André, Borgquist and Mölstad, 2003). One example of a rule of thumb that a practitioner could formulate and subconsciously apply during her/his engagement with patients in clinical practice is the following: "Able to lay down and sleep at night, no heart failure" (André et al., 2002:620). Such rules are based on the practitioner's own experience and that of others which has been internalised, and also on knowledge that is immediately available although not always conscious.

What the aforementioned studies show is an increased accentuation of the non-analytical elements of clinical decision-making. Another example is the recent qualitative studies by Stolper et al. (2009a, 2009b, 2010) on the concept of gut feelings in clinical practice, a form of intuitive knowing in practice originally frowned upon. Stolper et al. (2009a) identified two types of gut feelings on the basis of focus groups discussions held with a number of general practitioners in the Netherlands. These are, respectively, a sense of alarm and a sense of reassurance. A sense of alarm is composed of a number of elements. The first is an uneasy feeling that something is wrong with the patient even though the practitioner cannot seem to find any indications that objectively support that feeling; secondly, a distrust of the situation because the prognosis appears to be uncertain; and thirdly, a need for some kind of intervention in order to avoid an adverse health problem. A

sense of reassurance, on the other hand, is a secure feeling because the appropriate intervention is clear in the mind of the general practitioner even though a proper diagnosis could be lacking. A gut feeling can often be regarded as a source of knowledge of general practitioners, as one respondent in the study by Stolper et al. (2009a – no page number) also confirms: "At a certain moment, it becomes a matter of knowing, this gut feeling of alarm or reassurance, you just know."

The main determinants of gut feelings, according to Stolper et al. (2009a), are as follows:

- Fitting and alerting factors: General practitioners tend to form overall (expected) pictures of patients and diseases based on prior experience and accumulative knowledge. A feeling of alarm arises if there is a misfit between the expected picture and the picture presented, which then becomes an alerting factor. A sense of reassurance, on the other hand, occurs when the current picture is compatible with the one expected.
- Contextual information: Additional information about a patient, other than the presented symptoms, constitutes contextual knowledge. The latter provides a frame of reference when determining a fit between the current picture and the overall picture.
- Interfering factors: Gut feelings can be inhibited in cases where strong emotional reactions (sympathy, aversions, guilt) interfere with the work of the general practitioner.
- Medical education and experience: Gut feelings can be taught, although they are not easily learnt. In addition to the hypothetic-deductive method (where diagnoses are hypothesised on the basis of signs and symptoms, followed by supplementary questions, i.e. a rational diagnosing process), diagnostic feelings can also be developed through reflection. However, it is only through experience that a general practitioner is able to find meaning in the 'noise' and peculiarities that surround the presentation of symptoms and signs.
- Personality: The ability to take risks and tolerate uncertainty is often needed to act upon and deal with gut feelings. Also, general practitioners who lack self-confidence may not trust the sense of reassurance or alarm.
- Perceived consequences: The perceived consequence of not dealing with a sense of alarm is a motivating factor for the general practitioner to act upon gut feelings, in order to be on the safe side.
- Need for a compass amidst uncertainty: A single correct intervention or referral from acting on gut feelings provides direction when similar cases are presented in the future. A diagnosis that is reached on the basis of a sense of alarm or reassurance also helps with the management of complex situations and effectively manages the limited time available.

Stolper et al. (2010) locate gut feelings as occurring on the interface between, on the one hand, a general practitioner's knowledge and experience and, on the other hand, the information provided by patients. This interface, recalling again Figure 3.3 , is what EBM considers to be clinical expertise. Thus, gut feelings can be considered an integral part of clinical expertise and a form of implicit knowing. According to Stolper et al. gut feelings need to be taken seriously as they fulfil an important role in clinical reasoning. The same authors conceptualise medical knowledge as constituting an associative network of inter-connective knowledge parts that involve high-level concepts, contextual factors, patient information, symptoms, treatments, drugs, etc. Moreover, the richer and denser this network becomes in terms of medical expertise, the more automated and non-analytical the process of clinical reasoning also becomes, thereby sparking regular instances of gut feelings:

> With increasing experience, their knowledge network will become richer and more coherent, and non-analytical reasoning will more often be invoked, but experienced GPs are able to switch to analytical reasoning when the automatic approach is not enough to explain the patient's situation. The sense of alarm can be regarded as the first warning sign that automatically pops up from the knowledge network to slow down when no familiar pattern can be identified. Sometimes no satisfactory explanation can as yet be found, but prompt intervention is necessary bypassing a diagnosis. And sometimes GPs can feel reassured about the expected course of an illness even if they have as yet no clear diagnosis. (Stolper et al., 2010:200-201)

Welsh and Lyons (2001), who are from the nursing sciences, postulated a link between intuition, tacit knowledge and formal knowledge. Specifically, tacit knowledge for them is the result of the synthesis of formal knowledge (e.g. training received) with clinical experience. Tacit knowledge, in turn, informs intuition and for that reason is positioned between formal knowledge and intuition. Thus, whenever an intuitive decision is made, some element of formal knowledge is also being used, albeit indirectly. It is only through reflecting on one's actions that the tacit knowledge can be articulated and the underlying formal knowledge exposed. In effect, the discussion by Welsh and Lyons suggests that there are two forms of intuition: that which is based on the acquisition of formal knowledge (and hence classifiable as "evidence-based") and that which occurs without any reference to a formal knowledgebase. The first is deemed acceptable and the latter, in the authors' opinion, "has no place in professional practice" (Welsh and Lyons, 2001:305).

Moreover, these recent investigations into the non-analytical facets of EBM, such as gut feelings, tacit knowledge and mindlines, all seem to serve a single purpose: to demonstrate the scientific foundations

and undertones of intuitive clinical judgement.2 These investigations cannot easily be separated from the broader objective to achieve a synthesis between, on the one hand, clinical intuition, and, on the other hand, the rational choice approach that is typical of EBM. Such an objective is born out of a perception that clinical judgement is under attack within EBM and that EBM undermines the value of tacit clinical knowledge in practice (Gabbay and Le May, 2004; Mousa, 2009), given that EBM's "epistemological foundations are constructed on the elimination of clinical intuition" (Braude, 2009:196). However, despite the prominence of EBM within clinical practice its ability to eventually become practice-by-default is far from being settled:

> EBM will never entirely replace claim-based medicine (blind or as a justified conclusion of a logical argument); faith-based medicine (belief and trust in something); experience-based medicine (as given by the active involvement of a recorded or unrecorded individual in an activity or exposure to events or people over a period of time that leads to an increase in knowledge and skills); conviction-based medicine, based on firmly held opinions and beliefs (with or without grounds); 'big heart'-based medicine as dictated by the doctor's compassion, empathy, will to help and affection for the human suffering; reference (spoken and written word)-based medicine as conveyed to listeners and readers; gut feeling-based medicine as instinctive and intuition-driven understanding and decision-making; authority-based medicine, whatever the authority (as the right or power, justified or not, to enforce rules or give orders that are administrative or competency based) … (Jenicek, 2006:412)

In the next section we will see how a broader conception has increasingly become important in EBM and EBP, to the extent that it is no longer referred to as knowledge transfer but as knowledge translation. Knowledge translation is based on the perception that new factual knowledge, if left to its own devices, will seldom be used in practice because of the complexity of factors that work against its uptake (e.g. context, existing user norms and values, rival knowledge sources, etc.). A holistic approach to knowledge implementation is required, where utilisation – or the smooth integration of knowledge in user practice – is achieved through stakeholder interaction during all stages of the knowledge translation process (Haines and Donald, 1998). We will now discuss such planned knowledge utilisation.

Knowledge translation as a field of study

Selected authors and research traditions in the field

Essentially EBM is about changing the behaviour of clinical practitioners from opinion-based practice to evidence-based practice. However, with time it has been realised that behavioural change is a complex and multi-faceted process because practitioners are embedded in systems that involve multiple stakeholders. The values, norms and interests of all stakeholders therefore need to be considered and incorporated into the "change process", including those of researchers, patients, managers and policy-makers. Such a systems orientation towards behavioural change is part of the knowledge translation paradigm that recently gained prominence in the field of health policy. Various papers explicitly mention the notion of knowledge translation in relation to EBM (e.g. Davis et al., 2003; Glasziou and Haynes, 2005; Lang, Wyer and Haynes, 2007; Simunovic and Baxter, 2009).

The development of knowledge translation as a field of study can largely be attributed to developments in the health policy environment in Canada. In that country, since 1997, a strong move towards evidence-based decision-making could be observed after the National Forum on Health recommended the development of an evidence-informed health care system, proposing that policies and clinical decisions should incorporate knowledge based on solid research (Dobbins et al. 2007). Knowledge translation (KT) has since been adopted by the Canadian Institutes of Health Research (CIHR, the federal agency responsible for the funding of health research) as the primary method for bridging the gap from knowledge to practice. The CIHR also runs a research programme on KT and as such has made significant contributions towards the conceptual development of KT. Research on KT is part of a new scholarly domain known as implementation science. The latter is "the scientific study of methods to promote the uptake of research findings and hence to reduce

2 Apart from conceptual developments in relation to the "scientification of clinical judgement", similar developments with regard to the inverse can also be observed, which is to expose the judgemental character of scientific evidence, particularly evidence that is held in high esteem by proponents of EBM. This line of study is familiar territory for social constructivists who would argue that all evidence is socially shaped and not invariably scientific. De Vries and Lemmens (2006), for example, criticise EBM on the basis that the scientific evidence is contaminated with the biases of researchers and clinicians. The authors explained in great detail how commercial interests of largely drug companies can influence the design of the research protocol (for randomised controlled trials). One example is where researchers with industry sponsorship from drug companies manipulate trial design and subject selection (e.g. by selecting weak comparators to a sponsor's drug in a clinical trial, by using inappropriate dosages of the comparative drug, by manipulating the eligibility criteria to include subjects who will respond more positively to the sponsor's drug, etc.). Moreover, since industry-funded researchers have the necessary money to recruit subjects for clinical trials, industry-sponsored drugs are more researched and therefore more visible in the scientific literature. Also, review articles are very influential in EBM as they are incorporated into clinical practice guidelines. For that reason journals publishing review articles only appoint the most eminent experts in a particular field, and who have no financial relationship with the sponsors of any of the products of clinical trials being reviewed. However, there are indications that journal editors are increasingly becoming relaxed in this regard as instances have been reported where the review authors have direct interests in the drugs being reviewed.

inappropriate care" (Eccles et al. 2005:1)

KT now also characterises the works of other international health agencies, such as the National Center for Dissemination of Disability Research in the United States (NCDDR), and the World Health Organization (WHO). What these agencies have in common is the realisation that standard forms of knowledge creation (primary research), knowledge distillation (systematic reviews and clinical practice guidelines) and knowledge dissemination (mainly through journal publications), individually or combined, are insufficient to ensure actual knowledge application (Straus, Tetroe and Graham, 2009).

KT is often perceived as an acceleration of the knowledge cycle, involving a complex system of social interaction between researchers and various stakeholders, in order to move knowledge into action (Graham et al., 2007). The CIHR defines KT as a

> dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge to improve health, provide more effective health services and products, and strengthen the health care system. (Straus, Tetroe and Graham, 2009)

The NCDDR in the United States uses a similar definition:

> The collaborative and systematic review, assessment, identification, aggregation, and practical application of high-quality disability and rehabilitation research by key stakeholders (i.e., consumers, researchers, practitioners, and policy-makers) for the purpose of improving the lives of individuals with disabilities. (NCDDR, 2005)

Moreover, the defining characteristics of KT, according to Sudsawad (2007:2-3), are as follows:

- KT includes all steps between the creation of new knowledge and its application.
- KT needs multidirectional communications.
- KT is an interactive process.
- KT requires ongoing collaborations among relevant parties.
- KT includes multiple activities.
- KT is a nonlinear process.
- KT emphasises the use of research-generated knowledge (that may be used in conjunction with other types of knowledge).
- KT involves diverse knowledge-user groups.
- KT is user- and context-specific.
- KT is impact oriented.
- KT is an interdisciplinary process.

The CIHR (2007) distinguishes between two types of KT: end-of-grant KT and integrated KT. The difference between the two is that, with end-of-grant KT, the research is already complete before the knowledge translation activity starts whereas, in the case of integrated KT, the researchers and users are collaborating to shape the research process. End-of-grant KT therefore includes the normal dissemination strategies of researchers, which involve publications and presentations at various platforms. It also involves more interactive dissemination strategies and the use of brokers. Integrated KT goes by a variety of names, such as action-oriented research or collaborative research, and its aim is to produce findings that are highly relevant and therefore also usable. Thus, the KT effort can transfer both new knowledge and existing knowledge that has not yet been taken up in user domains.

In essence, however, one could argue that KT involves three central elements: the synthesis and tailoring of research outputs; an exchange between researchers and users; and social interaction as part of a complex process (Wallin, 2009). The notion of KT has also acquired more generic meanings in some circles. For instance, it is seen as an encompassing concept that includes all variants of knowledge utilisation and dissemination (research use, implementation research, etc.), technology transfer, as well as notions typically associated with health care practice, including clinical practice guidelines and continuing medical education (NCDDR, 2007). Simunovic and Baxter (2009) also describe KT as encompassing traditional mechanisms of facilitating EBM, such as clinical practice guidelines, continuing medical education and educational outreach. Others, for instance Lang, Wyer and Haynes (2007:355), view KT as "any activity or process that facilitates the transfer of high-quality evidence from research into effective changes in health policy, clinical practice, or products".

Selected questions asked and answered

The conceptual underpinning of KT relates to models of change, which, in turn, can be either classical change models or planned change models. Classical change models explain how change occurs whereas planned change models, which also incorporate insights from classical change models, are specifically designed to guide and bring about change (Graham et al.,. 2007). Planned change models in KT are strongly influenced by planned action strategies and for that reason often include a number of action categories which are typical of planned action (NCDDR, 2007):

- Identification of a problem that requires attention
- Identification of the need for change
- Identification of change agents, i.e. the actors who can bring about change
- Identification of the target audience
- Assessment of barriers that could prevent intervention
- Review of evidence and literature
- Tailor/develop intervention
- Link with relevant stakeholders
- Implement intervention
- Evaluate
- Maintain change or sustain the use of knowledge that is part of the intervention
- Disseminate the results of implementation.

The model on the diffusion of innovations by Rogers (Section on Diffusion of innovations as a field of study) is an example of a classical change model as it explains how change occurs by highlighting various elements in the diffusion and adoption process. Moreover, it is a generic model as the targeted adopters represent a variety of audiences, e.g. farmers, educators, health practitioners and consumers. On the other hand, models of planned action are currently concentrated in health services, and the prevailing ones are discussed in the next section.

Selected models of the field of knowledge translation

Ottawa Model of Research Use

The Ottawa Model of Research Use (OMRU) is a model for planned research use. It was developed by Logan and Graham (1998) as a holistic framework to guide the process of implementing research evidence. The process is portrayed as consisting of six central elements, namely: (1) the practice environment; (2) potential adopters; (3) evidence-based innovation; (4) strategies for transferring the evidence into practice; (5) use of the evidence; and (6) the outcomes of the process. Closer inspection of the OMRU reveals a richer description – in terms of examples cited – for the first four elements than for the last two. This is not surprising as the construction of elements was informed by an overview of literature in four study domains: research utilisation, the diffusions of innovations, physician behavioural change, and the development and implementation of practice guidelines. At the time of development of the model (mid- to late 1990s), however, studies on the evaluative aspects of knowledge implementation initiatives were still relatively underdeveloped, and the same applies to studies on the use of evidence in health practitioner settings.

The OMRU, in a nutshell, involves the assessment of potential barriers and supports that could affect the implementation of research evidence. These assessments are normally performed in relation to the first three elements (practice environment, potential adopters and the evidence-based innovation).

In the case of the first element, practice environment (health setting), the enabling and disabling factors are categorised as structural, societal and patient factors respectively:

- ***Structural factors*** are setting-specific influences such as the decision-making structure, rules and regulations, physical structure, workload, resources and incentives.
- ***Societal factors*** refer to the prevailing beliefs within a setting, as well as personalities and the presence of advocates of evidence-based innovation.
- ***Patient factors***, which are unique to health care settings, largely refer to patients' willingness or unwillingness to comply with a treatment for various reasons.

With regard to the second element, potential adopters, the model proposes that those wishing to facilitate research transfer should

identify all potential adopters or target audiences to whom they intend to direct the evidence and to

> define and describe them in terms of their attitudes, knowledge, motivation for adopting the evidence, skills, and current practices. (Logan and Graham, 1998: 232)

The belief is that the profiling of adopter attitudes will highlight additional barriers that can then be utilised in the design of a research transfer strategy. With regard to the third element, evident-based innovation, the assessment essentially concerns the relation between the potential adopters' arguments for adoption and use (or not), on the one hand, and their perceptions of the attributes of the innovation and the process by which the innovation has come about.

On the basis of these multiple assessments, effective research transfer strategies (fourth element) are then designed and implemented by incorporating insights of existing barriers and supports. According to Logan and Graham's (1998) interpretation of the literature, more effective strategies tend to be those ones that are tailored to salient barriers and supports. Once implemented, the way that the evidence is used (fifth element) needs to be systematically monitored to determine and understand instances of non-use and modified use. Eventually, however, evaluations of outcomes (sixth element) are required, as research use in practice settings is largely unpredictable and there is a need to establish to what extent both intended and unintended effects are created.

> The model has been applied on limited occasions as a framework for planned research use, e.g. to facilitate the use of clinical guidelines to treat pressure ulcers as part of skin care (Graham and Logan, 2004; Logan et al., 1999), the adoption of a decision support protocol by call centre nurses (Stacey et al., 2006) and the implementation of a research-based family assessment tool in a neonatal transport team (Hogan and Logan, 2004).

Knowledge-to-Action Model

Ian Graham, the CIHR's vice president of knowledge translation, also introduced the term "knowledge-to-action" to refer to KT. The term serves two purposes (Graham et al., 2007): (1) to have a generic term that encompasses and includes the various variants of knowledge utilisation (knowledge translation, knowledge exchange, knowledge transfer, research utilisation, knowledge exchange, implementation, dissemination, diffusion, etcetera) and (2) to have a term where the action element is broad enough to include knowledge use by all possible stakeholders (practitioners, policy-makers, the public, etc.). In an earlier co-authored paper, Graham et al. (2006) provide a model of the KTA process, consisting of two key interacting components: knowledge creation and an action cycle (Figure 5).

Knowledge creation consists of three phases which correspond to first-, second-, and third-generation knowledge. First-generation knowledge refers to the numerous research studies being conducted, published in different formats, accessible to various degrees, and also of varying quality. Basically, they are the direct outputs of knowledge inquiry. Second-order knowledge refers to knowledge that is already sifted and ordered in terms of quality and importance. The various forms of meta-analyses and syntheses are examples of these. Third-order knowledge refers to tools based on knowledge. In the health field a primary example is clinical practice guidelines. These three forms are presented in a filter format because knowledge needs to be increasingly distilled and refined in order to better suit the target audience. At any of these three stages of knowledge creation the knowledge producers can tailor their knowledge for specific audience. During knowledge inquiry, for instance, the research question can be tailored in such a way that it addresses the needs of potential users. Guidelines, for instance, can be tailored by the producing organisation to meet the resistance and needs of clinicians within a particular specialty.

The action cycle is largely informed by a study of planned action theories and models conducted by Graham et al. (2006:20). The authors identify seven phases that are common to the various theories and frameworks and these appear in the diagram:

- Identify a problem that needs to be addressed and identify, review and select the knowledge or research relevant to addressing the problem
- Adapt the identified knowledge or research to the local context
- Assess barriers to using the knowledge
- Select, tailor and implement interventions to promote the use of knowledge
- Monitor the use of knowledge
- Evaluate the outcomes of using the knowledge
- Sustain ongoing knowledge use.

The seven action stages do not necessarily need to occur sequentially; they can also occur simultaneously. At any point in the cycle the knowledge phase can alter or change the stages in the action phase (Straus, Tetroe and Graham, 2009). In reality the boundaries between the two components are often blurred.

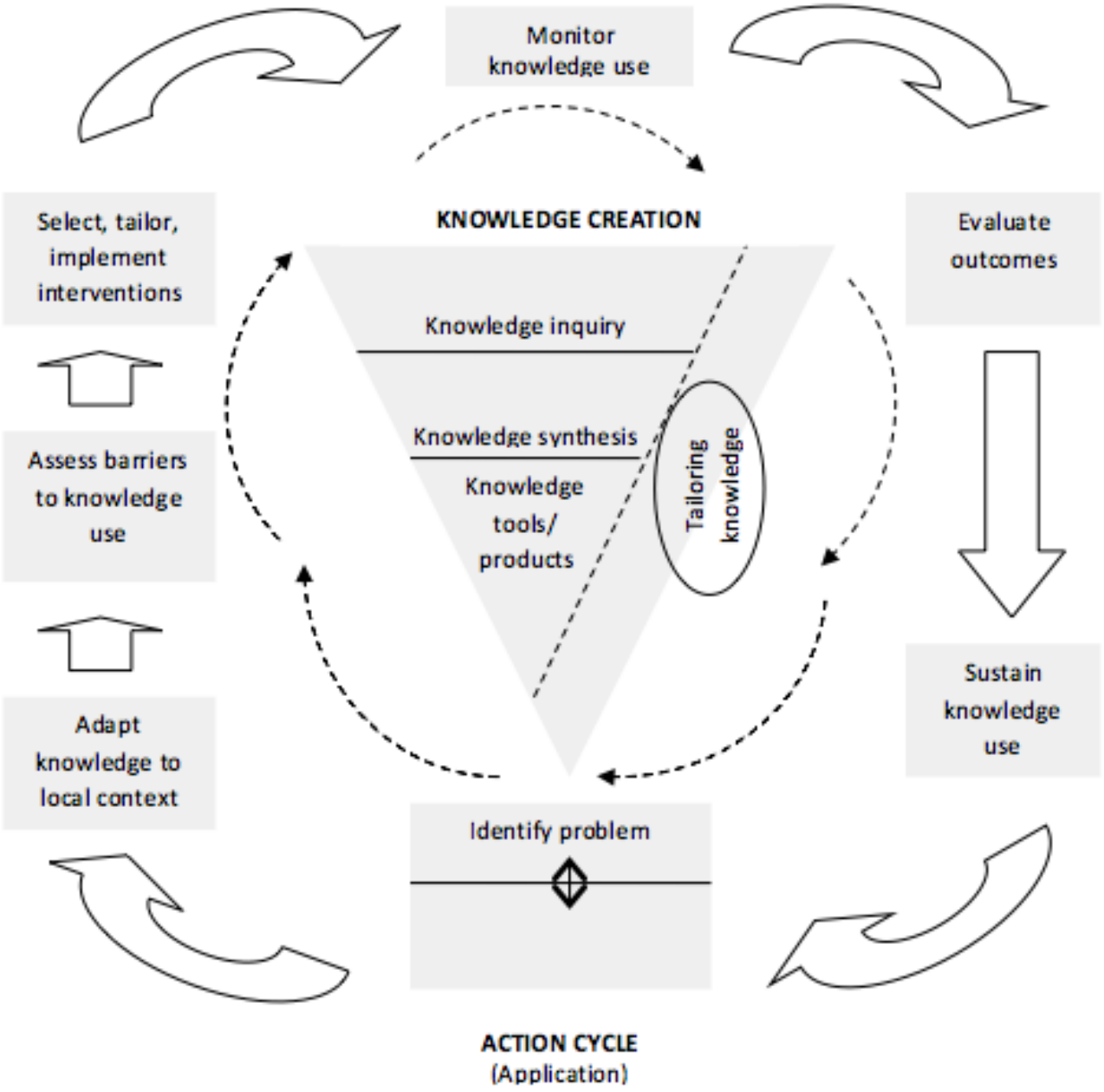


Figure 5: Knowledge-to-action (KTA) model, Source: Graham et al. (2006:19, Figure 1)

Stetler Model of Research Utilisation

The previous models largely operate on the assumption that knowledge utilisation is exhibited in the use of formal policies, procedures or protocols that are institutionalised and informed by research. However, knowledge utilisation can also be much less formal as practitioners often informally use research knowledge as part of their routines. Cheryl Stetler developed a series of critical thinking and decision-making steps to guide this everyday use of research, and presented it as a model. Her model was originally developed in 1976, together with Marram, as the Stetler/Marram model (Stetler & Marram, 1976) but has since undergone two revisions to become the Stetler model of research utilisation. The first revision occurred in 1994 (Stetler, 1994), when the conceptual underpinnings and assumptions of the model were made explicit, and the second in 2001 (Stetler, 2001) when the model – under influence of EBM – was further refined to also become a framework for practitioners to facilitate EBP. Although the Stetler model is located in nursing, it is equally relevant for other practice settings. The model is based on a set of six assumptions:

- The formal organisation may or may not be involved in the individual practitioner's utilisation of research.
- Utilisation may be instrumental, conceptual or symbolic.
- Decision-making or problem-solving often not only involve research evidence but also non-research-related

information (e.g. experiential information) and the different knowledge sources are combined.

- Both internal and external factors (e.g. the practitioner's existing knowledge and attitudes versus organisational characteristics) can influence an individual practitioner's frame of mind (or that of a group to which he/she belong) and therefore also influence the use of evidence.
- Appropriate and effective use can be inhibited by a lack of knowledge and skills of research utilisation and EBP.

The Stetler model, as said, consists of a series of critical thinking and decision-making steps that could help individuals to guide the use of research findings. The model involves five phases:

Phase 1: Preparation. In the preparatory phase the purpose behind using relevant research information needs to be clarified. This can range from the solving of a clinical, educational, managerial or other problem to an interest in maintaining the most updated knowledge base in a specialty area (Stetler, 1994). In this phase relevant sources of research information are identified. Critical thinking comes into play to the extent that the user needs to be conscious of external and internal factors that could influence their use of certain sources. External factors refer to factors unique to the organisational setting and broader environment, whereas internal factors refer to personal considerations, such as existing beliefs and attitudes.

Phase 2: Validation. This phase is characterised by a critique of the research findings identified during the preparation phase. It is not so much a traditional research critique of a study but a utilisation research critique. The focus is on the strengths and weaknesses of a study in terms of its applicability for utilisation (Stetler, 1994, 2001). The probabilistic meaning of the identified study's statistics in relation to other populations and individual subjects needs to be critically appraised. It is suggested that practitioners use existing tools, for instance, utilisation-focused review tables (e.g. Stetler et al. 1998) designed to determine the suitability of research results for incorporation in integrative reviews. On the basis of the validation exercise a study is either rejected or accepted. If accepted, phase 3 becomes the next step.

Phase 3: Comparative evaluation/decision-making. The core of this phase is a set of applicability criteria which, as a gestalt, can assist in determining the desirability of applying the validated study's results to the identified issue. The first criterion is whether or not there is any other substantiating evidence (additional research, professional standards, case studies, etc.) to support the findings. The second criterion relates to current practice, specifically what can be said about the level of effectiveness of current practice in the light of the findings, and reflections on the need for bringing about changes in practice. The appropriateness of the findings for the user and his/her setting is a third criterion. The fourth and last criterion is the feasibility of implementing the findings, and involves assessing the risks, resources required, and the readiness of other parties where external participation is required (Stetler, 1994, 2001).

Taking into consideration the different operations and activities so far, the user should now be in a position to decide on whether or not to use the findings of the validated study(ies). After collecting additional, pragmatic information, any one of three decisions is possible, namely not to use, to use, or to consider using. Obviously phases 4 and 5 only apply to instances of use and considered use.

Phase 4: Translation/application. This phase starts with a confirmation of the applicable type of utilisation (instrumental, conceptual or symbolic) as well as the method (formal or informal) and level of utilisation (individual, group or division/organisation). In some instances little if any translation of findings is required, and this is normally the case for expert individual users. However, in other instances of use, especially where the focus is on the formal and instrumental utilisation of findings by organisations (i.e. the individual wants to bring about formal organisational change), translation of the research findings becomes crucial, and the process then becomes one of planned research utilisation. Planned research always results in a blurring of boundaries between this phase and the next, which is evaluation, as evaluation is an essential component of planned research models. Moreover, in instances where the use of findings is still being considered, specifically with the aim to implement formal changes in an organisational setup, a pilot project is first required to collect the information needed in order to eventually decide between using and not using the knowledge.

Phase 5: Evaluation. Individual practitioners can assess the effect of their own utilisation of findings by means of direct observation. At higher levels of utilisation (instance of use by groups and organisations), formative data need to be collected to determine whether the findings are in fact being used as intended, and eventually also summative data to assess outcomes and goal achievement.

In conclusion, the Stetler model incorporates two notions of research utilisation that were earlier identified by Stetler (1985), namely the use of the products (findings) of research and the use of the individual components of the research process for routine problem-solving. The model's primary focus, however, is on the use of research findings, although the use of elements of the research process comes into play in the evaluation phase.

Another conceptual framework for KT is the PARiHS framework (Promoting Action on Research Implementation in Health Services), originally developed in 1998 by Kitson, Harvey and McCormack. A more recent version of the PARiSHA framework (Kitson et al. 2008) portrays successful implementation as a function that can be denoted as: successful implementation (SI) = f (E, C, F). Specifically, SI is a function (f) of three elements: the nature of evidence (E); the quality of the context (C) in which the evidence is introduced; and the type of facilitation (F) of the process. In earlier works Kitson and her colleagues (Harvey et al., 2002; McCormack et al., 2002; Rycroft-Malone et al., 2004b) performed detailed concept analyses of the three key elements.

Rycroft-Malone et al. (2004b) who considered the first of these elements, evidence, regard the latter as knowledge obtained from a variety of sources, provided that the knowledge has been tested and found to be credible. Thus, what counts as evidence must be independently observed and verified. Although the references to observation and verification suggest that Rycroft-Malone et al. are restricting evidence to research evidence only (i.e. factual, propositional knowledge), this is not the case. In fact, the conception of evidence by Rycroft-Malone et al. allows for both propositional and non-propositional knowledge:

> Propositional knowledge is formal, explicit, derived from research and scholarship and concerned with generalisability. Non-propositional knowledge is informal, implicit and derived primarily through practice. It forms part of professional craft knowledge (the tacit knowledge of professionals) and personal knowledge … Unlike research-based knowledge, professional craft knowledge is not usually concerned with transferability beyond the case or particular setting. However, this non-propositional knowledge has the potential to become propositional knowledge once it has been articulated by individual practitioners, then debated, contested and verified through wider communities of practice … (Rycroft-Malone et al., 2004b:83)

Thus, Rycroft-Malone et al. (2004b) are suggesting that tacit, professional craft knowledge should be articulated and made explicit (on the basis of various suggestions in the knowledge management literature) and subject to public scrutiny and assessment in order to be verified as evidence. Rycroft-Malone et al. furthermore suggest that the notion of evidence, apart from including knowledge based on research evidence and knowledge based on clinical experience, should also include knowledge from clients and patients (in health settings) as well as knowledge from the local context. The latter includes organisational audit and performance data, knowledge about the culture of the organisation, social and professional networks, and local and national policy. In another study that is based on limited empirical data, Rycroft-Malone et al. (2004a) express a clear need to understand the integration of the various forms of evidence in everyday clinical decision-making and practice.

The second element of SI, namely context, can generally be interpreted as the setting in which practice takes place (McCormack et al., 2002). However, the notion of context is conceptually complex and the study thereof in relation to the implementation of evidence also needs to include the notion of culture, which refers to the ways that things are normally done in a particular context. Moreover, McCormack et al. describe a context that is conducive to the successful implementation of evidence as one where the following conditions are in place: clear definition of boundaries (physical, social, cultural and structural), appropriate and transparent decision-making processes, appropriate resources, adequate information and feedback systems, and receptiveness to change. Next to a receptive organisational culture, other contextual factors that are conducive to successful knowledge uptake include effective and clear organisational leadership, and monitoring and evaluation mechanisms.

The last of the three elements, facilitation, refers to the process of enabling the implementation of evidence into practice (Harvey et al. 2002). The outcome of this process, according to Harvey and co-workers, can either be orientated towards the accomplishment of specific tasks, i.e. providing help to achieve a certain goal, or it can be more holistic and targeted towards the development of individuals and group processes, such as reflecting on or changing attitudes, skills, habits, etc. Moreover, according to the concept analysis, a facilitator is a change agent who is appointed in that role, and the facilitator can be either internal or external to the organisation where the change is to be implemented.

More recently Kitson et al. (2008) have started to promote the PARiHS framework as a diagnostic tool, where the most appropriate style of facilitation can be determined on the basis of the potential users' assessment of their organisational context and the nature of the evidence to be implemented.

Conclusion

It can be concluded that the literature on KU is vast and that each discipline has its own models and methods. Models of knowledge utilisation in various fields have evolved from linear models (science-push models that are researcher driven and controlled, and demand-pull models emphasising users/decision-maker interests) to acknowledging complexity and interactions between actors, the existence and importance of networks, and complex and nonlinear behaviour.

Knowledge utilisation is a multidisciplinary field with a range of terminology, subtopics, and models. This essay provided a highly selective review of existing models of knowledge utilisation paying special attention to the paradigms within which these models have been developed, as well as the underlying assumptions for these models.

References

Agarwal, R., & Prasad, J. (1998). The antecedents and consequents of user perceptions in information technology adoption. *Decision support systems,*22(1), 15-29.

Agarwal, S. P., Gupta, A., & Dayal, R. (2007). Technology transfer perspectives in globalising India (drugs and pharmaceuticals and biotechnology). *The Journal of Technology Transfer,* 32(4), 397-423.

Arrow, K. J. (1969). The organization of economic activity: issues pertinent to the choice of market versus nonmarket allocation. *The analysis and evaluation of public expenditure: the PPB system, 1*, 59-73.

Backer, T. E. (1991). Knowledge utilization The third wave. *Science Communication*, 12(3), 225-240.

Boshoff, N. (2014). Use of scientific research by South African winemakers. *JCOM,* 1, A01.

Bush, Vannevar. "Science: The endless frontier." *Transactions of the Kansas Academy of Science (1903) (1945)*: 231-264.

Bozeman, B. (2000). Technology transfer and public policy: a review of research and theory. *Research policy*, 29(4), 627-655.

Bryar, R., & Bannigan, K. (2003). The process of change: Issues for practice development. *Practice development in community nursing: Principles and processes,* 57-91.

Braude, H. D. (2009). Clinical intuition versus statistics: different modes of tacit knowledge in clinical epidemiology and evidence-based medicine. *Theoretical medicine and bioethics,* 30(3), 181-198.

Chen, E. K. and Dunning, J. H. (1994). Technology transfer to developing countries. Routledge.

Cockburn, I. M., & Henderson, R. M. (1998). Absorptive capacity, coauthoring behavior, and the organization of research in drug discovery. *The Journal of Industrial Economics,* 46(2), 157-182.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative science quarterly,* 128-152.

Dosi, G., 1988. The nature of the innovation process. In: Dosi, G. et al. (Eds.), Technical Change and Economic Theory. Pinter Publishers, London.

Dunn, W. N. (1980). The two-communities metaphor and models of knowledge use: an exploratory case survey.

Estabrooks, C.A., Derksen, L., Winther, C., Lavis, J.N., Scott, S.D., Wallin, L. and Profetto-McGrath, J. (2008). The intellectual structure and substance of the knowledge utilisation field: A longitudinal author co-citation analysis, 1945 to 2004. *Implementation Science.* 3(49). [Open access article available at: www.implementationscience.com/content/3/1/49]

Fliegel, F. C., & Kivlin, J. E. (1966). Attributes of innovations as factors in diffusion. *American Journal of Sociology,* 235-248.

Gabbay, J., & le May, A. (2004). Evidence based guidelines or collectively constructed "mindlines?" Ethnographic study of knowledge management in primary care. *Bmj*, 329(7473), 1013.

Gagliardi, A. R., Brouwers, M. C., Palda, V. A., Lemieux-Charles, L., & Grimshaw, J. M. (2011). How can we improve guideline use? A conceptual framework of implementability. *Implement Sci,* 6(1), 26.

Graham, I. D., & Tetroe, J. (2007). Some theoretical underpinnings of knowledge translation. *Academic Emergency Medicine,* 14(11), 936-941.

Guyatt, G. H., Haynes, R. B., Jaeschke, R. Z., Cook, D. J., Green, L., Naylor, C. D., ... & Evidence-Based Medicine Working Group. (2000). Users' guides to the medical literature: XXV. Evidence-based medicine: principles for applying the users' guides to patient care. *Jama,* 284(10), 1290-1296.

Haddow, G. & Klobas, E. 2004. Communication of research to practice in library and information science: Closing the gap. *Library & Information Science Research,* 26, 29-43.

Haines, A., & Donald, A. (1998). Making better use of research findings. *Bmj,*317(7150), 72-75.

Huberman, M. (1990). Linkage between researchers and practitioners: A qualitative study. *American educational research journal*, 27(2), 363-391.

Johnson, H., 1970. The efficiency and welfare implications of the international corporation. In: Kindleger, C. (Ed.), International Corporations. Cambridge Univ. Press, Cambridge.

Kitson, A. L., Rycroft-Malone, J., Harvey, G., McCormack, B., Seers, K., & Titchen, A. (2008). Evaluating the successful implementation of evidence into practice using the PARiHS framework: theoretical and practical challenges. *Implement Sci,* 3(1), 1.

Larsen J. Knowledge utilization: What is it? Know1 Creat Diff Util 1980;1:421-42.

Lambert, Helen. "Accounting for EBM: notions of evidence in medicine." *Social science & medicine* 62.11 (2006): 2633-2645.

Landry, R., Amara, N., & Lamari, M. (2001). Climbing the ladder of research utilization evidence from social science research. *Science Communication,*22(4), 396-422.

Landry, R., Lamari, M., & Amara, N. (2003). The extent and determinants of the utilization of university research in government agencies. *Public Administration Review*, 63(2), 192-205.

Lindquist, E. A. (2001). Discerning policy influence: Framework for a strategic evaluation of IDRC-supported research. *International Development Research Centre, Canada. Available on their website: www.idrc.ca* (June 2003).

Logan, J. O., & Graham, I. D. (1998). Toward a comprehensive interdisciplinary model of health care research use. *Science communication,* 20(2), 227-246.

Martin, Ben R. "The changing social contract for science and the evolution of the university." Science and innovation: Rethinking the rationales for funding and governance. Edward Elgar, Cheltenham (2003): 7-29.

McColl, A., Smith, H., White, P., & Field, J. (1998). General practitioners' perceptions of the route to evidence based medicine: a questionnaire survey. *Bmj*, 316(7128), 361-365.

Mittelman, J. H., & Pasha, M. K. (1997). Out from underdevelopment revisited: Changing global structures and the remaking of the Third World. New York: St. Martin's Press

Myers, M. D. (1994). A disaster for everyone to see: an interpretive analysis of a failed IS project. *Accounting, Management and Information Technologies,4*(4), 185-201.

NCDDR (2007). Knowledge translation at the Canadian Institutes of Health

Pielke, R., (2010). In Retrospect: Science — The Endless Frontier. *Nature,* Vol 466, 19 August 2010.

Ramanathan, K. (1994). The polytrophic components of manufacturing technology. *Technological forecasting and social change,* 46(3), 221-258.

Rich, R.F. (1979). The pursuit of knowledge. *Knowledge: Creation, Diffusion, Utilization,* 1, 6-30.

Rogers, E.M. (1988). The intellectual foundation and history of the agricultural extension model. *Knowledge: Creation, Diffusion, Utilization,* 9(4), 492-510.

Rogers, E.M. (2003). Diffusion of innovations (5th ed). New York: Free Press.

Rogers, E. M., & Shoemaker, F. F. (1971). Communication of Innovations; A Cross-Cultural Approach.

Ryan, B., & Gross, N. C. (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural sociology,* 8(1), 15-24.

Sackett, D. L., Rosenberg, W., Gray, J. A., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: what it is and what it isn't. *Bmj* 312(7023), 71-72.

Sahal, D. (1981). Alternative conceptions of technology. *Research Policy* 10, 2–24.

Sahal, D. (1982). The form of technology. In: Sahal, D. Ed., The Transfer and Utilization of Technical Knowledge. Lexington Publishing, Lexington, MA, pp. 125–139.

Sharp, L. (1952). Steel axes for stone-age Australians. *Human organization,*11(2), 17-22.

Simunovic, M., & Baxter, N. N. (2009). Knowledge translation research: a review and new concepts from a surgical case study. *Surgery,* 145(6), 639-644.

Souder, W. E., Nashar, A. S., & Padmanabhan, V. (1990). A guide to the best technology-transfer practices. *The Journal of Technology Transfer,* 15(1-2), 5-16.

Stetler, C. B. (1994). Refinement of the Stetler/Marram model for application of research findings to practice. *Nursing Outlook*, 42(1), 15-25.

Stetler, C. B. (2001). Updating the Stetler model of research utilization to facilitate evidence-based practice. *Nursing Outlook,* 49(6), 272-279.

Straus, S.E., Tetroe, J. and Graham, I. (2009). Defining knowledge translation. *Canadian Medical Association Journal*, 181(3-4), 165-168.

Sudsawad, P. (2007). Knowledge translation: Introduction to models, strategies, and measures. Austin, TX: Southwest Educational Development Laboratory, *National Center for the Dissemination of Disability Research.*

Tonelli, M. R. (2010). The challenge of evidence in clinical medicine. *Journal of evaluation in clinical practice,* 16(2), 384-389.

Wallin, L. (2009). Knowledge translation and implementation research in nursing. *International journal of nursing studies,* 46(4), 576-587.

Wingens, M. (1990). Toward a General Utilization Theory A Systems Theory Reformulation of the Two-Communities Metaphor. *Science Communication,*12(1), 27-42.

Weiss, C.H. (1978). Broadening the concept of research utilization. *Sociological Symposium,* 21, 20-33.

Weiss, C.H. (1979). The many meanings of research utilization. *Public Administration Review,* 39, 426-431.

Weiss, C.H. (1980). Knowledge creep and decision accretion. *Knowledge: Creation, Diffusion, Utilization,* 1(3), 381-404.

Weiss, C.H. (1981). Measuring the use of evaluation. In: J.A. Ciarlo (Ed.), *Utilizing evaluation: Concepts and measurement techniques* (pp. 17-33). Beverly Hills, CA: Sage Publications.

Welsh, I., & Lyons, C. M. (2001). Evidence-based care and the case for intuition and tacit knowledge in clinical assessment and decision making in mental health nursing practice: An empirical contribution to the debate. *Journal of Psychiatric and Mental Health Nursing*, 8(4), 299-305.

Zhao, L.M. and Reisman, A., 1992. Toward meta research on technology-transfer. *IEEE Transactions on Engineering Management* 39 (1): 13–21.

The Association of Commonwealth Universities

UNIVERSITEIT STELLENBOSCH UNIVERSITY