Use of Ecomaps in Qualitative Health Research

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Abstract

Qualitative health research plays a central role in exploring individuals' experiences and perceptions of wellness, illness, and healthcare services. Visual tools are increasingly used for data elicitation. An ecomap is a visual tool that applies ecosystems theory to human communities and relationships to provide an illustration of the quality of relationships. We describe the use of ecomaps in qualitative health research. Searches across eight databases identified 407 citations. We screened them in duplicate to identify 129 publications that underwent full text review and included 73 in the final synthesis. We classified and summarized data based on iterative comparisons across sources. Benefits of using ecomaps include improving rapport and engagement with study participants, facilitating iterative question development, and highlighting the social contexts of relationships. When used in conjunction with interviews, they promote data credibility through triangulation. Investigators have used ecomaps as a tool to facilitate primary and secondary analysis of data. Researchers have adapted the ecomap to meet their health research needs. Challenges to their use include additional time and training needed to complete, and potential privacy and confidentiality concerns. Ecomaps can be useful in qualitative health research to enhance data elicitation, analysis, presentation, and to augment study rigor.

Keywords

ecomap, graphic elicitation, qualitative health research, integrative review

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Qualitative health research plays a central role in exploring individuals' experiences and perceptions of wellness, illness, and healthcare services. Visual tools are increasingly used for data elicitation. An ecomap is a visual tool that applies ecosystems theory to human communities and relationships to provide an illustration of the quality of relationships. We describe the use of ecomaps in qualitative health research. Searches across eight databases identified 407 citations. We screened them in duplicate to identify 129 publications that underwent full text review and included 73 in the final synthesis. We classified and summarized data based on iterative comparisons across sources. Benefits of using ecomaps include improving rapport and engagement with study participants, facilitating iterative question development, and highlighting the social contexts of relationships. When used in conjunction with interviews, they promote data credibility through triangulation. Investigators have used ecomaps as a tool to facilitate primary and secondary analysis of data. Researchers have adapted the ecomap to meet their health research needs. Challenges to their use include additional time and training needed to complete, and potential privacy and confidentiality concerns. Ecomaps can be useful in qualitative health research to enhance data elicitation, analysis, presentation, and to augment study rigor.

Keywords: ecomap, graphic elicitation, qualitative health research, integrative review

Given the frequent use of different types of interviews to explore individuals' experiences and perceptions, words are a common medium of knowledge creation and communication in qualitative health research. However, experiences are multidimensional and using words alone may not capture the full extent of an individual's experience of the health or social phenomenon under exploration (Hartman, 1978, 1995). Limitations of thought and language may restrict comprehensive processing or communication when an extensive amount of information exists with respect to an experience. To address this challenge, visual tools are often used as elicitation strategies during qualitative interviews and focus groups (Glegg, 2019; Orr et al., 2020; Umoquit et al., 2011). These include photos, videos, and graphic representations of experiences, such as ecomaps. An ecomap is a simple diagram that depicts a visual summary of an individual's perceptions about supports and stressors in their life. They have been used to understand interactions and design solutions while considering the organizational context (Emam, 2014) and workplace culture (Bennett & Grant, 2016).

Initially described by Ann Hartman (1978, 1995) and based on principles of general systems theory applied to ecology, ecomaps have been extensively used for clinical purposes (Holtslander, 2005; McCormick et al., 2008). An ecomap provides an illustration of

psychosocial status based on key domains in a person's life, including the number, strength, and quality of their social relationships as well as flow of resources (Hartman, 1978). It illustrates the individual's or family's social context and relationships with larger systems including school, healthcare, work, and social communities. Ecomaps involve drawing, which gives participants time to reflect on the issues being explored. This encourages them to go beyond a verbal mode of thinking and to consider other dimensions of their experiences.

Key concepts considered in the development of ecomaps are relationships, social networks, and supports (Ray & Street, 2005a). The process of constructing an ecomap captures an individual's relationship types, social network composition, and sources of distress and support. Ecomaps have been used as clinical tools in social work (Darmsted & Cassell, 1983; Hoyle, 1995) and nursing (Dobson, 1989; Nascimento et al., 2014). More recently they have been used as a research tool (Ray & Street, 2005a; Rempel et al., 2007), albeit with limited guidance on methods to interpret, analyse, and report findings within the context of a qualitative research study. They have not been widely adopted in health research (Rempel et al., 2007). We examined existing literature on the application of ecomaps in health research to identify strengths and challenges to their use with the goal of understanding their value in qualitative health research.

Objectives

The objectives of this integrative review were to:

1. Identify, extract, and synthesize available literature on the use of ecomaps in health research.
2. Describe benefits and challenges of using ecomaps in qualitative data collection, analysis, and interpretation.
3. Summarize ecomap modifications used in health research.

The authors of this paper comprise a writing team with diverse disciplinary backgrounds including medicine (VM, AN, HLM), nursing (SMJ), and ethics (LS), expertise in quantitative (VM, AN, HLM), qualitative (VM, LS, SMJ) and mixed methods health research (VM, HLM, LS, SMJ), and programs of health services research with diverse foci such as violence prevention (HLM, SMJ), global health (LS), and clinical decision-making (VM). Four authors (VM, HLM, LS, SMJ) share a common history of completing graduate studies and/or holding a faculty appointment in the Department of Health Research Methods, Evidence, and Impact (formerly the Department of Clinical Epidemiology & Biostatistics), McMaster University (Canada). Within this Department, the concepts of evidence-based medicine and evidence-informed decision-making are highly valued; rigorous training in quantitative and review methods is foundational to each degree stream, and there is a commitment to advancing the science of research methodologies. As a Doctoral student within this Department (2015-19), VM was introduced to the principles and methods of qualitative health research, first in a graduate course and then during her thesis research (both led and supervised by SMJ), a mixed methods dissertation (Manja, 2019) on the ecology of clinical decision-making by cardiologists. Prior to this work, her research background and experiences were firmly grounded in post-positivist thought. Her experiences as a practising cardiologist included challenges with some veteran patients unable to adhere to treatment recommendations, and instances in which evidence-based medicine was not practiced led her to seek better ways to understand these behaviors and to design strategies to implement evidence-informed patient-centered care. During her doctoral studies, she came to value qualitative health research as a method to understand the reasons for non-adherence and to

optimize patient care. She was intrigued by the use of ecomaps to improve qualitative data collection and analysis. The senior author's (SMJ) interest in this work is grounded in two decades of experience conducting qualitative health research studies, several of which included purposeful samples of young pregnant and parenting girls and women. Many of these studies included open-ended questions about participants' formative experiences, their family of origin, as well as identification of the different forms of social and professional supports needed to achieve their health goals. Recognizing the complex family structures and ongoing needs for a range of services and supports, Dr. Jack started to use eco-maps within her qualitative interviews, first to help establish rapport and then as a tool to assist participants list and make sense of the many people and supports in their lives. Without purposeful training in the use of eco-maps, Dr. Jack was drawn to this review to explore what strategies other researchers have used to guide participants in the development of their eco-maps and then how to integrate them into the analysis.

Methods

Design

An integrative review is a comprehensive research review method that allows inclusion of theoretical and empirical literature as well as experimental and non-experimental research in order to fully understand a topic. This approach allows for concurrent synthesis of data from different research paradigms. The methodological strategies outlined by Whittemore and Knafl (2005) were used to guide the design and conduct of this integrative review across five steps:

1. Problem identification,
2. Literature review,
3. Data evaluation,
4. Data analysis, and
5. Presentation.

Problem Identification

In qualitative health research, researchers familiar with clinical assessment tools such as ecomaps have adapted them to generate research data within the context of a study. Within study methods sections, ecomaps are often listed as a data elicitation strategy used to augment information collected through semi-structured interviews, yet there is little methodological guidance available to support novice qualitative researchers on how to implement ecomaps within their studies nor how to analyze and interpret the resultant data.

Literature Review

Literature Search

We conducted a comprehensive and systematic search of the literature to explore and describe how ecomaps have been used within the research context. Using the keywords "ecomap," "ecomapping," and "graphic elicitation," we searched the following databases for documents published from the start of the database to April 25, 2019: PubMed, Embase, PsycINFO (Psychology and related disciplines), SSRN (Social Sciences Research Network), Scopus and CINAHL (Nursing and Allied Science Literature), Web of Science and PAIS Index (Public Affairs and Public Policy). We reviewed cross-references and bibliographic citations

of relevant publications. This review focused on peer-reviewed literature. It did not include grey literature such as web pages, blogs, or policy documents. "Graphic elicitation" was included in the search terms because it was noted as a phrase used to describe ecomaps. Although other mapping methods, including concept mapping and mind mapping resemble the ecomap, they are used for different purposes (Wheeldon & Faubert, 2009). Given the focus on ecomaps, we did not include additional terms such as visual methods, visual elicitation, graphic methods, or other combinations of similar terms.

Eligibility Criteria

We focused on peer-reviewed publications that used ecomaps in health research. We included full text articles originally published in English or those with readily available English translations on the publisher's website. We excluded abstracts and conference proceedings because they presented very limited information about methods. Publications that discussed the use of ecomaps in fields other than health research and articles that simply referred to the use of ecomaps in research without methodological details were also excluded. We included Ph.D. dissertations identified in the search if they described methodological aspects of ecomaps and electronic full text versions were freely available online.

Data Evaluation

We screened the final sample of citations in duplicate. Two reviewers (VM, AN) independently reviewed the titles and abstracts of potentially relevant publications, if either reviewer considered the article as possibly eligible, we included it in the full text review. These two reviewers assessed full text articles of the selected citations independently based on eligibility criteria. Disagreements were resolved by discussion. Since the purpose of this review was to synthesize individual study findings on the use of ecomaps in qualitative health research studies and not to assess the scientific quality of individual studies, quality assessments were not conducted. Systematic reviews that synthesize available evidence to answer a specific disease diagnostic or treatment question use study quality as a surrogate for validity of findings, and the extent to which they reflect a "true" answer to the research question (Higgins et al., 2019). In contrast, in this paper we seek to describe current practice in the use of ecomaps in health research.

The results of the literature search are summarized in the study flow diagram (see Appendix A). Of the 407 citations identified for title and abstract review, 129 qualified for full text review and 73 were included in the final synthesis.

Data Extraction

One reviewer (VM) performed complete data extraction. To ensure unbiased data extraction, a second reviewer (AN) independently extracted data from a random sample of 11 (15%) included studies for verification. We reviewed included publications for descriptions of different methods for use of ecomaps, their stated benefits, challenges, and methods to analyze the ecomap. Based on experience of using ecomaps in multiple research studies, we determined a *priori* that systematically reviewing the data for guidance on the process of ecomap construction, data elicitation/collection, data analysis, and ecomap modifications would be necessary to provide a comprehensive review of this topic. We performed initial data extraction on Microsoft Excel spreadsheets. We listed each study in a separate row. Column headings for fields of data extraction included the title, year of publication, authors, journal, field of study, description of the ecomap (what is an ecomap), reasons for using the ecomap (why use an

ecomap), instruction on construction (how to draw), details of analysis techniques used to analyze and interpret ecomaps, reported benefits and challenges with using an ecomap, ecomap modifications, and a column for miscellaneous findings not included in other headings.

Data Analysis and Synthesis

We used directed content analysis (Hsieh & Shannon, 2005) to guide the analytic process. We started with a deductive approach by classifying data into the broad categories noted above. During initial review of included manuscripts, sections reporting on methodological details were highlighted. Text from the highlighted section was coded based on the predetermined categories. Any text that did not align with the predetermined categories was given a new code. Based on the integrative review method, data analysis includes visualization of stored data in a single matrix facilitating iterative comparisons across primary data sources (Whittemore & Knafl, 2005). Accordingly, matrices (Miles et al., 2014) were chosen to summarize and collate data across studies. After completing the data extraction on the spreadsheet, we constructed separate tables for each category for comparison across studies. These included tables focused on instructions for construction, data elicitation/collection, data analysis, ecomap modifications, and other uses. As an example, the table on instructions for construction of the ecomap included all data relevant to the construction of an ecomap. We compared the instructions across studies, item by item, and identified patterns and relationships. We grouped similar concepts into separate sections including data on materials needed for ecomap construction, time of introduction of ecomaps in the study, decisions regarding perspective taking, and instructions for drawing. We repeated this process for each category, coalesced similar concepts into tables with each row listing and describing concepts, with relevant references. To ensure consistency in the process, data were extracted by the first author (VM); all other authors frequently reviewed and discussed emerging findings. All authors participated in regular meetings and email exchanges to review and refine draft tables. To better convey the analytical process, we have included a figure with example tables (see Appendix B). The final results of this analysis are included in Tables 1-4 (see Appendix C).

Rigor

We followed an established methodological process to conduct this study. To limit bias, we screened title/abstracts and reviewed the full text publications in duplicate. We reviewed extracted data, ongoing analysis, and discussed emerging themes in frequent meetings. The first author kept detailed notes of findings, methodological decisions, and questions that arose during the process of the study and frequently connected with the other authors for clarifications.

Results

Ecomaps have been used in diverse types of qualitative studies including case studies (Praeger & Martin, 1994), ethnographic case studies (Okido et al., 2012; Ray & Street, 2005b), and ethnography (Mudry et al., 2010). The most frequent use of ecomaps has been to concisely describe and analyze family and organizational structure and interpersonal interactions.

Authors frequently alluded to the benefits of ecomaps (Table 1), in contrast, very few considered challenges with their use (Table 2). Researchers have applied quantitative and qualitative methods to analyze ecomaps (Table 3) and designed numerous modifications (Table 4) to meet their evolving research needs (see Appendix C). In the following paragraphs, we summarize available literature on the use of ecomaps in health research.

Uses, Benefits, and Challenges of the Ecomap

Tables 1 and 2 summarize published uses, benefits, and challenges of using ecomaps in health research with references. The following paragraphs describe pertinent findings regarding the rationale for use, the benefits, and challenges described in the literature with using ecomaps in health research. Researchers have used ecomaps to enhance data elicitation, collection, organization, and analysis. Ecomaps have been used as an impactful data presentation tool and as a tool to enhance rigor in qualitative research. Challenges include additional time within interviews required for their completion, resource and training needs, and potential concerns around participant privacy and confidentiality. The ecomap was found to be reliable with an internal reliability of 0.88 by Calix (2004). She studied the psychometric properties of the ecomap in comparison to the performance of two other tools that measure social support—the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1994) and the Young Adult Social Support Inventory (YA-SSI; McCubbin et al., 1997).

Data Elicitation/Collection Tool

Authors of several studies (Okido et al., 2012; Ray & Street, 2005a; Rempel et al., 2007) commented on the ability of the ecomap to facilitate a relational process that led to intimate conversations and disclosure of sensitive information that otherwise may not be readily shared with strangers. Okido and colleagues (2012) noted:

> The ecomap played an important role as an initial ice-breaker. These instruments not only provide a graphic representation, but permit further approximation, knowledge, and immersion in the field, as their elaboration demands social interaction between the researcher and the research subject. (p. 1067)

The visual representation of the connections was noted to be a powerful tool for iterative questioning and elicitation during interviews. Ecomaps prompted discussion among interviewers and research participants and acted as a catalyst for conversation and self-reflection (Rempel et al., 2007) leading to elicitation of in-depth data (Ray & Street, 2005a). The process of ecomapping identified new information (Zanchetta et al., 2007a) and generated additional interview questions (Rempel et al., 2007), which may have not been considered otherwise (Ray & Street, 2005a). As noted by Rodrigues and colleagues (2014), "the use of the ecomap has the advantage of being an objective indicator, disclosing interactions that are not identified within the analysis of the testimonies by means of verbal language" (p. 463). Ecomaps were also noted to be a tool for creative engagement (Crawford et al., 2016), which deepened the narratives (Fernandes & Boehs, 2013) and enabled the exploration of supportive and depleting connections (Simpson & Lawrence-Webb, 2009). Several authors (de Souza & Kantorski, 2009; Fernandes & Boehs, 2013; Washington, 2009) noted improved recall and communication when using an ecomap during interviews. In addition, the adaptive nature of an ecomap facilitated data collection from participants with different linguistic and cultural backgrounds or with cognitive and educational limitations (Correa et al., 2011; Doyle et al., 2017; Valentine, 1993).

Data Organization Tool

Authors reported ecomaps organize a vast amount of data and variables in a format that was easily accessible and comprehensible (Praeger & Martin, 1994; Waldrop, 2006). This

facilitates the description of network size, strength, and quality, allows for the identification of potential barriers limiting access/use of supports, and contributes to the researcher's understanding of the context underpinning the participant's social relationships.

Data Analysis Tool

Ecomaps have been used as a tool by researchers for secondary data analysis in studies to gain insights into the data. In a study of end of life caregiving systems, ecomaps were developed and constructed from transcribed narratives as a way of organizing data (Waldrop, 2006) after data collection was complete. In a study evaluating employed mothers' worker ideology and social network composition (Mudry et al., 2010), researchers re-analyzed data from two previously conducted longitudinal studies; construction of ecomaps was a method of data analysis in this study. Waldrop (2006) suggested that constructing ecomaps from previously transcribed interview data by a different researcher and correlating the findings with those of interview analysis resulted in "observer triangulation" and a method to improve trustworthiness of a study. Ecomaps have helped identify emerging themes in interview data (Grant et al., 2016).

Data Presentation Tool

Benefits commonly cited in studies were the visual appeal of an ecomap and the ability to identify and discern patterns within them (Zanchetta et al., 2007b) that may not be easily apparent otherwise (Simpson & Lawrence-Webb, 2009). Dobson (1989) described ecomaps as an ecological metaphor that portrays the individual and organizational ecology in an efficient, visually engaging way. Researchers alluded to the ease of use (McCormick et al., 2008) and visual impact in communicating social networks. In addition to the ability to organize and present a large amount of information, an ecomap displays the relationships between the variables in a study in rich detail. As noted by Hartman (1978) in her original paper, "the connections, the themes, and the quality of the family's life seems to jump off the page and this leads to a more holistic and integrative perception" (p. 468). An ecomap depicts the complexity of social interactions and discloses interactions difficult to identify with the use of language alone (Crawford et al., 2016; Holtslander, 2005; Rodrigues et al., 2014). It provides a holistic portrayal of social connections (Doyle et al., 2017) and displays different kinds of supports (Baumgartner et al., 2012; Ray & Street, 2005a). This improved understanding of relationships may highlight unexplored social connections, generate hypotheses for future studies, and ultimately lead to improved knowledge and insights.

Ecomaps as a Method to Enhance Rigor

Ecomaps were credited with improved study quality and rigor as a result of data triangulation (Kennedy, 2010; Rempel et al., 2007; Simpson & Lawrence-Webb, 2009; Washington, 2009), observer (Waldrop, 2006) triangulation, and methodological coherence (Mudry et al., 2010). When used in combination with interviews, ecomaps served as a method of triangulation to generate a thick description of the lived experience (Washington, 2009). Waldrop and colleagues (2006) used a coder who had not participated in the interviews to develop ecomaps from the transcribed interviews and achieved observer triangulation, a process in which different researchers review data and come to similar conclusions. Mudry and colleagues (2010) established methodological coherence by ensuring a fit between the research questions, the methods, and the use of content analysis and ecomaps to extract and organize interview data.

Diagnostic, Planning, and Intervention Tool

The ecomap has been described as useful to families and professionals in diagnosing, planning, and problem solving (Valentine, 1993). Due to the powerful visual presentation of information, it may be used as a presentation tool to improve communication and collaboration (Praeger & Martin, 1994). Ecomaps can help identify sources of variation across different providers and families (Jacobs Johnson et al., 2017) and be used as a tool to assist in discharge planning (Miller et al., 2017), as a policy planning tool by identifying desired supports in the future (Richardson & Derezotes, 2010), and have therapeutic value by creating awareness of the stresses and supports of individuals and families who could use the knowledge to plan for the future (Clausson & Berg, 2008). Ecomaps identified vulnerable points for participants, suggested effective community support strategies, and provided perspectives on family relationships (Nascimento et al., 2014). In one study, ecomaps were used as an intervention tool to change nurses' attitudes about the importance of families in surgical hospital units (Blondal et al., 2014). It has been used as a tool for record keeping, evaluating outcomes, and measuring and documenting change (Hartman, 1995). When used to depict community ecology, the ecomap can identify the need to create an action plan for community and public health. Richardson and Derezotes (2010) used ecomapping to design efforts to develop, engage, and maintain strong relationships among local leaders and organizations.

Challenges with Using Ecomaps

Challenges identified with using ecomaps as a tool in qualitative health research studies are summarized in Table 2. These include increased time required within interviews for their completion and additional resources required for their construction (Bravington & King, 2018; Reblin et al., 2017). Authors identified a potential for inaccuracies in drawing the ecomap due to insufficient instructions by the researcher, inadequate comprehension of the instructions by participants, or from varying comfort levels and abilities to visually depict ideas coherently (Kennedy, 2010). Participants with limited social supports may be uncomfortable sharing their ecomap in group settings (de Souza & Kantorski, 2009). Participants may depict an overly optimistic illustration due to social desirability bias, underscoring the need to contextualize with other sources of information for accuracy of representation (de Souza & Kantorski, 2009).

Confidentiality issues need to be acknowledged when using ecomaps, especially in a group setting (Kennedy, 2010). Unintended consequences including second-hand disclosure (examples include revealing a relationship or identity that is potentially delicate such as unintentional disclosure of infidelity or misattributed paternity or disclosing someone's sexual and/or gender identity without the other person's consent) risk jeopardizing trust. Thus, boundaries need to be considered and discussed prior to the creation of the ecomap (Nguyen et al., 2016). Construction of ecomaps have been critiqued for ways in which they can be perceived as sexist, paternalistic, and insensitive to issues of cultural diversity and societal differences in power. Assessment of psychopathology often aided by ecomaps creates cultural conditions for deeming certain people as normal and others as diseased or dysfunctional (Iversen et al., 2005).

Descriptions of Ecomap Construction

Ecomap construction was described in methodological articles (Kennedy, 2010), primary qualitative studies (Crawford et al., 2016; Rempel et al., 2007; Rocha et al., 2009: Simpson & Lawrence-Webb, 2009), and Ph.D. dissertations including qualitative studies. (Adelson, 2018; Borja, 2017; Sutton, 2012) and mixed method studies (Summerville, 2018).

Ecomaps were used as a data elicitation strategy in either individual one-on-one (Perez, 2010; Ray & Street, 2005b; Washington, 2009), family (Clausson & Berg, 2008; Rocha et al., 2009; Rodrigues at al., 2014), or focus group (de Souza & Kantorski, 2009) interviews. Within this construction process, it was evident that researchers were required to make multiple methodological decisions with respect to ecomap materials, perspective-taking and data representation, timing of when to introduce the ecomap in the study, and instructions for drawing.

Typically, the materials required to construct an ecomap consisted of pencils (including colored pencils) and paper (Hartman, 1978, 1995; Rempel et al., 2007; Washington, 2009) or a pre-formed worksheet (Crawford et al., 2016). Although several free electronic online templates (www.canva.com/graphs/ecomap/; templatelab.com; creately.com) are available for use, they were infrequently referenced in studies included in this review. Rickert and Rettig (2006) used the computer package smart Draw Professional 6 to construct the ecomaps. Some authors explicitly noted using paper and pencil to draw ecomaps (Perez et al., 2010; Washington, 2009), while others did not mention the ecomap in the methods section, simply presenting ecomaps in the results section (Anderson et al., 2018). In studies using ecomaps with elementary school children (Adelson, 2018; Borja, 2017; Summerville, 2018), supplies included construction paper, crayons and/or markers, and index cards.

Ray and Street (2005a) suggested researchers have three options to consider when determining perspective and data creation. First, a researcher may choose to conduct an interview that includes questions that explore the participant's social networks, relationships, and supports and then construct the ecomap by representing the data as they (the researcher) perceive it as an outsider, providing an etic view of the data. Authors who adopted an etic approach to ecomap construction include Early et al. (2000), Tsibidaki and Tsamparli (2007) and Valentine (1993). In this approach, the participants have no control over the ecomap construction, potentially resulting in inaccurate or incomplete representation of the nature of relationships and social networks. Researchers' biases may be reflected in the ecomap with no opportunity for participant input and correction. A second option would involve the participant constructing the ecomap during the interview with minimal researcher participation or only a few prompts from the interviewer, thus providing an insider or emic view. Examples of this approach can be found in studies by Waldrop (2006) and Woodgate et al. (2016). This method may also result in an incomplete ecomap if the participants forget or misunderstand the instructions and elements of ecomap construction. A third approach (Ray & Street, 2005a) involves the researcher and participant collaboratively co-constructing the ecomap through discussion, with each party constantly negotiating control of the process. In addition to increased accuracy of representation of the social network, this has the added benefit of establishing a closer working relationship between the interviewer and participant that enables the researcher to explore additional lines of inquiry as further details emerge promoting a deeper understanding of the topic. Among the studies included in this review that described the process of construction of the ecomap, this strategy of combining perspectives was commonly applied (Clausson & Berg, 2008; Dias et al., 2007; Ray & Street, 2005b; Rocha et al, 2009). Several studies included in this review did not explicitly comment on the perspective of ecomap construction (Filizola et al., 2011; Nishimoto & Duarte, 2014; Okido et al., 2012; Rodrigues et al., 2014; Zanatta & Motta, 2015). Some authors specified the focus on the individual (ego-centric) versus groups (socio-centric) during ecomap construction (Borja, 2017; Summerville, 2018). In studies involving family members, authors have constructed ecomaps with the participation of several family members (Dias et al., 2007; Fernandes & Boehs, 2013). One way to distinguish relative contributions of different family members is to use different colored pens for different members of the family (Rempel et al., 2007).

Authors constructed the ecomap during the initial interview in some studies (Rodrigues et al., 2014; Zanatta, & Motta, 2015). In others, the interviewer drafted the ecomap after the first interview followed by refinement by the participant in subsequent interviews (Ray & Street, 2005b; Rempel et al., 2007), yet others constructed the ecomap during the second interview (Okido et al., 2012). In a longitudinal ethnographic study of social support of caretakers of patients with Motor Neuron Disease, the ecomaps were photocopied between interviews, a new date was added, and alterations were made to the map to represent changes since the previous interview (Ray & Street, 2005b).

General guidance for developing instructions to guide the participant on how to draw or complete the ecomap were extracted. Ecomaps were constructed with pencil and paper on blank sheets of paper or on a pre-formed worksheet (Crawford et al., 2016). Typically, the ecomap was initiated with a request to have the participant place themselves (often through use of initials, name, pseudonym, or a genogram for studies of family supports) in the center of the page, with a circle around it. Based on the objective of the study, circles radiating from the center were drawn for individuals in the immediate family (Hartman, 1978, 1995) or outside systems and organizations of influence (Crawford et al., 2016). Some of the common systems in the lives of most families include work, school, peers, sports, recreation, healthcare, spiritual influences, and extended family. The next step involves providing guidance on how the participant could characterize the nature of the relationships. Coded lines between the participant/family and various systems indicates connections between them (Crawford et al., 2016). The nature of the relationship can be expressed by the type of line drawn—a solid or thick line represents an important or strong supportive connection, a dotted (or series of dashes) line a tenuous connection (Kennedy, 2010), and a straight solid line with slashes (or jagged marks) through it represents a stressful relationship (Hartman, 1978, 1995; Valentine, 1993). A tenuous relationship may indicate a relationship that is neither supportive nor stressful or both supportive and stressful with neither dominating (Valentine, 1993). The flow of resources or interest is depicted by drawing arrows along the connecting lines. A brief description of the connection can be written along the connecting line (Hartman 1978, 1995). Researchers have used variations including relationship lines in which the number of lines represent the strength of the relationship (Ray & Street, 2005b). Ray and Street (2005b) use one line to depict a professional or acquaintance relationship, two lines for a closer relationship and three lines for a strong or intimate relationship. Washington (2009) used the width of the lines to depict the strength of the relationship, the wider the line, the stronger the relationship. Rempel et al. (2007) suggest using one color pen or pencil with the first family member and different colors with subsequent family members to track contribution of data. For sequential ecomaps constructed during multiple interviews, different colored pens may be used for different modifications (Rempel et al., 2007). A legend depicting the various symbols and their meaning is usually included on the page with the ecomap. After the completion of the ecomap, Crawford et al. (2016) asked the participants to describe the communication patterns between the participant and each element in the ecosystem. This provided a fuller understanding of the relationships that influenced the participant.

Researchers working with children have modified the instructions for easy comprehension (Adelson, 2018; Borja, 2017; Summerville, 2018). Children drew themselves on construction paper or index cards that were then placed in the center of the construction paper followed by pictures representing their relationships in the surrounding space. Children were then asked to code each relationship (e.g., supportive/stressful) using developmentally appropriate language. The authors outlined modifications for use of ecomaps when collecting data from children including gentle prompting, breaking down the process into many simple steps, and positive reinforcement (snacks or stickers) as motivation to complete tasks.

Methods to Analyze Ecomaps

Table 3 summarizes available guidance on analyzing ecomaps. A variety of strategies, both quantitative and qualitative, have been used to analyze, interpret, and present the results of the ecomap.

Qualitative methods used to analyze the ecomap include a narrative description of ecomap data either in text or a tabular form (Correa et al., 2011), sorting of the relationships based on quality (e.g., supportive or stressful; Valentine, 1993), and a thematic interpretation of the results by probing the ecomap context through the accounts provided in the interviews (Nishimoto & Duarte, 2014; Woodgate et al., 2016). Studies have also used deductive and inductive coding in analysis (Borja, 2017; Summerville, 2018) of the ecomap.

Quantitative methods commonly used to analyze ecomaps include calculating averages of the number of connections and measures of dispersion, representing the density of connections in the form of bar or pie charts, and tabulating the number, type, and strength of connections. In the study by Ray and Street (2005b), data were collated numerically across ecomaps and presented as bar graphs depicting the various sources of support. Filizola et al. (2011) digitalized the data and transformed them into simple percentages based on the strength and quality of different connections. Pie charts and tables were used to provide a concise picture of relationship network and quality (Matsopoulos et al., 2017). The density of different kinds of networks was analyzed by Early and colleagues (2000) and presented in a tabular format. Valentine and colleagues (1993) calculated the mean and range of the relationships, categorized them into supportive or stressful, and, based on this data, developed a classification system to identify the level of support experienced by families. Perez et al. (2010) calculated the average use of different areas of support depicted by the research participants. Kuhn et al. (2018) tested the correlation between ecomap connections and results of tests on psychological wellbeing.

Modifications of Ecomaps

Ecomaps are adaptable tools that have evolved with the changing needs of researchers and participants and have been used with different methodological approaches in diverse research settings. More than 10 modifications of the ecomap (summarized in Table 4) were identified including the "virtual" ecomap that includes the digital world of clients (Gustavsson & MacEachron, 2013) to capture the increasing part of clients' lives that is spent online. It provides an opportunity to assess a participant's interaction with the virtual space and to enhance their ability to access the information and resources available online.

Modifications that have assisted with decision-making include the "family support" ecomap that adds explicit resource (social and community resources) data on the ecomap to aid legal decisions concerning the support of children (Rickert & Rettig, 2006) and the "community planning" ecomap, in which the authors (Richardson & Derezotes, 2010) encouraged participants to create three ecomaps, each depicting their perception of community relationships in the past, the present, and their goals for the future to assist appropriate allocation of resources and planning.

Early and colleagues (2000) used an adaptation to study the relationship between the needs and the support networks of hospice patients. The "circle of care" ecomap (Early et al., 2000) used concentric circles to reflect less intimate relationships moving outward. In this modification, the innermost circle represented the patient, the next circle contained the chosen caregiver responsible for basic day-to-day needs. Surrounding these was the intimate circle, representing other individuals who provided support (usually family members). Next the kinship circle consisted of persons connected to the dying person by familial or informal ties. Finally, the institutional circle represented the formal organizational care including doctors,

nurses, and the legal, religious, and social services. The density of support networks varied with the number of individuals in the support networks ranging from 3 to 16. Mapping allowed the researchers to promote awareness of the composition of the support network and to identify associations between the types of relationships. This map provided a tool to assess areas of support need.

Other modifications include the "spiritual" ecomaps (Hodge, 2005) highlighting spiritual connections, the colored eco-genetic relationship map (CEGRM) that provides a simple, concise, visual representation of family and non-kin relationships and stories about inherited diseases in a simple series of pictorial maps with shapes and colors. Olsen et al. (2004) blended the pictorial representations of the pedigree, genogram, and ecomaps to portray family history and social connections comprehensively. Yarwood et al. (2016) combined the ecomap and a genogram in an "ecogram." Sequential ecomaps were used when the interconnected network of supports and stressors were complicated and could not be captured on a single ecomap (Mattaini, 1995; McCormick et al., 2008). The "relational competence" ecomap was developed by Colesso (2011) to improve the validity and reliability of the ecomapping process. User friendly electronic tools including an "app" for ecomap (Heller et al., 2016) and the electronic social network assessment program (E-SNAP) have been recently developed (Reblin et al., 2017, 2018).

Discussion

Ecomaps are increasingly used in qualitative health research studies with a goal of identifying and examining the nature of participants' relationships with other individuals and organizations. This review summarized the current literature on use of ecomaps in qualitative health research. Across 73 included studies, ecomaps were used to enhance data elicitation, collection, organization, presentation, and as an analysis tool. It has also been used as a diagnostic, planning, and intervention tool in research studies and as a strategy to increase rigor. Several modifications were identified to meet the evolving societal and researcher needs including modifications for easier use by children, an app, and a virtual ecomap.

The inclusion of ecomaps as a data source or data elicitation strategy in applied qualitative health research projects shows much promise. Health researchers using qualitative methods to describe and understand the number and types of relationships among individuals, teams, and organizations can make use of ecomaps as a data collection strategy, to triangulate findings and be more comprehensive in their approach to understanding the phenomenon under study. Ecomapping can give a rich understanding of the strengths, conflicts, weaknesses, and stressors of relationships.

Based on this review, we recommend using ecomaps to enhance the methodological quality in diverse research settings and study designs in qualitative health research. Within this sub-discipline of research, a primary goal is to not only describe individuals' experiences of health/illness but also to understand the social contexts in which their experiences or trajectories of care and healing occur (Morse, 2016). The construction of an ecomap provides an efficient strategy for identifying key actors or supports and their relationships to the study participant. A clear understanding of the purpose and methodology of drawing the ecomap is essential to obtaining high quality data. The interviewer should be familiar with the drawing prompts and the interpretation of the different symbols used on the map. They should also be able to guide the participants through the process as needed. This tool may be used in depicting the interrelationships among the individuals in a group in a focussed ethnography study, as well as in the multidimensional understanding of lived experience as in phenomenological research.

Although ecomaps have been used sporadically in research for over two decades (Valentine, 1993), their adoption as a method in qualitative research has increased in recent

years. With increasing recognition of the need for and value of qualitative research in the applied sciences and calls for increased acceptance (Greenhalgh et al., 2016) of the use of qualitative methods in the medical sciences, there is the potential for tools that enhance this method to have wide application. Individuals are not isolated entities; they are part of a complex ecological system that shapes their behaviours. Understanding the forces that impact their ability to cope and comply with treatment recommendations is essential to planning care (Miller et al., 2017) and improving health outcomes. Ecomaps may provide an opportunity to understand patients' social support and contextual factors allowing better understanding of disease. For instance, in patients with congestive heart failure, research has shown that lack of social support is a significant risk factor for poor outcomes including increased healthcare utilization (Lofvenmark et al., 2009) and decreased health-related quality of life (Årestedt et al., 2012). Failing to consider contextual factors that impact a patient's ability to manage their disease can lead to suboptimal planning of support services and ultimately to failure of the treatment strategy. Research to help improve understanding of social supports and connections is integral to treatment success in this and other chronic diseases and may be enhanced by using ecomaps.

Other potential uses in research include exploration of the contextual factors that influence interdisciplinary collaboration and team science (Stokols et al., 2008). In healthcare, the essential nature of inter-professional collaboration (Gaboury et al., 2009) to improve patient outcomes is increasingly being recognized. Research using ecomaps can provide fundamental insights into organizational culture that hinders or facilitates inter-professional relationships and collaborations, improve understanding of system functioning, and facilitate development of strategies to design systems improvement.

This integrative review has several strengths including a systematic literature search performed using several databases, duplicate screening, identification of studies from diverse disciplines summarizing current methods, strengths, and limitations with using the ecomaps. An integrative review is a broad research review method that allowed inclusion of publications with diverse methodologies. We followed the methodological guidance outlined by Whittemore and Knafl (2005) to provide a comprehensive overview of the current knowledge about and potential future applications of ecomaps.

A potential limitation of this review is that although we included many databases that index health research publications, we may have missed some publications indexed in databases not included in our search. Additionally, studies using ecomaps may not have been indexed using the keywords we used in our search, further limiting identification of potentially applicable studies.

In summary, ecomaps appear to be a valuable tool to supplement qualitative studies. Their increased use in qualitative health research has many potential benefits as summarized in this review. Health researchers seeking to describe and understand relationships between individuals and organizations with a specific social context might consider augmenting data collection with creation of ecomaps.

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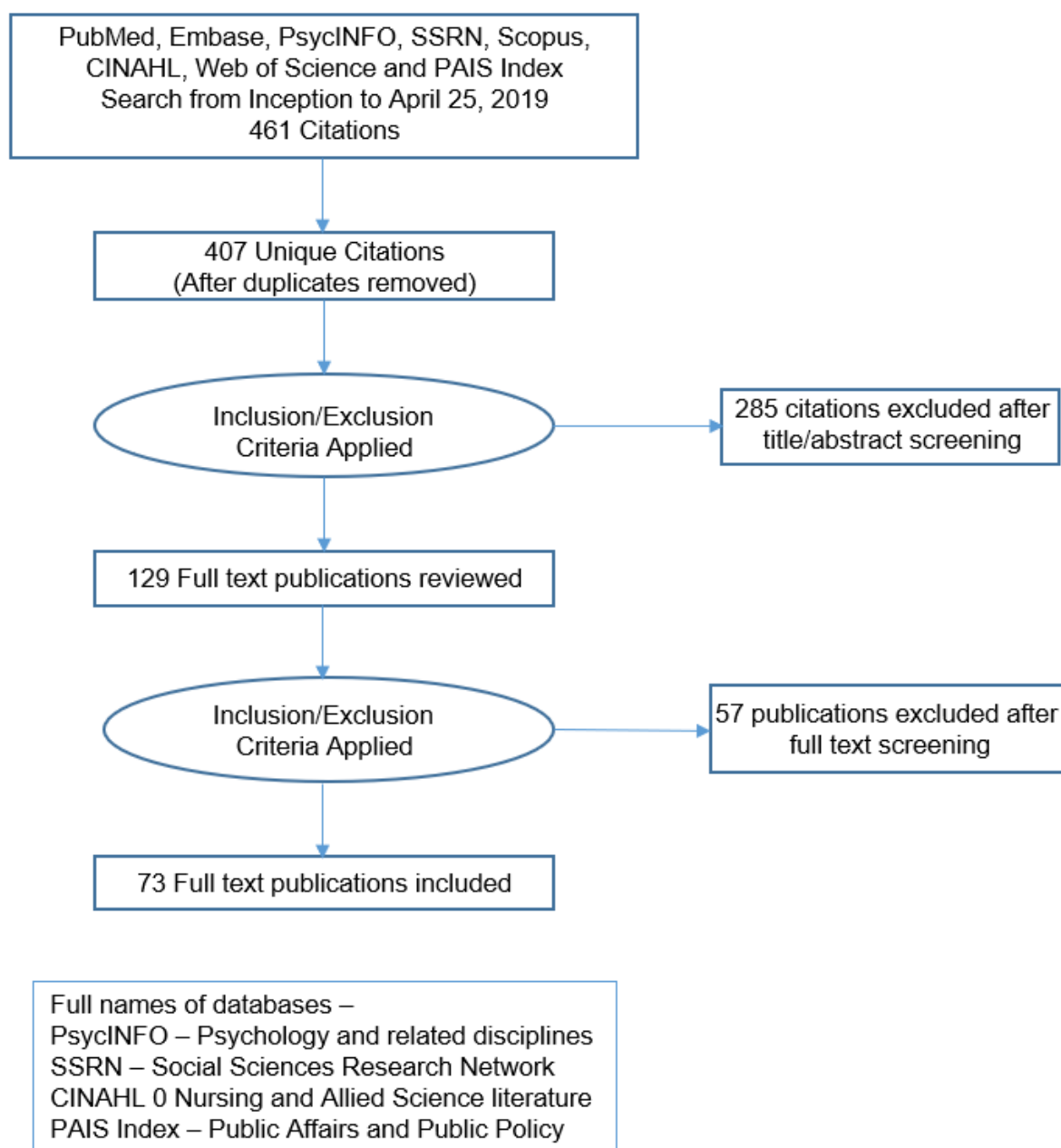McGuinness, T. M., Noonan, P., & Dyer, J. G. (2005). Family history as a tool for psychiatric

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Appendix A

Literature Search Results

```
┌─────────────────────────────────────────────┐
│ PubMed, Embase, PsycINFO, SSRN, Scopus,     │
│ CINAHL, Web of Science and PAIS Index       │
│ Search from Inception to April 25, 2019     │
│ 461 Citations                               │
└─────────────────────────────────────────────┘
                     │
                     ▼
         ┌───────────────────────────────┐
         │ 407 Unique Citations          │
         │ (After duplicates removed)    │
         └───────────────────────────────┘
                     │
                     ▼
          ╭─────────────────────────╮         ┌──────────────────────────────┐
          │ Inclusion/Exclusion     │────────▶│ 285 citations excluded after │
          │ Criteria Applied        │         │ title/abstract screening     │
          ╰─────────────────────────╯         └──────────────────────────────┘
                     │
                     ▼
         ┌───────────────────────────────────┐
         │ 129 Full text publications reviewed│
         └───────────────────────────────────┘
                     │
                     ▼
          ╭─────────────────────────╮         ┌──────────────────────────────┐
          │ Inclusion/Exclusion     │────────▶│ 57 publications excluded after│
          │ Criteria Applied        │         │ full text screening          │
          ╰─────────────────────────╯         └──────────────────────────────┘
                     │
                     ▼
         ┌───────────────────────────────────┐
         │ 73 Full text publications included │
         └───────────────────────────────────┘
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┌────────────────────────────────────────────────┐
│ Full names of databases –                      │
│ PsycINFO – Psychology and related disciplines  │
│ SSRN – Social Sciences Research Network        │
│ CINAHL 0 Nursing and Allied Science literature │
│ PAIS Index – Public Affairs and Public Policy  │
└────────────────────────────────────────────────┘
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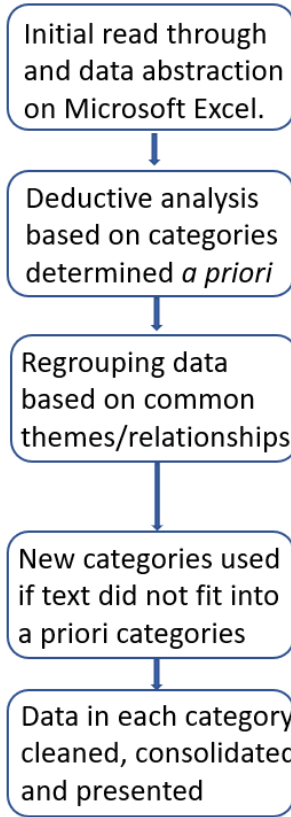**Appendix B**

Steps in Data Analysis: An outline of the steps involved starting from data extraction to the result is presented below. We went through several more iterations of the tables between regrouping the data and reaching the final result presented in this paper.

Initial read through and data abstraction on Microsoft Excel.

Deductive analysis based on categories determined *a priori*

Regrouping data based on common themes/relationships

New categories used if text did not fit into a priori categories

Data in each category cleaned, consolidated and presented

	A	B	C	D	E	F
1	Title	Year publishe	Author	Journal	Volume/pages	Abstract
2						
3	Genograms and ecomaps	1989	Dobson, S.	Nursing Times	85(51): 54-56 53	
4	Integration of a nursing model into a local commun	1993	Dalton, C. and C. I	The Canadian nur	89(3): 37-40.	Four years ago, matern
5	Children with special needs: Sources of support and	1993	Valentine, D. P.	Journal of Social	8(2): 107-121.	Explored the sources o

	Descriptions of ecomaps Instructions for construction	Why use ecomaps	Analysis techniques	Benefits/Challenges	Miscellaneous
(41)	This study created ecomaps with five young men. Ecomaps may be used to document, diagram and	People have many systems in their lives that they navigate, and ecomaps are useful for gaining insight	Data from the ecomaps were derived in two ways. First, the ecomap was completed with the	Ecomapping provides a tool for creative engagement with a client. The process of discussing the ecomap and	Overall, the researcher found that ecomaps varied widely from participant to participant. Some were

Improve Rapport between the Interviewee and the Researcher
The ecomap played an important role as an initial ice-breaker. not only provide a graphic representation, but permit further approximation, knowledge and immersion in the field, as their elaboration demands social interaction between the researcher and the research subject (Okido, Pizzignacco et al. 2012)

Elicitation Tool
Catalyst for obtaining in-depth data(Ray and Street 2005), illustrations provide discussion triggers for interviewers and participants
Ongoing and iterative question posing, 'Catalyst for conversation and self-reflection' (Rempel, Neufeld et al. 2007)

Primary Analysis
Visual impact / Written description
'The process of constructing the genogram and ecomap and the completed depictions provided a rich context for understanding the social networks of the caregivers who participated in our research'. (Rempel, Neufeld et al. 2007)
'For analysis, ecomaps were connected to interview transcripts in an NVivo software data management program through the DataBite function allowing their content to be analyzed in conjunction with interview data'. (Ray and Street 2005)

As a Therapeutic tool and assist in developing targeted Interventions
Ecomaps as a therapeutic resource - 'In that sense, they were appointed as means to identify vulnerable points for the research participants, to indicate support strategies in the community and to reveal perspectives on the family relationships'. (Nascimento, Dantas et al. 2014)
'Provides families with an immediate, concise and visual picture of where some of the difficulties lie. Parents with educational or cognitive limitations find the ecomaps especially helpful. Valuable diagnostic and planning device to help families begin the problem solving process's. (Valentine 1993)

Benefits of Using Ecomaps

Concept	Description	References
Visual appeal	Powerful visual gestalts that provide an overview of the social supports and networks; holistic and integrative perception. Captures complex information in a way that is visually appealing and simple. Simple to use and understand.	(Dobson, 1989); (Hartman, 1995); (Zanchetta, et al., 2007a); (De Paula et al., 2008);(de Souza & Kantorski, 2009)
Data display	Ability to denote and distinguish between emotional supports and direct care	(Hartman, 1995); (Mattaini, 1995);

Appendix C

Table 1
Benefits of Using Ecomaps

Benefits of Using Ecomaps			
	Concept	Description	References
Data Presentation Tool	Visual appeal	Powerful visual gestalts that provide an overview of the social supports and networks; holistic and integrative perception. Captures complex information in a way that is visually appealing and simple. Simple to use and understand.	de Souza & Kantorski, 2009; De Paula et al., 2008; Dobson, 1989; Hartman, 1995; Zanchetta et al., 2007a
	Data display	Ability to denote and distinguish between emotional supports and direct care through additional notation. Rich and dynamic portrayal of complexity of social connections and relationships between individuals and communities. Depth and reciprocity of relationships are readily identified. Draws attention to sources of stressors and support. Ability to portray the duality (both positive and aversive aspects may coexist in relationships) of connections. Discloses interactions that are not identified by means of verbal language.	Baumgartner et al., 2012; Charepe et al., 2011; Crawford et al., 2016; Doyle et al., 2017; Hartman, 1995; Holtslander, 2005; Mattaini, 1995; Ray & Street, 2005a; Rodrigues et al., 2014; Roque & Ferriani, 2007; Simpson & Lawrence-Webb, 2009; Washington, 2009
Data Collection Tool	Visual trigger for elicitation	Visual trigger for discussion. Enhances iterative question posing, the data emerging from the construction of the ecomap acts as a catalyst for obtaining additional in-depth data. Catalyst for conversation and improved recall. Generation of additional useful questions during data generation and analysis.	Crawford et al., 2016, de Souza & Kantorski, 2009; Grant et al., 2016; Okido et al., 2012; Ray & Street, 2005a; Rempel et al., 2007; Washington, 2009; Zanchetta et al., 2007a
	Improve rapport Collaborative inquiry	Form of approximation and relational posture between the interviewer and participant leading to an atmosphere of equality and disclosure of sensitive information. Due its conversational, collaborative, and strengths-based approach, it can be a good way to build rapport with participants.	Nascimento et al., 2014; Ray & Street, 2005a
	Increased efficiency	Effective in getting a more complete picture of the social context rapidly. Efficiency in conducting follow-up interviews by updating the diagram during each interview.	Clausson & Berg, 2008

	Applicability across populations (due to diagrammatic nature of the tool)	Especially helpful for those with educational or cognitive limitations and participants with limited language skills. Can be readily used with people of different linguistic and cultural backgrounds as it does not present a high literacy demand.	Correa et al., 2011; Doyle et al., 2017; Rempel et al., 2007; Summerville, 2018; Valentine, 1993
	Adaptability, creative engagement	Adaptable to the size and content (children, adult) of the cohort. Can depict current state and progress. An engaging and flexible research tool for understanding complex childcare arrangements and documenting social networks. Allows for creativity of the participant and researcher.	Crawford et al., 2016; McCormick et al., 2008
	Ability to gather complex data	Feasible to gather extensive information about families, their resources, and supports.	McCormick et al., 2008
	Cultural sensitivity	Can be modified to be more culturally sensitive. Reflect the complex individual, dyadic, and group process frequently present in the LGBQT communities. Useful in diverse family structures and participants with multiple minority identities.	Nguyen et al., 2016; Rempel et al., 2007
Data Organization Tool	Organizing voluminous data	Organizes a vast amount of information and variables to visually portray the participant/family within a social context Analysis method to organize vast data.	Hartman, 1995; McCormick et al., 2008; Praeger & Martin, 1994; Waldrop, 2006
	Recognizing contextual influences	Rich contextual foundation. Organizes and depicts information about network size, strength, quality, and function, and identifies barriers to support.	Perez et al., 2010; Reblin et al., 2017; Rempel et al., 2007
Data Analysis Tool	Identify change over time	Ecomap photocopied between interviews and alterations made to the original.	Ray & Street, 2005b
	Identify emerging themes	Identification of emerging themes and patterns related to the participant's reflections related to the ecomap.	Grant et al., 2016
	Observer triangulation	Using an outside coder to develop ecomaps led to "observer triangulation," a strategy to enhance rigor and limit bias.	Waldrop, 2006
	Secondary Analysis	Ecomap created based on initial interview, changes documented on subsequent interviews to reveal change in networks.	Mudry et al., 2010
	Methodological coherence	By ensuring a fit between research questions, the ethnographic method, use of content analysis and ecomaps.	Mudry et al., 2010

A Diagnostic, Planning and Implementation Tool in Research Studies	Diagnostic and planning applications	Valuable diagnostic and planning tool. Identify sources of variation across different providers and families.	Lise et al., 2018; Valentine, 1993
	Plan and guide interventions including discharge planning. Plan and measure change	Guide nursing intervention – suggest new family dynamics. A tool to plan and measure change. Visualize unrealized social resources and build communication and rapport. Excellent supplemental tool to develop a clear picture of the client-systems strengths and needs.	Machado et al., 2018; Miller et al., 2017; Reblin et al., 2017; Richardson & Derezotes, 2010; Simpionato et al., 2005
	An empowering tool to facilitate change	Allow participants to externalize their emotions when sharing history of personal trauma. Help users to work on bonds that need to be kept, broken, or strengthened as social support. Indicate support strategies that offer hope and incentives for growth and sustenance.	Crawford et al., 2016; Doyle et al., 2017; Nascimento et al., 2014; Nguyen et al., 2016
	Considering contextual influences when implementing change over time	Portray the influence of contextual factors on illnesses and management. Highlights the nature of interfaces, conflicts to be mediated, bridges to be built and resources to be sought; tool in planning intervention.	Dobson, 1989; Hartman, 1995; McGuinness et al., 2005; Praeger & Martin, 1994; Richardson & Derezotes, 2010
	Allocation and flow of resources	Displays the nature of boundaries and resources. Assess if energy and time are being optimally assigned to support subjects. Inform development of programs and resources.	Dobson, 1989; Hartman, 1995; Richardson & Derezotes, 2010; Rocha et al., 2009; Valentine, 1993
Record keeping Tool	Record keeping	Tool for record keeping, portray the past and the future, evaluate outcomes and document change.	Hartman, 1995

Table 2
Challenges in using ecomaps

Challenges with using an ecomap		
Concept	Description	References
Need for additional resources – time and training	Additional time allocation for training and appropriate instruction and support during construction of the ecomap. Training to instruct participants in the construction of the ecomap. In large studies with multiple researchers, uniformity of instruction is essential for unbiased results. May be a barrier in research in a clinical setting where clinic workflow needs to be maintained.	Bravington & King, 2018; Reblin et al., 2017
Accuracy of construction	Variable accuracy of construction due to issues related to variable instructions, comprehension, and ability. When drawn in a group setting, the expectations and perceptions of others present may influence the drawing of ecomaps.	Bravington & King, 2018; de Souza & Kantorski, 2009
Need to address issues raised	Potential challenges in addressing issues raised by caregivers when constructing the ecomap.	Reblin et al., 2017
Varying perspectives need to be considered	Different members of a group may have different discordant perspectives on relationships, may be addressed by constructing ecograms from different perspectives.	Simpionato et al., 2005
Simplify complex experiences or relationships	Potential to miss complexity due to diagrammatic mode of data collection.	Simpionato et al., 2005
Confidentiality	Confidentiality may be an issue when sharing data with family members. May be mitigated by negotiating agreements to share data. Insufficient as a stand-alone tool, need simultaneous interviews in order to provide situational context. Concern for secondhand disclosure.	Kennedy, 2010; Nguyen et al., 2016; Rempel et al., 2007
Ethical challenges	Interpretation of an ecomap has the potential to be sexist, paternalistic, patronizing, and insensitive to issues of cultural diversity and societal differences in power.	Iversen et al., 2005

Table 3
Methods for analysis of ecomaps

Analysis of Ecomaps (Primary Analysis of ecomap data)			
	Concept	Description	References
Initial Analysis and Coding	Visual Impression	Depth and reciprocity of relationships was readily identified. Conflictual relationships were easily identified on visual inspection of the ecomap.	Washington, 2009; Zanatta & Motta, 2015
	Connecting the ecomap with the interview	Connected to interview transcripts in an NVivo software data management program through the Databite function allowing the contents to be analyzed in conjunction with the interview data. Transcribed interviews and ecomaps were submitted to first reading in search of hypotheses or guiding questions.	Ray & Street, 2005b; Rocha et al., 2009
	Data triangulation	Concurrent and comparative analysis of ecomap and interview data. Data from ecomaps and interviews were triangulated to authenticate the themes presented. Results of thematic analysis of interview data were correlated with ecomapping results. Verbal and visual data collected and analyzed. Triangulation upon comparison of interview and ecomap findings.	Doyle et al., 2017; Hoppough, 2003; Kennedy, 2010; Ray & Street, 2005b; Rempel et al., 2007; Simpson & Lawrence-Webb, 2009; Washington, 2009
	Comparing evolution of ecomaps over time	Comparative analysis to determine content and function of ecomap, changes that occurred between interviews and recurrent patterns of relationships across interviews	Ray & Street, 2005b
	Member checking	Encouraged member checking to ensure that labelling was accurate.	Summerville, 2018
	Inductive versus deductive coding	Deductive (based on a-priori (etic) themes from the literature) and inductive coding of ecomap narratives. Deductive coding followed by inductive coding during.	Borja, 2017; Summerville, 2018
Quantitative Analysis	Number of relationships mean (Standard Deviation/range), percentages	Descriptive statistics of connection types between the participants and the system within each ecosystem level and the total ecosystem calculated and reported. Number of relationships calculated (mean, range). Data collated numerically to illustrate networks of support. Ecomaps were digitized and described, data collated and transformed into simple percentages of different types of networks and connections.	Correa et al., 2011; Filizola et al., 2011; Kuhn et al., 2018; Machado et al., 2018; Perez et al., 2010; Ray & Street, 2005b; Valentine, 1993

	Parametric versus non-parametric tests	Non-parametric tests used when assumption of normality violated (for example majority of relationships coded as supportive).	Summerville, 2018
	Mean network size, stress-support index (SSI), Scores based on weak/strong and stressful/hopeful connections	Network sizes calculated by summing up all the relationships drawn on an ecomap. Mean network size calculated across the sample. Type of relationships (parents, peers, others) coded and mean proportion of identified network members calculated across the sample. The percentages were averaged by relation types across the sample. A total SSI calculated to examine the balance of supportive and stressful relationships (coded as 1-supportive, 1.5-Ambivalent, 2-stressful). Weak, stressful, strong, and hopeful connections at each level summed. Network sizes were calculated and reported as mean (SD). Families classified into well supported, stressed, isolated, and overextended based on connections, responsibilities, supports, and interactions.	Adelson, 2018; Kuhn et al., 2018; Summerville, 2018; Valentine, 1993
	Testing correlations between ecomap findings and other tests	A series of two-tailed Pearson correlations between the number of ecomap connections (strong, hopeful, weak/stressful) at each ecosystem level and psychological well-being variables (depressive symptoms, perceived stress, and burden) tested. Ecomap connection type counts converted into standardized z-scores to account for the variation in the range at different ecological systems levels.	Kuhn et al., 2018
	Graphs	Data graphed to capture trends across interviews.	Ray & Street, 2005b
	Tables, Pie charts	Relationships networks and qualities on ecomaps presented as pie charts and tables.	Matsopoulos et al., 2017
Qualitative Analysis	Narrative description	Narrative description of findings on the ecomap. Text description of findings on the ecomaps in a table—rows dedicated to describing the quality of connections with family/friends/others. Identify supports based on graphical representation.	Correa et al., 2011; Crawford et al., 2016; de Souza & Kantorski, 2009; Okido et al., 2012; Pinto et al., 2017; Praeger & Martin, 1994; Ray & Street, 2005a; Zanchetta et al., 2007b
	Quality of relationships	Quality of relationships was recorded (supportive or stressful).	Valentine, 1993

	Pattern Recognition	Ecomaps allowed researchers to view consistent patterns within families and communities.	Simpson & Lawrence-Webb, 2009
	Incorporating findings into themes obtained from interview data	Data on ecomaps were incorporated into relevant themes during analysis. Helped inform themes. Ecomaps were read by probing the context through the accounts provided in interviews.	Nishimoto & Duarte, 2014; Woodgate et al., 2016

Table 4

Modifications of ecomaps

Modification	Description	References
Sequential ecomaps	Useful when the interconnected networks of stressors, supports, resources, and issues are complicated, and a single map cannot capture all the important data.	Mattaini, 1995; McCormick et al., 2008
Circle of Care Ecomap	A type of network mapping. Concentric circles represent layers of support. The innermost circle is occupied by the patient, followed by the chosen caregiver in the next circle. Next is the intimate circle consisting of individuals connected by familial or informal ties who are close and support the caregiver. The network circles become less intimate and more distant from the inside out. The intimate circle is followed by the kinship circle which includes extended family, neighbors, and friends. The final circle includes formal, organized caring systems connected to the patient. The authors classified patients based on the density of natural networks and suggest that this may help with allocation of resources to those most in need of formal support.	Early et al., 2000
Blending pedigrees, genograms, & ecomaps	A tool that blends the three pictorial representations of family history and social connections will enhance the ability to visualize inheritance patterns and health risks and to design interventions to health and enhance personal and ecological resources.	Olsen et al., 2004
Spiritual ecomaps	Focus on participant's current spiritual relationships (god or transcendence, faith, communities, rituals).	Hodge, 2005
Colored Eco-Genetic Relationship Map (CEGRM)	Based on social exchange and resource theories. Provides a simple concise, visual representation of social interaction domains of information, services, and emotional support. Tool for presenting information about family and non-kin relationships.	Peters et al., 2004, 2006
Family support ecomaps	Combining family financial information with genograms and ecomaps to produce a 1-page succinct diagram of complex family environment information with clarity. Systematic method for compiling information. Ability to present a large amount of information in a visually organized manner. Diversity within and across family systems could be revealed.	Rickert & Rettig, 2006
Planning tool	Construct ecomaps to portray historical view, present state and future aspirations about social supports and connections between various stakeholders in the community,	Richardson & Derezotes, 2010
Separate ecomaps for school, family, peers, environment	Study over 10 sessions, Session 4 included activities around environmental stressors (study of experiences after Tsunami in Sri Lanka) and an environment ecomap, sessions 6, 7, and 8 included creating school, family, and	Nastasi et al., 2011

	friend-peer ecomaps and session 9-10 included developing a summary "life ecomap."	
Virtual ecomap	Parallels the ecomap of the real world with important domains of their social environment. Provides a visual representation of the client's interaction with the internet. A more complete picture of struggles and strengths.	Gustavsson & MacEachron, 2013
RC Ecomap	Based on Relational Competence Theory.	Colesso, 2011
Ecogram	Emerged during nursing interviews regarding the use of ecomaps and genograms, used in combination to "cuts through the chase - have something concrete."	Yarwood et al., 2016
App for ecomap	Project to develop an application for creating ecomaps using touch screen with tangible objects, to test its usability and psychometric properties.	Heller et al., 2016
E-SNAP Electronic social network assessment program	Conceptual model based on the stress-process model. Visualization can be messy with a traditional ecomap, difficult sometimes to include many resources and no consistent logic as to where different resources are placed. Identified the most logical process to collect and present information in an electronic tool using mental models for information architecture. Makes the process of ecomapping more user friendly.	Reblin et al., 2017, 2018

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