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The use of conferencing technologies to support drug policy group knowledge exchange processes: An action case approach

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ABSTRACT

Objectives: To describe experiences, lessons and the implications related to the use of conferencing technology to support three drug policy research groups within a three-year period, using the action case research method.
Design: An action case research field study was executed. Three different drug policy groups participated: research, educator, and decision-maker task groups. There were a total of 61 participants in the study. The study was conducted between 2004 and 2007. Each group used audio-teleconferencing, web-conferencing or both to support their knowledge exchange activities.
Measurements: Data were collected over three years and consisted of observation notes, interviews, and meeting transcripts. Content analysis was used to analyze the data using NIVIO qualitative data analysis software.
Results: The study found six key lessons regarding the impact of conferencing technologies on knowledge exchange within drug policy groups. We found that 1) groups adapt to technology to facilitate group communication, 2) web-conferencing communication is optimal under certain conditions, 3) audio conferencing is convenient, 4) web-conferencing forces group interactions to be "within text", 5) facilitation contributes to successful knowledge exchange, and 6) technology impacts information sharing.
Conclusions: This study highlights lessons related to the use of conferencing technologies to support distant knowledge exchange within drug policy groups. Key lessons from this study can be used by drug policy groups to support successful knowledge exchange activities using conferencing technologies.

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1. Introduction

1.1. Scientific background

As collaborative healthcare research groups continue to communicate at a distance, information and communication technologies will play an increasingly important role in supporting such interactions. When these interactions occur between clinicians, academics, and policy makers in a network of collaboration and information sharing, they are referred to as knowledge exchanges [1]. Much of the healthcare knowledge exchange literature has focused on how such groups engage, collaborate, and share ideas about research within a face-to-face setting [1]. Several studies have investigated the impacts of distant knowledge exchange within the information systems literature [2,3]; however, little is known about the impacts of distant knowledge exchange within the healthcare field [4]. The Canadian Institute for Health Services Research defines knowledge exchange as:

> *Knowledge exchange is collaborative problem-solving between researchers and decision makers that happens through linkage and exchange. Effective knowledge exchange involves interaction between decision makers and researchers and results in mutual learning through the process of planning, producing, disseminating, and applying existing or new research in decision-making.*

The purpose of this article is to describe the experiences of three groups working within the field of drug policy using conferencing technologies to support knowledge exchange activities.

1.2. Rationale for the study

Currently, various forms of information and communication technology ICT are used to support group communication. These forms include web-conferencing, videoconferencing, online communities and collaborative technologies, such as document management, application sharing, desktop sharing, white boarding, and co-browsing. As healthcare groups continue to communicate and collaborate through long-distance knowledge exchange, ICT will play a larger role in supporting such interactions. However, to date, the literature on knowledge exchange has remained separate from that of ICT. Unlike the field of information systems, the healthcare field has not fully studied the potential role of ICTs in supporting long-distance knowledge exchange between healthcare groups in general and within drug policy groups specifically. For that purpose, the research question posed by this project was what are the impacts of information and communication technologies on knowledge exchange groups working within the field of drug policy?

2. Study context

The benefits of knowledge exchange occur when decision-makers incorporate research evidence derived from the knowledge exchange process into the decision-making process. The existence of knowledge exchange networks within drug policy is not new. For example, in 1997, Soumerai et al. published a paper on various factors that influence drug cost-containment policies within the United States [5]. The authors found that one factor influencing drug policy decision-making was the knowledge exchange that occurred through various stakeholders around certain Medicare policies. Similarly, a study examining drug policy knowledge exchange practices within six different countries found that knowledge exchange networks involving academics and drug policy decision-makers helped influence various drug policies within each country [6].

In Canada, there have been several examples of successful knowledge exchange within drug policy that have influenced drug policy decision-makers. For example, in 1995, the British Columbia reference-based pricing (RBP) policy set up a knowledge exchange group involving face-to-face interactions between academics and policy-makers to produce evidence that informed drug policy decisions. The implementation of RBP led to $30 million in cost savings during the first year alone [7]. Also, in 2004, the Canadian Optimal Medication Prescribing and Utilization Service (COMPUS) was created to develop more effective drug policy and services to encourage the use of information in decision-making among healthcare providers and consumer drug plan formulation [8]. One of COMPUS' mandates is to facilitate knowledge exchange among clinicians, academics, and policy makers. Its purpose is to produce best practices information for health care providers and improve drug prescribing and use among patients and consumers. Early indications have demonstrated the success of COMPUS in influencing the use of blood glucose test strips, proton pump inhibitor therapy and many other health domains.

These results demonstrate the benefits of creating face-to-face knowledge exchange networks among academics, clinicians, and drug policy makers. The promising results from such programs have led to considerable interest in forging more collaborative partnerships among various stakeholders within the drug policy domain to enhance drug policy decision-making. To date, little is known regarding the impacts of knowledge exchange interactions when they move from a face-to-face setting to a more virtual one. The lessons learned from this study will help improve how future distant knowledge exchange activities are conducted.

3. Methods

3.1. Study design

For this research study, the action case study approach was selected as an appropriate method. There is no standard textbook definition of an action case, but an action case study examines a phenomenon in its natural setting, with the researcher acting as a participatory agent within the research project [9]. There were two primary reasons for using the action case research method. First, it provides a method with which to study drug policy groups while being minimally active with the participants. For example, the researcher helped to set up the audio conferencing and web-conferencing

meetings and solved technical problems. The researcher did not participate in group discussions or decision-making. Second, the action case method provided an opportunity for the researcher to observe the groups and learn about distant knowledge exchange as it occurred within its natural setting.

3.2. Participants

There were three groups that participated in this study: an education task group, a research task group, and a decision-making task group. A total of 61 participants were included in the study.

3.2.1. Education task group

The education task group consisted of academic detailers who produced research reviews regarding new drugs, for dissemination to physicians. Academic detailing involves the study of how knowledge is used, defining the objectives of knowledge, clarifying the parts that practitioners and opinion leaders have in the academic detailing process, and supporting the implementation of research knowledge [10].

Of the 26 potential participants in the education task group, 20 were included in the study. The 6 participants who were excluded were observers and administrative assistants. The 20 participants included in the education task group were researchers, educators, and decision-makers. The education task group comprised 10 (50%) men and 10 (50%) women. Of the 20 participants, 3 (15%) participants were decision-makers, 3 (15%) participants were researchers, and 14 (70%) were educators. All participants had at least a bachelor's degree. Thirteen of the educators were pharmacists by training, and one was a physician. All three researchers were experienced drug policy researchers. The educators were from five Canadian academic detailing programs located in British Columbia, Alberta, Saskatchewan, Manitoba, and Nova Scotia. A one- to ten-year range of experience in academic detailing was noted for the different academic detailing programs. All the researchers involved in the education task group were based in British Columbia, and each had over ten years of drug policy research experience. The list of participants was obtained from an administrative member of the education task group. Consent to participate was obtained via e-mail. No incentives to participate in the study were offered or given to the participants. All group members had experience using e-mail, audio conferencing, and desktop computers.

3.2.2. Research task group

The research task group consisted of researchers and decision-makers working together on evaluating physician education materials focused on improving patient care. There were 17 potential participants in the group, of which 14 were included in the study. The three excluded participants were observers and administrative assistants. The included participants were either researchers or decision-makers. The research task group had 9 (64%) men and 5 (36%) women. The group consisted of 12 (86%) researchers and 2 (14%) decision-makers. The level of education of each researcher was higher than a bachelor's degree. One of the researchers was located in the United States, and the remaining 11 were in Canada (Victoria and Vancouver, British Columbia). No incentives to participate in the study were offered to participants. The list of participants was obtained from an e-mail distribution list. Consent to participate was obtained through a consent form, which was returned via fax.

3.2.3. Decision-making task group

As part of a Health Canada-funded research program, a group of researchers met with decision-makers and their staff members on a monthly basis using synchronous (live audio conferencing) to disseminate research information on the latest drug policy research trends.

There were 32 potential participants identified in the decision-making task group, of which 27 were included. The 5 excluded individuals were observers and administrative assistants. The 27 participants included in the decision-making task group included researchers, decision-makers and staff from provincial Canadian drug plans. The decision-making task group was composed of 13 (48%) men and 14 (52%) women, consisting of 22 (82%) decision-makers and staff as well as 5 (18%) researchers. All participants had at least a minimum of a bachelors degree. All decision-makers were senior representatives of seven major Canadian drug policy programs located in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Prince Edward Island. All researchers, with one exception, were university teaching professors working in the field of drug policy. No incentives to participate in the study were offered to the participants. The list of participants was obtained from an e-mail distribution list. Consent to participate was obtained via a consent form that was returned through e-mail. All group members had prior experience using e-mail and audio conferencing.

3.3. Meeting structure

3.3.1. Education task group

With regard to audio conferencing meetings, the education task group met the third Tuesday of every month with a rotating chair (i.e., process facilitator) to facilitate the group process. The rotating chair was selected according to location. For example, if a particular geographical area presented one month, another geographical area would present during the second month, and so on. Prior to the audio conferencing meetings, the education task group members sent out an agenda a few days in advance of the meeting. The meeting information and related documents were transmitted via e-mail. In the e-mail, a toll-free number and meeting code were also included, so group members could gain access to the audio conferencing meeting. Education task group members usually logged in a few minutes prior to the meeting. The group members generally opened up e-mailed documents if necessary during the meeting. Sample topics discussed in the education task group audio conferencing meetings included communication needs, physician education materials, relationships with funding agencies, a literature synthesis project, roles and relationships, and group identity issues.

In web-conferencing meetings, the education task group met the third Tuesday of every month with a rotating chair (i.e., process facilitator) to facilitate the group process. Agenda

items were sent in advance along with a link to the web-conferencing meeting. Group members were asked to log in at least 20 min earlier than the designated meeting time, so any technical glitches could be addressed. The facilitator placed agenda items on the whiteboard and performed a sound check. During the sound check, the facilitator asked group members to speak into their microphones. They would signal whether or not they could hear the speaker by using either the voting/poling or the checkmark feature. If they did not hear the speaker clearly, they would signal with an (x). The group followed the agenda and crossed out items as they finished them. Sample agenda topics included grant proposals, physician education materials, literature, time-lines and project deliverables for the group evaluation project, as well as status reports.

3.3.2. *Research task group*

The research task group attempted to meet every month in web-conferencing meetings. Approximately one week before the meeting, the research task group sent out the meeting agenda along with a link to the web-conferencing meeting. PowerPoint presentation slides were placed on the whiteboard for the entire group to see. A sound check was performed, in which the process facilitator ensured that all participants could be heard during the meeting. The sound check process was identical to the process followed by the education task group. The research task group members followed the agenda and crossed out items as they completed them. Sample group discussion topics included developing group roles, attending conferences, reviewing group methodologies, achieving project deliverables, moving to new offices, and discussing the research process. Near the end of the research project, the research task group reverted to face-to-face communication and abandoned the web-conferencing sessions.

3.3.3. *Decision-making task group*

Regarding the structure of the live audio conferencing for the decision-making task group, the format was a 15 min presentation with another 5 min for questions. Prior to the meeting, a telephone number was sent to each participant via e-mail with appropriate meeting details and PowerPoint slides. At the designated meeting time, the chair introduced the speaker and the topic. The speaker spoke for 15 min and 5 min were left for a question and answer period.

3.4. *Technologies used*

The selection of ICTs was based on discussions conducted with the three groups prior to initiation of the study. The discussions determined that the decision-making task group would only utilize the audio-teleconferencing to support group communication because it was simple and convenient. The education and research task groups decided to begin with audio conferencing and gradually move towards the use of web-conferencing. However, at a later stage, the research task group abandoned the use of web-conferencing and switched to face-to-face communication.

For the web-conferencing, Elluminate Live V-Class edition was used because it was provided by the university without a fee. Furthermore, the version of the technology employed in the study allowed for half-duplex audio communication that permitted users to speak one at a time. Elluminate allowed users to upload agendas to the whiteboard, share documents via application sharing, use instant text message, vote/poll participants, use emoticons, raise hands, and see participant names. These were the most relevant features used by the groups in the study. For each of the web-conferencing meetings, the researcher within the study acted as technical facilitator, and a group member facilitated the group discussion for each meeting.

Fig. 1 shows a generic screen shot of the Elluminate Live technology. The most visible feature is the participant window (top left). Participant names are displayed in this window, along with emoticons and the hand-raising feature. Below this window is the direct text messaging feature, which allowed group members to communicate using text messages. Below the direct messaging window is the half-duplex audio communication function. The group used this function to communicate using audio. The whiteboard page is the main screen. This allowed group members to share PowerPoint slides and manipulate the slides using whiteboard tools.

Audio conferencing was used in the study when the group required that the technology allow for multiple participants to speak at a time. There was no video or other media for communication. A participant simply dialled a telephone number, entered a conference code, and responded to a prompt requesting his or her name; a beep sound let other participants know that someone had joined the meeting. To use this technology, group members needed access to e-mail and a telephone. E-mail was necessary to inform the participants about the meeting details (time, numbers to dial, and the agenda). A telephone was required to participate in the meeting. Furthermore, each group included a moderator to facilitate group discussions using the audio conferencing technology.

3.5. *Data collection*

The data collection process took place over three years (April 2004–July 2007). Different data were collected for the three drug policy groups. Phase 1 data included a compilation of baseline interviews for the researcher and educator group and observation data for all three groups. Baseline interviews were not conducted with the decision-making group. Phase 2 data included recorded meeting transcript data for the three drug policy groups. Phase 3 data included post-interview data and survey data results for the three drug policy groups. Table 1 provides a summary of the data collection phases and data types for each group. Baseline interviews, post-interviews, and audio conference meetings were audio-recorded via telephone. Web-conferencing meetings were recorded using the Elluminate Live recording feature. It recorded the audio and screen captures of group interactions using emoticons, voting/polling, text messages, and the whiteboard.

Furthermore, the researcher transcribed all baseline interview data and hired a transcription company to transcribe the meetings and the post-interview data. The baseline interview, meetings, and post-interview data were transcribed verbatim.

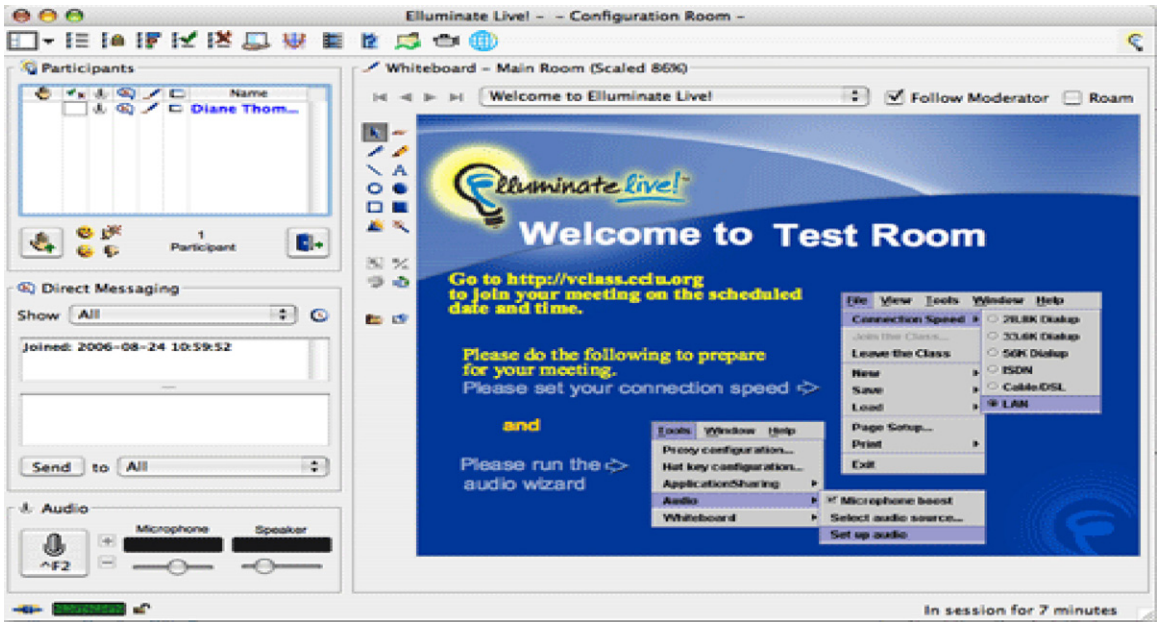

Fig. 1 – Elluminate Live screen shot.

3.6. *Data analysis*

In this study, the analysis focused on exploring the impacts of conferencing technologies on knowledge exchange within the three drug policy groups. The analysis method used in the study was qualitative direct content analysis [14]. This method of content analysis is specific to qualitative studies. In general, content analysis is a data analysis approach that can be used to analyze qualitative data; it is a systematic process of analyzing communication messages and making inferences based on the analysis [11,12]. Content analysis involves the interpretation of textual data that have been categorized in to concepts. Once the concepts or categories had been identified, data were categorized to one of several themes [13].

For the analysis, groups of phrases or sentences provided an appropriate level of sampling for the baseline, follow-up inter-view and meeting transcript data. A subsequent step in the analysis was to extract and compile all of the transcripts, interview responses and observations. During this process, responses from the education, research, and decision-making task groups were separated from each other. The researcher familiarized himself with the data by reading the data for each of the groups. Sentences and phrases were selected as the basic units of analysis. Furthermore, NVIVO was used as the qualitative data analysis software tool.

4. Results

Six key lessons have been identified in the study with regard to the impacts of conferencing technologies on knowledge exchange groups. The basis for these lessons and how they compare with findings reported by the relevant literature are

Table 1 – Types, volume, and data sources.

Type	Volume	Source
Phase 1(baseline interviews): Face-to-face and telephone interviews were conducted with education and research task groups between April and July 2004	12 education groups, 9 research groups, 0 decision-making task group	Participant members. Collected by researcher
Phase 1 (observations): Researcher collected observational data on the three groups between 2004 and 2006	15 pages of notes stored on Microsoft word and Excel	Researcher perceptions
Phase 2 (meeting transcripts): Meeting transcripts were collected between March 2004 and November 2006	Education group (6 teleconference, 4 web-conferencing); Research group (1 teleconference, 4 web-conference); Decision-making group (7 teleconference)	Participants. Recorded using microphone on telephone, windows media encoder
Phase 3 (post-study interviews): Participant interviews with key stakeholders from each group. Interviews occurred between April and July 2007	7 education groups, 5 research groups, 5 decision-making group	Participant members. Collected by researcher

Table 2 – Six key lessons learned on the impacts of conferencing technologies on knowledge exchange drug policy groups.

Lessons learned
Finding 1: groups adapt to technology to facilitate group communication: when using new technologies, groups adapt their structure of communication around technology features.
Finding 2: web-conferencing communication is optimal under certain conditions: web-conferencing is an appropriate choice for knowledge exchange when there are limited budgets, large geographic dispersion, and a need for a high level of collaboration.
Finding 3: audio conferencing is convenient: when compared to web-conferencing, audio conferencing technology is a very simple and convenient technology to use for knowledge exchange.
Finding 4: web-conferencing forces group interaction "within text": web-conferencing will shift away interactions from interacting with each other to interacting via the text displayed on the whiteboard.
Finding 5: facilitation contributes to successful knowledge exchange: when moving from a non-verbal rich medium, such as face-to-face, to a less rich non-verbal medium, such as web-conferencing, the facilitator needs to have strong facilitation skills to engage participants effectively. Otherwise, the knowledge exchange process may fail.
Finding 6: technology impacts information sharing: neither did audio conferencing or web-conferencing impact the type of evidence that was shared between group members. However, web-conferencing and audio conferencing did impact how the information was.

discussed in this section. The lessons are summarized in Table 2, above.

4.1. *Finding 1: groups adapt to technology to facilitate group communication*

This finding applies to the education and research task groups: both groups experienced changes in social interaction norms when communicating using web-conferencing. For example, when both the education and research task groups started to use web-conferencing, the technology limited their communication, allowing only one person to speak at a time. The groups implicitly started to introduce other forms for communication, such as text messaging, voting and polling, emoticons, and application sharing, to enhance the group discussions. These new discussion norms were introduced to compensate for the loss of immediacy and spontaneity in group discussion via web-conferencing interactions. This demonstrated that when encountering a highly structured approach to communication, the group members resorted to other forms of communication to compensate for the lack of socio-emotional interactions inherent to web-conferencing. Two statements below support the above finding:

> Just in the sense that if somebody was talking on and on and you wanted to interrupt them you wouldn't be able to do it vocally. You would have to do it via a little text note or something like that. [Educator within the education task group]

> I recall one of my problems is that I tend to interrupt when I get excited about a point. That was less possible with web-conferencing because you had to take turns more. [Educator within the education task group]

An explanation of the lesson learned may be that the dynamics of group communication changed as the education and research task groups moved from unstructured communication-type environments (i.e., face-to-face or audio conferencing) to the highly structured web-conferencing. With web-conferencing, group members could communicate only via voice, one person at a time, using the hand-raising function. The groups compensated for this loss of immediacy in communication by adapting and introducing new methods and structures for communication. Group members started to use text messaging and emoticons as a way to improve group socio-emotional interactions. This finding is consistent with adaptive structuration theory (AST). [15]. According to AST, the use of ICT introduces structures that influence the rules and resources that govern social interactions. Within both the education and research task groups, new forms of interaction norms were introduced to moderate the influence of technology on group social interactions.

4.2. *Finding 2: web-conferencing communication is optimal under certain conditions*

The evidence from this research suggests that web-conferencing is an appropriate choice to facilitate knowledge exchange when groups have limited budgets, large geographic dispersion, and a need for a high level of collaboration. The education task group tolerated the learning and the highly structured communication process required to use web-conferencing because the group had a limited budget, was geographically dispersed, and was highly collaborative. However, the research task group had a budget to support travel; its members were often located in the same area and highly collaborative. Therefore, the research task group was not as interested in web-conferencing meetings because they had the resources to meet face-to-face. As a result, they abandoned the use of web-conferencing.

The decision-making task group had a limited budget, was geographically dispersed, and was not highly collaborative. Such a group may not tolerate web-conferencing. In this study, the drug policy decision-makers were too busy to learn a new technology such as web-conferencing. For this group, live audio conferencing meetings were the preferred method of communication.

These results are similar to those reported by Orlikowski and Yates in their study of technology-enabled computer language designers collaborating on a multi-year project involving the development of various programming languages [16]. The authors found that different group inputs affected how the groups chose to communicate with each other. Over time, the group reinforced the pattern of how they communicated with each other until the technology they chose became the main method with which group members worked together.

From a more theoretical view, this finding can be explained by the literature on social presence. Social presence is defined

as "those communication behaviors that enhance the closeness to, and non-verbal interaction with, each other" [17]. The concept of social presence suggests that a higher degree of interaction between individuals materializes with a greater presence of non-verbal cues, body movement, and eye contact, which increase sensory stimulation [17]. Such high-level interactions are found primarily in face-to-face interactions. According to the study results, both the education and research task groups preferred meeting face-to-face because of the groups' preference for a higher degree of interaction. However, due to budget and geographical constraints, the education task group communicated via audio conferencing and web-conferencing, whereas the research task group, which was not affected by the same constraints, was able to meet face-to-face and later discontinued the use of web-conferencing.

4.3. *Finding 3: audio conferencing is convenient*

Respondents noted that audio conferencing had the advantage of making the participation process easy and convenient. The audio conferencing platform provided a very simple process for enabling participation because all participants had access to and were familiar with the technology. The participant simply called a number and entered a meeting code to participate in the meeting. It was more difficult to participate in web-conferencing than in audio conferencing. For web-conferencing, the user needed a computer, a microphone, software, and skill in using the relevant applications. As the education and research task groups noted, members needed to learn how to use the equipment before participating in the web-conference, as demonstrated in the following statements by the decision-making and education task groups:

> In terms of audio conferencing, it doesn't require you to get on a plane and go somewhere. It's much more convenient for regularly scheduled meetings. [Educator, within the education task group]

> [Audio conferencing is a] quick, easy tool that is widely available. [Drug Policy Maker within the decision-making task group]

4.4. *Finding 4: web-conferencing forces group interaction "within the text"*

Education and research task group members noted that when group members started to use web-conferencing, their interactions changed from interacting with each other to interacting within the text. For example, when the education or research task groups met face-to-face, group members would face each other directly and share the same space. In web-conferencing, however, the agenda would be placed on the whiteboard for all to see. All members would interact with and talk about the agenda placed on the whiteboard. The whiteboard itself represented the shared space, whereas in a face-to-face meeting, the shared space would be the office or room. Group interactions within web-conferencing were structured around the text, and the documents were shared on the whiteboard as demonstrated by the following statements:

> [Web-conferencing] allows people to engage visually in addition to being able to talk and listen, which is a key component particularly when a lot of our work was going through education materials. For example, [in web-conferencing] everybody is looking at the same thing on a screen, and that kind of keeps the group together for one, and it also helps make sure that we're all talking about the same thing. [Educator within the education task group]

> Web-conferencing made us feel that we were meeting within the text. The group meets within the document or slide. It is a group space just like the difference you would feel at your home office vs. downtown in a shared space. [Researcher within the research task group]

Cramton conducted studies on the effects of text-based interactions on group communication [18,19]. In the studies of a performance appraisal system design firm, the author observed that due to the absence of non-verbal cues in e-mail messages, group members did not pay attention to certain messages embedded within the e-mail. The author notes that text-based interactions, especially e-mail communication, can lead to group members missing messages embedded within the text. Even though Cramton's study focused on e-mail messages, it is important to note the potential ramifications of text-based interactions with regard to how information is processed by group members [18,19]. The potential implication for knowledge exchange is that pieces of information may be missed or misinterpreted by decision-makers or researchers.

4.5. *Finding 5: facilitation contributes to successful knowledge exchange*

In the analysis, group members noted that process facilitation skills were vital to the success of knowledge exchange meetings. The group facilitators played an important role within the education and research task groups; they managed the group discussion and participation process. Without such guidance, the knowledge exchange process would likely have failed. When moving from a non-verbal-rich medium, such as face-to-face, to a non-verbal-poor medium, such as web-conferencing, the facilitator needs to have strong facilitation skills to engage participants effectively, as demonstrated in the following statements:

> I think in the face-to-face meetings, there are different kinds of cues that the facilitator can use, including visual cues, body language, etc. Whereas on the web-conferencing, you lose visual cues, but there are certain types of electronic ways to try and capture that. So on web-conferencing, the facilitator has to be a lot more conscious about the lack of cues. [Facilitator within the research task group]

> The facilitator needs to be more aware of the need to check with other people. This will help make sure everybody is included. They should not move on to the next item until they checked that all discussions are finished for that item. [Facilitator within the education task group]

In a study on the effects of trained facilitators on group processes, Anson et al. noted that process facilitation is a critical factor for improving group meetings in a technology-enabled environment [20]. They noted that higher quality process facilitation improves the meeting process and training and that experience is important for building high-quality process-facilitation skills.

4.6. *Finding 6: technology impacts information sharing*

The data suggest that respondents in the education and research task groups believed that technology had little effect on the level of evidence shared in the group, as demonstrated by the following statements, by two educators from the education task group:

> We're all pretty much evidence-based people, and I don't think anybody would explicitly disagree that web-conferencing affected the level of evidence. [Educator within the education task group]

> No, I think the level of evidence we discussed still stayed the same. [Researcher within the research task group]

A possible explanation for this finding is that the group had arranged to share the documents (PowerPoint slides and PDF documents) before the meeting. Because they had pre-arranged the presentation of the evidence independently of the technology, the groups perceived that the technology had no real effect on the level of evidence.

Even though respondents noted that technology did not affect the strength of the evidence, they acknowledged that technology did affect how the evidence was shared within the group. For example, respondents noted that web-conferencing limited the amount of information that a member could share on the whiteboard, which forced the group to summarize the information for display on the computer screen.

In general, the ICT literature on information exchange has focused on types of information (i.e., task information, social information, and contextual information), distribution of information, information-sharing challenges, and general effects of technology on information sharing [21]. Only a few studies have examined the effects of technology on the level of evidence and how information is shared.

5. Discussion

This study demonstrated that conferencing technologies had an impact on knowledge exchange within drug policy groups. For example, respondents reported that different types of conferencing technologies (i.e., web and audio conferencing) had different effects on knowledge exchange. For the decision-making task group, audio conferencing provided a simple and convenient method for participation at a distance and maintained the immediacy and spontaneity that would be available in face-to-face meetings in group discussions.

Web-conferencing was the preferred method of communication when the groups needed to collaborate, had a limited budget, and were geographically dispersed, which occurred in the education task group. Groups with these traits found web-conferencing to be a more valuable medium than audio conferencing because it provided a much richer forum for interaction through its voting and polling, whiteboard, application-sharing, and participant information display functions. However, certain group respondents noted some difficulties with using web-conferencing, especially with the communication structure that it forced on the group, which may have dampened social interactions within the group.

The results of the study are relevant to the literature on ICT. In general, the ICT literature tends to view social interaction norms within a group as a way of bringing a form of governance to online environments. Group members learn through social interaction norms what is or is not socially acceptable within a group. Social interaction norms are crucial for the smooth operation of group meetings and interactions when technology is used to collaborate at a distance [22]. The findings in the education, research, and decision-making task groups indicated that each group introduced various social interaction norms to facilitate group interactions within its meetings. This diversity in social interaction norms can be explained by the differences in group inputs, such as group characteristics, culture, and technology structure. This is similar to the findings of Yates et al. in their study of the use of collaborative technology among organizational group members [23]. Studying three groups within an organization for a seven-month period, the investigators found that social interaction norms developed differently in each of the groups. These differences were attributed to group size, task, and attitude towards the new technologies. Group members replicated similar social interaction norms within the new system and made innovations in creating new norms, including highlighting text in documents, embedding documents created in other media, and implementing faster turnaround in group-to-group discussions. Another interpretation could be that with the introduction of new communication technologies, the groups started to adapt to the new way of communication. For example, in their study of robot control from a distant location, Luff et al. [2] found that participants adapt to, or "make sense" of, the environment they work in and modify their behavior accordingly.

Furthermore, within the education, research, and decision-making task groups, no explicit norms were introduced into the groups to regulate behaviors. In other studies, e.g., that of Ackerman et al., the groups involved in the study explicitly introduced social norms into the technology-enabled group and outlined social repercussions for not adhering to the social interaction norms [24]. In Ackerman et al.'s study, the groups used high-quality audio for communication: users had the option to listen and speak during group discussions [24]. The group consisted of nine members working on engineering-related projects. The group members developed social interaction norms for dealing with background noise, knowing when someone was present and listening, and limiting violations of personal privacy. Sanctions stopped unwanted behavior. A concerted effort was made to adhere to the social norms, and the result was improved group meetings. It is not clear why the drug policy groups did not introduce explicit social norms to influence group behavior. Many of the group behaviors within this study, which were expressions of social interaction norms, occurred implicitly. Multiple expla-

nations may account for why explicit rules for moderating group behavior were not expressed. Group members may have relied on the facilitator to carry out the task, may have been too busy, or may not have believed that the control of social behavior was a major issue that affected group meetings.

According to the findings of the research, each of the three drug policy groups used a different communication medium to carry out meetings. The education task group preferred web-conferencing to facilitated group communication by teleconference and face-to-face. The research task group essentially abandoned audio conferencing and web-conferencing in favor of face-to-face communication. The decision-making task group preferred audio conferencing to facilitate group communication. This suggests that each group produced social interaction norms while using communication media and that these norms defined how the group worked together. Over time, the three groups found the communication medium that best facilitated their group interactions, which became the norm under which group members operated. This is similar to the findings of Orlikowski and Yates in their study of technology-enabled knowledge workers and computer language designers, who collaborated on a multi-year project to develop various programming languages [16]. The authors analyzed over 2000 transcripts of archived e-mails, finding that when a group forms, members come to an agreement, whether implicitly or explicitly, on which communication medium to use. When group members incorporate these norms into the group, they produce social interaction norms that define how the group works together. Over time, the groups studied reinforced the pattern of social interaction until it became the main method by which group members worked with each other. These social interaction norms continued to change and evolve as circumstances changed within the group.

In this study, the drug policy groups noted the importance of having a trained process facilitator to manage group interactions to improve group meetings. For example, Anson et al. analyzed the consequence of group decision support systems (GDSS) and the influence of a process facilitator on group performance and on group interaction processes [20]. The results demonstrated that group which had more structure through process facilitation, but without GDSS support, exhibited better group processes than GDSS-supported groups that lacked process facilitator support. Based on their findings, the authors observed that process facilitation is a critical factor for improving GDSS effectiveness, higher-quality process facilitation improves the meeting process, and training and experience are important to building high-quality process facilitation skills. The research findings of Anson et al. were reflected in the statements of the drug policy group participants regarding process facilitation [20].

Our study findings show that technology had little effect on the level of evidence in information exchange but did affect how the information was shared. In the ICT literature, many of the studies have focused on the use of information in problem-solving tasks, such as admitting university students, general decision-making, or product development [25–27]. More specifically, the ICT literature on information exchange has focused on the various types of information and how they are distributed, as well as the challenges associated with information distribution [21]. The literature discussing the effects of technology on the level of evidence and information-sharing is scarce.

6. Limitations

There are a number of limitations in the study. First, there are limitations to using the action case study methodology. For example, the action case method may be criticized for not being generalizable to other times, places, or settings. Other limitations of the study arise from the dynamic nature of drug policy groups. For example, each of the groups had different numbers of participants, data types, and meetings. As a result, it was difficult to compare all three groups. Some of the interview questions for each of the groups had to be slightly modified to take group context into account; further, no baseline data was collected for the decision-making task group. Additionally, not all the groups used the same technologies. The decision-making task group used audio conferencing; the research task group used web-conferencing and later abandoned it; and the education task group used both audio conferencing and web-conferencing. Future studies should not be limited to drug policy groups and should expand to other health- and non-health-related groups working on knowledge exchange activities using virtual collaboration tools.

Furthermore, the study focused on knowledge exchange, a process focused on networking and information exchange. Future studies should focus on the effects of web-conferencing, audio conferencing, and other technologies, as well as knowledge synthesis, the contextualization of research findings, the application of research, and decision-making processes.

As well, the version of the Elluminate web-conferencing technology employed in the study allowed for half-duplex audio communication that allowed users to speak one at a time. Future studies should look at the effects of full-duplex web-conferencing technology on knowledge exchange processes.

7. Conclusions

The research described in this article has contributed to the general theoretical and practical understanding of the role of information and communication technologies (ICT) on knowledge exchange processes within drug policy groups. More specifically, the study focused on the impacts of different communication media (face-to-face, audio conferencing, and web-conferencing) on various group processes such as social interactions, facilitation, and information exchange. Differences became evident within the drug policy groups according to how they adapted to the different communication media to distant knowledge exchange. As discussed earlier, the differences in how the groups used communication media can be accounted for by differences in group research tasks, group characteristics, group context, and group culture.

In terms of social presence theory, the study found that different communication technologies provided varying levels of social presence. For example, web-conferencing had a

higher degree of social presence than did audio conferencing. The study also found that the selection of the appropriate communication media for group communication was highly influenced by factors other than social presence, such as, geographical distance between group members and a budget that supported face-to-face meetings. The findings suggested that drug policy groups that were not geographically dispersed, had a budget to support group travel, and were highly collaborative preferred face-to-face communication, which provides the highest form of social presence. However, if these groups were unable to meet face-to-face because of budget constraints and geographical separation, the groups were content to use other forms of communication, such as, audio conferencing and web-conferencing. This demonstrates that groups may find it important to meet face-to-face because of the higher level of interactions; however, they can be limited by geographical dispersion and budgets that do not allow traveling for face-to-face meetings.

With regard to Adaptive Structuration Theory (AST), the use of ICT introduced structures that influenced the rules and resources governing social interactions. In the study, AST helped explain why groups adapt to the use of ICT differently. According to AST, the use of ICT introduces structures that influence the rules and resources that govern social interactions. Within drug policy groups, new forms of social interaction norms were introduced to moderate the influence of ICTs. Each group adapted to the technologies used in the study differently. The findings presented in the study support the use of AST to understand how groups use and are influenced by the use of ICTs to govern group social interactions.

From a methodological perspective, the use of action case study provided an in-depth look into how distant knowledge exchange processes develop within drug policy groups. The study demonstrated that action case can be used as a viable method in health informatics research. Using the action case study method helps to provide an in-depth look at how processes develop within distant knowledge exchange groups. Action case allows the researcher to participate at a level that is not overly intrusive to the group being studied. In addition, the use of multiple data sources in the analysis made it feasible to examine the nature of the results in the context of the other data collected.

In conclusion, this study has made a significant scientific contribution to advancing our understanding of the role information and communication technologies play in shaping knowledge exchange within drug policy groups. The study has led to findings not previously reported. In addition, the research has important implications for the domains of distant knowledge exchange, ICT, and drug policy. In summary, the research described in this article has contributed in a number of original ways to the advancement of scientific knowledge.

Future studies should explore the effects of conferencing technologies on knowledge translation activities and processes related to collaborative problem-solving; the synthesis, contextualization, and application of evidence; and decision-making. Future researchers should also study multiple groups in different health domains that involve researchers and decision-makers who employ current technologies, such as videoconferencing and group decision support systems.

Summary points

The article makes the following contributions to health informatics:

"What was known"

- Knowledge exchange within drug policy helps inform decision-making
- Information and communication technologies help support group communication.

"What the study contribution was"

- Distant knowledge exchange within drug policy impacts the knowledge exchange process, especially that of social interactions.
- Group size, budget, geography, helps determine the type of the preferred method of interaction between groups i.e., face-to-face, audio conferencing, and web-conferencing.
- Web-conferencing did not impact the level of evidence, but it did impact how the information was shared and viewed by group members.
- It demonstrated the use of action case, as a viable research method for distant knowledge exchange.

Author contributions

The study was designed by the lead author Dr. Mowafa Househ. Drs. Kushniruk and Maclure contributed to the definition of the study. Dr. Househ collected the data, conducted the analysis, and drafted the manuscript. All authors contributed to the critical revision of the manuscript. Dr. Kushniruk was the supervisor during the whole study, including the reporting. Dr. Maclure contributed as a liaison with the drug policy groups.

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