



Knowledge translation approaches and practices in Indigenous health research: A systematic review

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ABSTRACT

Knowledge translation (KT) is a critical component of any applied health research. Indigenous Peoples' health research and KT largely continues to be taught, developed, designed, regulated, and conducted in ways that do not prioritize local Indigenous Peoples' ways of sharing knowledges. This review was governed and informed by Indigenous health scholars, Knowledge Guardians, and Elders. Our systematic review focused on answering, *what are the promising and wise practices for KT in the Indigenous health research field?*

Fifty-one documents were included after screening published literature from any country and grey literature from what is now known as Canada. This included contacting 73 government agencies at the federal, territorial, and provincial levels that may have funded Indigenous health research. Only studies that: a) focused on Indigenous Peoples' health and wellness; b) documented knowledge sharing activities and rationale; c) evaluated the knowledge sharing processes or outcomes; and d) printed in English were included and appraised using the Well Living House quality appraisal tool. The analysis was completed using an iterative and narrative synthesis approach. Our systematic review protocol has been published elsewhere.

We highlight and summarize the varied aims of Indigenous health research KT, types of KT methodologies and methods used, effectiveness of KT efforts, impacts of KT on Indigenous Peoples' health and wellness, as well as recommendations and lessons learned. Few authors reported using rigorous KT evaluation or disclosed their identity and relationship with the Indigenous communities involved in research (i.e. self-locate). The findings from this review accentuate, reiterate and reinforce that KT is inherent in Indigenous health research processes

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⁵ Scottish Settler

⁶ Métis-Cree (Red River, Papaschase)

⁷ Eastern European Settler

⁸ European raised on Michi Saagiig territory

and content, as a form of knowing and doing. Indigenous health research *must* include inherent KT processes, if the research is by, for, and/or with Indigenous Peoples.

1. Introduction

The quality and commitment to effective *knowledge translation* (KT) is often recognized as an important component for health research that is intended to provide, test, and/or evaluate evidence that improves health and wellness outcomes of specific populations (Ranford and Warry, 2006). KT is a frequently used term by researchers and funders in Canada to describe efforts and methods for sharing research knowledges with specific populations. Mention of KT in research grants and literature often focus on the dissemination of research findings within academic research networks and modalities, including conferences and peer-reviewed journals (Rand et al., 2015). When “knowledge users” are mentioned in grants and papers, authors are usually referring to policy and decisions makers who might implement changes based on the research findings and recommendations (Clark, 2008). Rarely does KT prioritize the peoples, nations, or communities who need – and have the rights to – the knowledge(s) the most, which maintains gaps in health literacy and inequities between the researchers and the researched (Jull et al., 2017; Smylie, 2011).

Terms used to describe KT vary across disciplines, and include concepts such as knowledge mobilization, dissemination, knowledge synthesis, knowledge transfer, knowledge to action/practice, and knowledge sharing (Estey et al., 2009; Graham et al., 2006; Jardine and Furgal, 2010; Oliver et al., 2019; Straus et al., 2009; Sudsawad, 2007). While terms such as *integrated knowledge translation* describe how knowledges are shared, expressed, or passed throughout the research process, the way academic research KT is taught, funded, conducted, and recognized privileges Euro-Western KT approaches. When KT initiatives cross over from Euro-Western science boundaries into Indigenous science contexts (colonialism) or from Indigenous science boundaries into Euro-Western contexts (appropriation), knowledges from research are transformed (Ermine et al., 2004; Smylie, 2011). Albeit, the transformation is commonly ineffective at addressing systemic and structural power imbalances. In the context of our review, we defined KT as locally developed systems that link culturally relevant and useful knowledge from/during the research, to “sharing what we [referring to Indigenous Peoples] know about living a good life” (Kaplan-Myrth and Smylie, 2006; Morton Ninomiya et al., 2017).

KT in health research is often conceptually presented as a separate and a value-added investment in non-Indigenous knowledge systems. Within Indigenous knowledge systems and contexts, research without practical relevance or application has no merit or value. In short, KT is intrinsic and inherent for Indigenous Peoples, who have successfully conducted research as part of everyday life long before research became an academic endeavour. Indigenous Peoples have thrived and survived for as long as we know due to expansive and intricate knowledges of the land, and all that depends on the land, in areas where families and nations lived, and continue to live (Dahl Aldern and Goode, 2014; Kimmerer, 2002). In many ways, Euro-western scientific knowledge systems of observation are catching up to place-based knowledges that have been understood and used by Indigenous Peoples since time immemorial. Moreover, Indigenous methods of observation and Indigenous sciences are slowly being recognized by Euro-western trained researchers as being similar to or consistent with contemporary Euro-western research methods (Cajete, 2000; Dahl Aldern and Goode, 2014; Kimmerer, 2002).

Past and ongoing forms of colonization have prevented and/or limited Indigenous nations, groups, and organizations from acquiring or holding research funding, conducting research, or controlling how their health data is presented or used. Despite many systemic barriers and pervasive racism, there are Indigenous scholars that have acquired

essential skills, practices, and Euro-western credentials while also staying connected and committed to their Indigenous nations, community, kin, or groups. For years, Indigenous Elders, Knowledge Guardians, and scholars alike have championed the need for more Indigenous research that honours and respects the contextually relevant ways of knowing and doing in health research. As a team of authors who value and recognize the importance of relationships, community and kinship accountability, and identity, we self-locate and describe our respective roles in this systematic review below.

Indigenous health research and KT has been generally fraught with policies, practices, training, and funding that does not prioritize local, regional, country-wide, or international Indigenous Peoples, or Indigenous Peoples’ ways of knowledge sharing (Estey and Smylie, 2009; Smylie et al., 2004). Indigenous health scholars, researchers, and community members involved in research have clearly articulated that KT definitions, examples, and language are often at odds with Indigenous ways of knowing, being, and doing (Estey et al., 2010; Smylie et al., 2014; Smylie, 2011). Some Indigenous researchers assert that how knowledges from, and within, health research is shared must “be culturally relevant and useful ... to improve Indigenous health status, policy, services, and programs” (Kaplan-Myrth and Smylie, 2006), “[share] what we know about living a good life” (Smylie et al., 2014), and work to support people achieving a Good Mind and a Good Life (Brascoupé, 2020).

While research can play an important role in articulating and addressing large health disparities between Indigenous and non-Indigenous Peoples in Canada and internationally (Gracey and King, 2009; King et al., 2009), *how* research with and for Indigenous Peoples is conceived, governed, conducted and intended is often problematic (Smith, 2012). We intentionally capitalize Indigenous Peoples to recognize Indigenous Peoples as Nations. Our review is concerned with Indigenous Peoples who have, despite ongoing cultural genocide and colonization, continued to survive, (re)claim, (re)build, (re)vitalize and assert culturally rooted knowledges and knowledge systems (Truth and Reconciliation Commission of Canada, 2015a, b). Out of concern for how Indigenous health research has harmed and disregarded Indigenous Peoples in the past, there are many policies, guidelines, and principles that have been developed and implemented (Paradies, 2006; Smith, 2012). Indigenous communities involved in research, rarely have the resources including power, time or funding, to hold researchers or funders accountable. Indigenous Peoples are grossly under-represented in academia and research institutions and most Indigenous research has been, and continues to be, conducted by non-Indigenous researchers (Anderson, 2019; Brown, 2018; Canadian Association of University Teachers, 2018). Many non-Indigenous researchers are unaware of their colonial lens and many Indigenous researchers are trained to use Euro-western and other non-Indigenous research methodologies and methods that privilege or exclude other knowledge systems. This includes Indigenous knowledge systems that cannot be researched using Euro-Western-informed research methodologies. The authors humbly acknowledge and respect that Indigenous Peoples are diverse and constitute many nations, language groups, cultures, knowledge systems, knowledges, protocols and perspectives that bring vitality to our world and our research (The United Nations General Assembly, 2007).

If health research is intended to support the best possible health and wellness outcomes of any group or all peoples, we argue that it is imperative that how research knowledges are gathered, analyzed, shared, protected, and valued – that is, KT – is better understood, documented, intended and shared. There is a dearth of literature on Indigenous KT practices and Indigenous KT evaluation. Our systematic review aims to help envisage, generate, develop, and evaluate ways for

health research knowledges to better serve Indigenous Peoples, communities, organizations, and governments.

1.1. Self-location and governance

There are important reasons for authors engaged in Indigenous research to be upfront and transparent about their Indigenous or non-Indigenous identity as well as their respective roles in the research itself (Kovach et al., 2013). The intentions and motivations of the authors for this systematic review are to go beyond gathering and synthesizing a body of literature, and use the findings to draw attention to, address and privilege the power dynamics of Indigenous Peoples' rights to helpful and meaningful health research. The first author is a non-Indigenous female scholar of a blended Japanese and Swiss-German Mennonite background and the second author is an Indigenous male scholar from the Modewa Clan, in Papua New Guinea. All other authors were Advisory Team members. The Advisory Team includes six people [SB, NR, DA, MF, JS, CZ]; three of whom are Indigenous [SB, NR, JS], two are senior scholars [SB, JS], most do Indigenous health and wellness focused research and work [SB, NR, DA, MF, JS], and one who is a non-Indigenous information specialist who conducted the published database searches [CZ].

At the start of the systematic review, three Indigenous Elders and Knowledge Guardians who are respectfully known as the "Counsel of Grandparents" for the Well Living House (Well Living House, 2019), an action research centre for Indigenous health and wellness at St. Michael's Hospital in Toronto, met to discuss how Indigenous knowledges and knowledge sharing practices are important in different contexts. These Counsel of Grandparent meetings informed all aspects of the review, including the framing of thematic findings. The Advisory Team was heavily involved in guiding and informing this systematic review – from development, commencement, and to the end of each review phase. The first author [MMN] was involved throughout all phases of the review and formally mentored by the last author [JS] as a postdoctoral fellow, at the start of the review. The second author [RM] was involved in all phases after title and abstract screening. MMN and RM appraised, recorded, and analyzed data from all included documents. Collectively, this review is the product of an iterative process that required (re)analyses and (re)framing Euro-western constructs and drawing attention to what is missing in the literature, particularly when analyzing paper written by non-Indigenous researchers.

1.2. Objectives of the review

The research question that guided this systematic review was *what are the promising and wise practices for KT in the Indigenous health research field?* We identified how knowledges in diverse Indigenous research contexts were shared and used to improve and benefit Indigenous Peoples' health and wellness and determinants of health. Our intentions were to inform Indigenous Peoples, nations, networks, groups, and organizations involved in research, researchers outside Indigenous communities, research institutions, and funders on promising KT methods and processes. Further, we highlight the importance of evaluating KT to help ensure researchers and funders are accountable to Indigenous communities. In this paper, we define health and wellness as a broad and holistic term that includes distal and proximal social determinants of health, such as self-determination, colonization, racism, housing, and education (Greenwood et al., 2015; Reading and Wien, 2013).

2. Methods

Our systematic review is registered with the International Prospective Register of Systematic Reviews (no. CRD42016049787). A detailed description of the rationale and methods have been published in a protocol paper (Morton Ninomiya et al., 2017), in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses

(PRISMA) guidelines (Moher et al., 2009).

2.1. Data collection process

We searched the following indexed databases in February 2016, updated in July 2017, July 2019, and again in October 2020: Aboriginal Health Abstract Database, Bibliography of Native North Americans, CINAHL, Circumpolar Health Bibliographic Database, First Nations Periodical Index, Ovid Medline, National Indigenous Studies Portal, Ovid PsycInfo, Social Work Abstracts, Web of Science Core Collection (Science Citation Index, Social Sciences Citation Index, Arts & Humanities Citation Index, Conference Proceedings Citation Index - Science, Conference Proceedings Citation Index - Social Science & Humanities, Emerging Sources Citation Index) and the following ProQuest databases: Applied Social Sciences Index & Abstracts, International Bibliography of the Social Sciences, ProQuest Dissertations & Theses Global, Sociological Abstracts, Social Services Abstracts. The full Medline search strategy can be found in our protocol paper (Morton Ninomiya et al., 2017).

While the published literature was not geographically limited, grey literature sources were focused on Canadian repositories and collections. A comprehensive search using subject headings and keywords for Indigenous Peoples internationally, knowledge translation, and evaluation was carried out. Non-indexed and grey literature were searched in the following 23 databases, search engines, and document collections: Arctic Health Publications Database, Arctic Science and Technology Information System, CAMH Library, Canadian Best Practices Portal - Aboriginal Ways Tried and True, Canadian Health Research Collection, Canadian Knowledge Transfer and Exchange Community of Practice, Canadian Women's Health Network, Centre for Indigenous Environmental Resources, First Nations Child & Family Caring Society of Canada, Google Scholar, Government of Quebec, Health Evidence, Hope-Lit Database, INSPQ Public Health Expertise and Reference Centre, Inuit Studies, KT Clearinghouse, National Aboriginal Health Organization, National Collaborating Centre for Indigenous Health, Native Health Database, Pan American Health Organization, Pimatisiwin, Population Health Improvement Research Network Library, University of Manitoba Health Sciences Libraries Aboriginal Health Collection.

Between February and May 2017, we contacted 73 government and funding agencies at the federal, territorial, and provincial levels that may have funded Indigenous health research. Five key informants who produced or worked in the area of Indigenous KT in Canada were identified through the Advisory Team and contacted to identify additional grey literature.

2.2. Study selection

Only studies that a) focused on Indigenous Peoples' health and wellness; b) documented knowledge sharing activities and rationale; c) evaluated the knowledge sharing process or outcomes; and d) printed in English were included and appraised. Studies that used an implementation science model of testing programs, tool, and practices were excluded. All studies that met the inclusion criteria after full text screening were then appraised using the Well Living House quality appraisal tool (Minichiello et al., 2016; Morton Ninomiya et al., 2017; Smylie et al., 2016).

2.3. Quality appraisal

Using the Well Living House quality appraisal tool (Morton Ninomiya et al., 2017), each document was scored in three domains: 1) community relevance, 2) rigour of KT evaluation methodology, and 3) strength of evidence. Out of total possible score of 12, any documents that scored less than six were excluded from the review.

2.4. Data extraction

A data extraction table was developed and pilot tested before recording information from each included document. Quality appraisal scores were documented in the table as well as identified themes and trends for the analysis. Our extraction table also included: the reference; quality appraisal scores in each domain and the average score between the two reviewers; physical/geographic location(s) of studies; Indigenous nation(s) or organizations; urban, rural, and/or remote (i.e. where urban amenities are inaccessible) community context; perceived target

audience; research topic area; types of researchers involved; organizations and institutions involved in the research; aim(s) of KT efforts; KT evaluation methodology; thick or thin description of KT evaluation methodology; measures of KT success; KT methods used; authors' definition of KT; how KT methods were validated by Indigenous communities; key people involved in KT; type and level of Indigenous Peoples' involvement in KT; key results from the KT evaluation; and recommendations based on the KT evaluation.

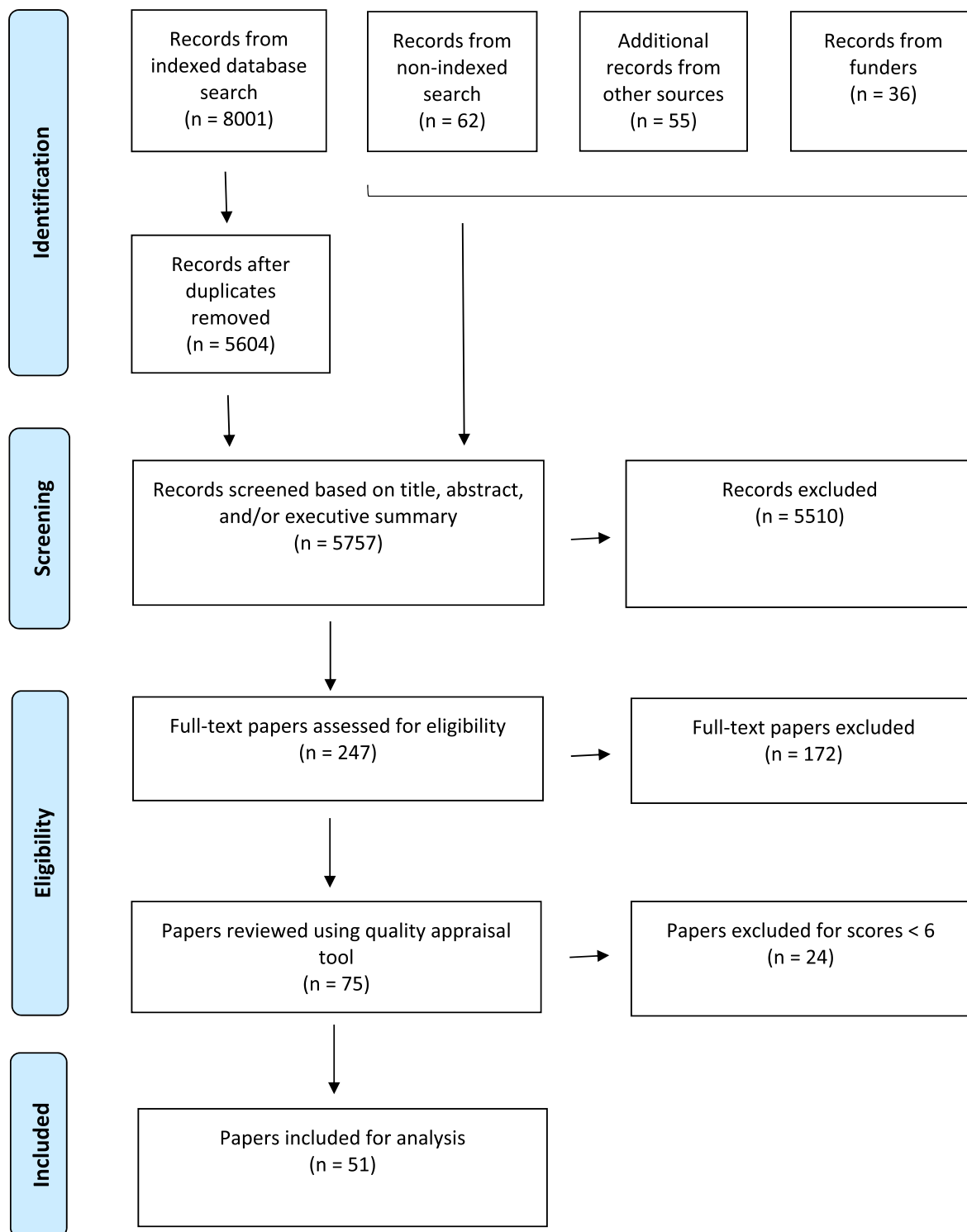


Fig. 1. PRISMA flow chart of document selection for analysis.

Table 1

List of governments and organizations that funded or conducted Indigenous health research that responded to request for relevant documents in 2016.

Federal/Territory/Province	Government/Organization
Federal (9)	<ul style="list-style-type: none"> • Aboriginal Nurses Association of Canada • First Nations Child and Family Caring Society of Canada • National Association of Friendship Centres • National Collaborating Centres for Indigenous Health • Public Health Agency of Canada • Native Women's Association of Canada • First Nations Information Governance Centre • Aboriginal Health Research Networks Secretariat • Indigenous Services Canada
Northwest Territories (2)	<ul style="list-style-type: none"> • Aboriginal Affairs & Intergovernmental Relations • NWT Gov't: Health & Social Services, Senior Advisor
Yukon Territory (2)	<ul style="list-style-type: none"> • Indigenous Services Canada: Northern (representing northern Canada) • Council of Yukon First Nations
Nunavut (2)	<ul style="list-style-type: none"> • Department of Health • Qaujigiartiit Health Research Centre
British Columbia (4)	<ul style="list-style-type: none"> • First Nations Health Authority • First Nations Health Council • Metis Nation of BC • BC Aboriginal Child Care Society
Alberta (2)	<ul style="list-style-type: none"> • Indigenous Services Canada: Alberta • Métis Nation of Alberta
Saskatchewan (2)	<ul style="list-style-type: none"> • Indigenous Services Canada: Saskatchewan • Indigenous Peoples' Health Research Centre
Manitoba (2)	<ul style="list-style-type: none"> • Manitoba Metis Federation • Assembly of Manitoba Chiefs • Centre for Aboriginal Health Research • University of Manitoba Community Health
Ontario (4)	<ul style="list-style-type: none"> • Indigenous Services Canada: Ontario • ON Fed Indigenous Friendship Centres • Cancer Care Ontario - Aboriginal Directorate • Anishnabe Kekendazone
Québec (4)	<ul style="list-style-type: none"> • Québec Departmental Aboriginal Affairs Coordinators • Network for Aboriginal Mental Health Research • Nasivvik NEAHR Centre for Inuit Health and Changing Environments • Assembly of First Nations of Quebec and Labrador • No responses
New Brunswick (0)	
Nova Scotia (2)	<ul style="list-style-type: none"> • Atlantic Aboriginal Health Research Program (representing Atlantic Canada) • Indigenous Services Canada: Atlantic (representing Atlantic Canada)
Newfoundland & Labrador (4)	<ul style="list-style-type: none"> • Department of Health and Community Services - Aboriginal Health • Labrador & Aboriginal Affairs Office • Health and Social Sector, NunatuKavut Community Council • Department of Health and Social Development, Nunatsiavut Government
Prince Edward Island (2)	<ul style="list-style-type: none"> • Native Council of PEI • PEI Aboriginal Affairs Secretariat

2.4.1. Analysis

We used an iterative narrative synthesis approach (Popay et al., 2006) to identify Indigenous Peoples' involvement in KT planning and activities, including authorship of included papers; produce rich descriptions of the KT processes in Indigenous contexts; identify themes and patterns across studies; describe the relevance of KT outcomes to improved health and wellness; and identify KT evaluation methods and rationales. A narrative synthesis approach involves using an iterative process to 1) examine commonalities across studies as to how, why, and for whom an intervention works (KT in our case); 2) synthesize study findings to inform preliminary results; 3) consider and explore relationships within and between studies; and 4) determine the robustness of the synthesis and synthesis process, which in our case involved Indigenous scholars and Elders (Popay et al., 2006). A narrative synthesis approach was deemed appropriate and most suitable, given the diversity of Indigenous communities, knowledges, and research topics, KT methods, and evaluation methodologies. Some of the descriptors, such as study locations were tabulated. For extracted data that included considerable description, excerpts, details, and contextually specific nuance, emerging themes were identified consistent with the aforementioned narrative synthesis approach. Based on our data extraction

table, emerging themes were identified for KT aims (e.g. what was being evaluated), approaches and methods, effective KT, KT evaluation methods, and health outcomes from KT. Then for each theme, all studies reporting information related to a theme were recorded in a table, along with notes describing each study's unique context and/or variations.

Preliminary findings drafted by the first two authors were reviewed, critically analyzed and discussed by the Advisory Team. The Advisory Team identified themes that may have been missed, suggested terminology to more accurately articulate and reflect themes, sought clarity and examples to better describe thematic findings, and highlighted conceptual terms that warrant clear definitions and examples in the writing of the findings. Documents were re-analyzed to ensure a comprehensive search for evidence, including recognising any additional themes or subthemes that Advisory Team members identified.

3. Results

3.1. Search results and characteristics

A total of 8154 documents were identified from indexed and non-indexed databases of published literature, and grey literature before

Table 2
Included document appraisal, location, Indigenous Peoples and type of involvement in project.

Author(s)	Appraisal Score (low = 6–7, med = 8–9, high = 10–12)	Authorship (Indigenous/non-Indigenous; member/non-member of Indigenous population involved in research)	“Inside” Indigenous Peoples involvement in writing paper	Indigenous Peoples’ involvement in KT and KT evaluation	Indigenous Peoples (Nation/Group, Country)
Abonyi and Jeffery (2006)	low	Non-Indigenous non-members	None mentioned	Academic researchers, a research coordinator, and research assistants do not clearly self-identify as Indigenous or non-Indigenous. Collaborators, provincial health organizations and health directors from the First Nations communities were involved ever 1–2 months.	First Nations in Saskatchewan, CA
Allen et al. (2006)	med	Non-Indigenous non-members	None mentioned	Community co-researchers offered 1) thick descriptions in qualitative research; 2) cultural input, auditing, and interpretation; and 3) understanding of Indigenous language.	Yup’ik Alaska Natives, US
Alvarez et al. (2016)	high	Non-Indigenous non-members	None mentioned	Indigenous youth and community members attended community events, sometimes serving on an implementation team.	Northern Inuit communities, CA
Anticona et al. (2013)	low	Non-Indigenous non-members	None mentioned	Indigenous people were consulted on research priorities, attending presentations to provide support for further action.	Achuar in the Corrientes River Basin, PE
Avey et al. (2018)	med	Both Indigenous & non-Indigenous non-members	None mentioned	The study team that developed the presentation was comprised of many Indigenous community members, and the feedback/evaluation of the presentation was provided by 31 AN/AI adults.	Alaska Native/American Indians, US
Bailie et al. (2013)	low	Non-Indigenous non-members	None mentioned	Unclear if the people from health clinics serving Indigenous populations were Indigenous.	Torres Straight Islanders in Northern Territory, AU
Baldwin (1999)	low	Indigenous non-member	None mentioned	Indigenous People were involved in advising, data collection, consultants, and evaluation.	Native American communities (unclear), US
Banks (2003)	high	Unclear	None mentioned	KT was exclusively led by Indigenous Peoples.	Mohawk of Kanestake, Six Nations Confederacy, CA
Barclay et al. (2014)	med	Both Indigenous & non-Indigenous non-members	Contributed to manuscript drafts; read & approved final manuscript	All co-researchers, advisory committees, reference groups, local health workers were Indigenous.	2 large rural communities, northern AU
Baydala et al. (2014)	med	Both Indigenous & non-Indigenous non-members	None mentioned	Indigenous People were involved throughout evaluation process.	Alexis Nakota Sioux Nation, Treaty 6, Alberta, CA
Beans et al. (2018)	low	Indigenous members Non-Indigenous non-members	Unclear	The forum team was comprised of several Indigenous individuals.	Alaska Natives/American Indian, US
Bisset et al. (2004)	med	Both Indigenous & non-Indigenous non-members	None mentioned	Indigenous co-researchers were involved in the evaluation, exact involvement is unknown.	Odawa, Pottawottomie, and Ojibway of Wikwemikong Unceded Indian Reserve, CA
(Blodgett et al., 2011a, b)	med	Both Indigenous & non-Indigenous non-members	None mentioned	Indigenous community members involvement throughout, with academic researcher guidance at times.	Odawa, Pottawottomie, and Ojibway of Wikwemikong Unceded Indian Reserve, CA
Bradford and Bharadwaj (2015)	low	Non-Indigenous non-members	None mentioned	Indigenous students were involved in producing a video; community stakeholder engagement in feedback; Indigenous participants in original research formed the video content.	Communities in Slave River and Delta Region of Northwest Territories, CA
Brown et al. (2002)	med	Unclear	None mentioned	Indigenous community members and health professionals that work in the Indigenous communities involved were	Torres Straight Islander, North Queensland, AU

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Table 2 (continued)

Author(s)	Appraisal Score (low = 6–7, med = 8–9, high = 10–12)	Authorship (Indigenous/non-Indigenous; member/non-member of Indigenous population involved in research)	“Inside” Indigenous Peoples involvement in writing paper	Indigenous Peoples’ involvement in KT and KT evaluation	Indigenous Peoples (Nation/Group, Country)
Carry et al. (2011)	med	Unclear	None mentioned	heavily involved in KT decisions and implementation. Indigenous Peoples were involved throughout most of KT, except evaluation. Unclear if researcher authors are Indigenous.	Inuit, Nunavut, CA
Castleden (2008)	low	Indigenous members	Contributed writing to & provided feedback on manuscript	Indigenous participants were co-producers of knowledge, through generating and analyzing data.	Huu-ay-aht First Nation, CA
Counil et al. (2012)	low	Both Indigenous & non-Indigenous non-members	None mentioned	Indigenous Peoples were involved in consultation for, decision making, and implementing the prevention programming. Indigenous Peoples were central to KT.	Inuit, Nunavik, CA
Dickson (2000)	low	Non-Indigenous non-member	None mentioned	The study was designed by Indigenous community researchers, including the KT.	Cree, CA
Dieter et al. (2018)	low	Indigenous members & non-members	Unclear	Indigenous community members were consulted and tested and provided feedback to determine effectiveness. An Indigenous artist was commissioned to do illustrations. Elders and community members were involved in planning and facilitating educational and cultural activities and acted as peer mentors. All participants were Indigenous.	First Nations part of File Hills Qu’appelle Tribal Council, Treaty 4, CA 2 First Nations communities, CA
Douglas et al. (2013)	low	Non-Indigenous non-members	None mentioned		
Edge and McCallum (2006)	low	Indigenous non-members	None mentioned		Métis, CA
Elias and O’Neil (2006)	low	Non-Indigenous non-members	None mentioned	High levels of Indigenous Peoples’ participation and uptake of KT findings and outcomes. Unclear if research leads are Indigenous or non-Indigenous.	Manitoba First Nations, CA
Esler (2008)	low	Non-Indigenous non-member	None mentioned	Indigenous research assistant, advisory committee members provided ongoing feedback.	Danila Dilba, Northern Territory, AU
Farrin et al. (2004)	low	Non-Indigenous non-members	None mentioned	Unclear if the researchers or two community project workers are Indigenous. Focus groups and people most involved and consulted in the evaluation process were primarily Indigenous People.	Whyalla and Upper Eyre Peninsula, AU
Garwick and Auger (2003)	low	Non-Indigenous non-members	None mentioned	Indigenous People were involved throughout the project at all locations.	American Indian, Minnesota, US
Heffernan et al. (2015)	low	Indigenous member & non-Indigenous non-members	Unclear	Indigenous Peoples’ involvement in all phases of study and KT.	Unclear group, AU
Hopkins (2012)	med	Non-Indigenous non-member	None mentioned	Indigenous Peoples’ involvement throughout the project.	Tijchq, Northwest Territories, CA
Jacklin and Kinoshameg, 2008	med	Indigenous member & non-Indigenous non-member	Unclear	Indigenous Peoples’ involvement throughout the project. Local Indigenous people were trained as research assistants and Indigenous leadership provided project oversight.	Odawa, Pottawottomie, and Ojibway of Wikwemikong Unceded Indian Reserve, CA
Jardine and Furgal (2010)	low	Non-Indigenous non-members	None mentioned	Indigenous People were involved in data collection, analysis, and dissemination.	Dene from N’Dilo and Dettah, Northwest Territories and Inuit in Nain and Hopedale, CA
Jernigan et al. (2015)	low	Indigenous & non-Indigenous non-members	None mentioned	Indigenous Peoples’ involvement throughout the project.	American Indian and Alaska Native in California, US
Jernigan (2010)	low	Indigenous member	Lead author only	Indigenous Peoples’ involvement throughout the project.	American Indian and Alaska Native of Santa Clara Valley, California, US

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Table 2 (continued)

Author(s)	Appraisal Score (low = 6–7, med = 8–9, high = 10–12)	Authorship (Indigenous/non-Indigenous; member/non-member of Indigenous population involved in research)	“Inside” Indigenous Peoples involvement in writing paper	Indigenous Peoples’ involvement in KT and KT evaluation	Indigenous Peoples (Nation/Group, Country)
Laycock et al. (2019)	high	Non-Indigenous non-members	None mentioned	Research team was composed of Indigenous and non-Indigenous researchers. Indigenous Peoples were consulted throughout the project.	Australia Aboriginal and Torres Strait Islander, AU
Lee et al. (2008)	low	Unclear	None mentioned	Indigenous Peoples’ involvement throughout all KT activities and initiatives.	Australia Aboriginal from Arnhem Land, Northern Territory, AU
Legaspi and Orr (2007)	med	Non-Indigenous non-members	None mentioned	Indigenous Peoples’ involvement throughout the dissemination process.	Yup’ik Native Alaskan, US
Manderson and Hoban (2008)	med	Non-Indigenous non-members	None mentioned	Led by an Indigenous researcher and a reference group of six Indigenous women.	Aboriginal & Torres Strait Islander, Queensland, AU
McCalman et al. (2015)	med	Indigenous member(s) & Non-Indigenous non-members	Read and approved manuscript, as co-authors	Indigenous health workers were heavily involved in the planning and implementation of changes based on findings from evaluation.	Murri, Cape York, AU
Pufall et al. (2011)	low	Indigenous member(s) & Non-Indigenous non-members	Unclear	Unclear.	Inuit, Nain, CA
Rasmus (2014)	low	Non-Indigenous non-member	Unclear	Indigenous Peoples’ involvement in KT activities though, evaluation involvement was only as participants (not evaluation analysis).	Yup’ik Alaska Native, US
Rawson (2016)	low	Indigenous member	Lead author only	An Indigenous person was hired as a consultant and local Indigenous people were featured on campaign posters.	Maori, Christchurch, Canterbury, NZ
Rivkin et al. (2013)	med	Indigenous and non-Indigenous non-members	None mentioned	Indigenous People were involved in all phases of project engagement and dissemination.	Yup’ik Alaska Native, US
Salsberg et al. (2007)	low	Indigenous members & Non-Indigenous non-members	Identified members reviewed paper to ensure accuracy and acceptability; co-authorship roles unclear	Indigenous involvement was present in most stages of research planning, data collection and dissemination. It is unclear how involved community members or if graduate students involved in the analysis were Indigenous.	Mohawk in Kahnawake, Oji-Cree in Sandy Lake, Moose Cree in Moose Factory, CA
Santhanam et al. (2006)	low	Non-Indigenous non-members	None mentioned	Indigenous community involvement is implied, as part of the community feedback, use of participatory action research, and the implementation of a strategy.	Aboriginal Peoples, Northern Queensland, AU
(Smylie et al., 2006a, b)	low	Indigenous members, Indigenous non-member, & non-Indigenous non-member	Read and approved submission, as co-authors	Indigenous Peoples were involved throughout the project, including the lead researcher.	Inuit, Ottawa, CA
Stefanich et al. (2005)	low	Unclear	None mentioned	Extensive involvement by Alaska Native women for whom the program was intended.	Alaska Natives, US
Venner et al. (2007)	low	Indigenous member & non-Indigenous non-members	Co-author only	Research participants (focus group) that informed the manual are Indigenous. The manual was endorsed within the Indigenous community.	American Indian, New Mexico, US
Alonso et al. (2019)	low	Unclear, with at least one non-Indigenous non-members	Unclear, may be co-authors	Leadership was involved in policy changes, implementation of initiatives, and measuring changes, in partnership with an outside government organization.	Winnibago Tribe, Nebraska, US
Camargo Plazas et al. (2019)	med	Indigenous non-member, non-Indigenous non-members	Read and approved manuscript	Local school board, Chief and Council, health and education leaders, and community Elder worked to support popular theatre by youth with diverse audiences.	First Nations community, Alberta, CA
Kyoon-Achan et al. (2018)	high	Indigenous members and non-members, non-Indigenous non-members	Read and approved manuscript	First Nations’ leadership named priorities and an Elders advised throughout.	Eight First Nations communities, Manitoba, CA
Webkamigad et al. (2020)	med	Indigenous non-members, non-Indigenous non-member	Read and approved manuscript	Community members involved in previous studies with same researchers offered guidance, input, and feedback on materials.	Six First Nations and urban First Nations’ communities, Ontario, CA
Prince et al. (2019)	low	Unclear, at least one Indigenous co-author	Read and approved manuscript	First Nations’ leaders supported initiatives, Elders and Knowledge Carriers were involved in sharing Indigenous Knowledges. Unclear if local health providers were Indigenous.	Four First Nations: Three in Ontario and one in Manitoba, CA

duplicates were removed (Fig. 1). Of the 5604 documents that were screened on title, abstracts, and/or executive summaries, 247 documents remained for full-text screening. Of the 247 documents, 75 were included after full-text screening and 51 of the documents scored an average of 6 or higher using the Well Living House appraisal tool. Almost all 24 documents that scored less than 6 using the appraisal tool scored very low in the methodological rigour of evaluation and the strength of evidence. In other words, KT evaluation was not featured or well described in the document. One study published a pair of sister papers: one on the development of the KT tools and activities, and one on the evaluation of the tools and activities. For this systematic review, we counted these sister papers as *one* of the 51 included documents. Of the 51 included documents, 50 were published articles and one was a case study within a report (Abonyi and Jeffery, 2006).

Analyzed documents included studies from Canada (n = 25), United States (n = 13), Australia (n = 11), New Zealand (1), and Peru (1). The average scores on the appraisal tool varied: 29 papers scored between 6 and 7.99, 16 papers between 8 and 9.99, and six papers between 10 and 12.

Forty three of the 73 organizations (59% response rate) replied to our queries about documents that might meet the inclusion criteria. The federal, territorial, and provincial governments and organizations are listed in Table 1.

Most papers were authored by non-Indigenous authors only (n = 21) or a combination of Indigenous and non-Indigenous authors (n = 22). Thirteen or more papers were written, as lead or co-author, by members of the Indigenous group that was involved in the study and KT (see Table 2). The authors of the remaining 38 papers did not represent or include people that were part of the Indigenous Peoples or communities directly involved in the study as an author or co-author.

3.2. *KT aims: what was being evaluated?*

Documents that detailed how and what KT was used as well as its outcomes were included, as evaluation through observations. Of the 46 documents, 24 were evaluated based on well documented observations (Abonyi and Jeffery, 2006; Allen et al., 2006; Alonso et al., 2019; Anticona et al., 2013; Bailie et al., 2013; Baydala et al., 2014; Bradford and Bharadwaj, 2015; Camargo Plazas et al., 2019; Counil et al., 2012; Dickson, 2000; Dieter et al., 2018; Douglas et al., 2013; Edge and McCallum, 2006; Elias and O'Neil, 2006; Farrin et al., 2004; Garwick and Auger, 2003; Heffernan et al., 2015; Jacklin and Kinoshameg, 2008; Jardine and Furgal, 2010; Jernigan, 2010; Kyoan-Achan et al., 2018; Manderson and Hoban, 2008; McCalman et al., 2015; Prince et al., 2019; Rawson, 2016; Stefanich et al., 2005; Venner et al., 2007; Webkamigad et al., 2020), nine studies used questionnaires or surveys (Alvarez et al., 2016; Avey et al., 2018; Baldwin, 1999; Beans et al., 2018; Bradford and Bharadwaj, 2015; Carry et al., 2011; Laycock et al., 2019; Legaspi and Orr, 2007; Smylie et al., 2006a, b), 11 conducted interviews (Alvarez et al., 2016; Baldwin, 1999; Bisset et al., 2004; Blodgett et al., 2011; Castleden, 2008; Hopkins, 2012; Laycock et al., 2019; Lee et al., 2008; Pufall et al., 2011; Rasmus, 2014; Smylie et al., 2006a, b), nine held focus groups (Baldwin, 1999; Beans et al., 2018; Blodgett et al., 2011; Carry et al., 2011; Jernigan et al., 2015; Lee et al., 2008; Pufall et al., 2011; Rasmus, 2014; Salsberg et al., 2007), and several used a mix of qualitative and quantitative methods with pre- and post-measures (Banks, 2003), case studies (Barclay et al., 2014; Dickson, 2000), epidemiology and financial analysis (Barclay et al., 2014). Five evaluated through analyzing reflexive and reflective field notes (Counil et al., 2012; Laycock et al., 2019; Legaspi and Orr, 2007; Rivkin et al., 2013; Salsberg et al., 2007), one conducted a document review (Laycock et al., 2019), and one used a realist evaluation (Santhanam et al., 2006).

The aims and purposes of the KT varied between studies. However, all studies aimed to produce at least one of the following outcomes: 1) increasing or building knowledges and awareness within community (ies); 2) changing individual behaviours; 3) improving programs, services, or systems to improve health and wellness; and 4) conducting research in a good way.

First, increasing knowledges among community members was focused on challenges such as access to services, parenting skills, or healthy pregnancies (Bradford and Bharadwaj, 2015; Carry et al., 2011; Lee et al., 2008; McShane et al., 2013; Smylie et al., 2006a, b). Similarly, increased awareness was around issues including health hazards, personal health practices, and healthy actions (Abonyi and Jeffery, 2006; Avey et al., 2018; Beans et al., 2018; Counil et al., 2012; Douglas et al., 2013; Pufall et al., 2011; Rawson, 2016).

Second, KT that targeted individual behaviour change was focused on prevention and health promotion efforts such as breastfeeding (Banks, 2003) and tuberculosis (Alvarez et al., 2016), interventions (Brown et al., 2002) including hiring grandmothers as health educators (Dickson, 2000), and upskilling health service providers (Baldwin, 1999) and community members (Baydala et al., 2014).

Third, some KT efforts focused on improving services (Manderson and Hoban, 2008; McCalman et al., 2015; Rivkin et al., 2013; Stefanich et al., 2005; Venner et al., 2007) such as maternity care (Barclay et al., 2014) or child and youth mental health care (Santhanam et al., 2006) improving community supports (Avey et al., 2018; Bailie et al., 2013; Dieter et al., 2018) including housing for youth (Farrin et al., 2004), making policy changes (Manderson and Hoban, 2008), changing program approaches to be more culturally relevant (Manderson and Hoban, 2008; McCalman et al., 2015; Rivkin et al., 2013; Santhanam et al., 2006; Stefanich et al., 2005; Venner et al., 2007), and assessing KT readiness for health promotion efforts in diabetes prevention (Salsberg et al., 2007).

Fourth, 16 studies evaluated the *process* of conducting their study and/or developing and implementing KT. Authors understood that effective Indigenous KT is necessarily embedded and inseparable from the research process. Authors identified that researchers were concerned that research knowledges were shared in a way that was relevant, specific, and appropriate for the community(ies) and local culture; involving local Indigenous members including leaders and Elders as key drivers and contributors to the project (Edge and McCallum, 2006; Jacklin and Kinoshameg, 2008; Legaspi and Orr, 2007; Rasmus, 2014); ensuring that the project was governed by Indigenous communities or rightsholders (Garwick and Auger, 2003; Heffernan et al., 2015); using local Indigenous processes and protocols for putting knowledges into action (Hopkins, 2012); and using community participatory research methodologies to centre local cultures, knowledges, and people that have inherent relevant KT pathways (Elias and O'Neil, 2006; Esler, 2008; Jardine and Furgal, 2010; Jernigan, 2010; Jernigan et al., 2015; Laycock et al., 2019).

3.3. *KT approaches and methods: what did people do?*

Many of the authors of included documents focused on the *process* and *approach* as an integral part of their KT methodology (Table 2). Many research teams intentionally involved a variety of rightsholders, stakeholders and other relations throughout the study. By *rightsholders*, we refer to the Indigenous community members and/or leaders that have clear rights to guide, own, and use the research process and findings. This intentional engagement and involvement of rightsholders and stakeholders throughout a study is sometimes referred to as a *integrated knowledge translation* approach (CIHR, 2012). Integrated KT is primarily concerned with maximizing the relevance and uptake of research by

Table 3
Summary of knowledge translation aim, method, and outcome themes.

Themes	Examples	References
KT Aims: What was being evaluated?		
Knowledge and awareness within community(ies)	<ol style="list-style-type: none"> 1. increased knowledge (e.g. existing services and parenting skills) 2. increased awareness such as hazards, personal health, and healthy actions 	<ol style="list-style-type: none"> 1. (Bradford and Bharadwaj, 2015; Carry et al., 2011; Laycock et al., 2019; Lee et al., 2008; Smylie et al., 2006a, b; Webkamigad et al., 2020) 2. (Abonyi and Jeffery, 2006; Avey et al., 2018; Beans et al., 2018; Camargo Plazas et al., 2019; Counil et al., 2012; Douglas et al., 2013; Pufall et al., 2011; Rawson, 2016)
Individual behaviour change	<ol style="list-style-type: none"> 1. prevention efforts and health promotion 2. interventions 3. upskilling (capacity building) 	<ol style="list-style-type: none"> 1. (Alvarez et al., 2016; Banks, 2003; Dickson, 2000) 2. (Alonso et al., 2019; Baldwin, 1999; Brown et al., 2002) 3. (Abonyi and Jeffery, 2006; Baydala et al., 2014; Salsberg et al., 2007)
Improved system, programs, or services (for improved health and wellness)	<ol style="list-style-type: none"> 1. service delivery 2. community supports 3. policy change 4. program approaches 	<ol style="list-style-type: none"> 1. (Camargo Plazas et al., 2019; Manderson and Hoban, 2008; McCalman et al., 2015; Rivkin et al., 2013; Stefanich et al., 2005; Venner et al., 2007) 2. (Avey et al., 2018; Bailie et al., 2013; Barclay et al., 2014; Dieter et al., 2018; Farrin et al., 2004; Prince et al., 2019) 3. (Manderson and Hoban, 2008) 4. (Alonso et al., 2019; Manderson and Hoban, 2008; McCalman et al., 2015; Rivkin et al., 2013; Santhanam et al., 2006; Stefanich et al., 2005; Venner et al., 2007)
Doing research in a good way	<ol style="list-style-type: none"> 1. relevance to community, including cultural relevance 2. involving leaders, Elders, and knowledge holders within community 3. Indigenous-governed 4. Indigenous model for putting knowledge into action 5. used community participatory research methodologies 	<ol style="list-style-type: none"> 1. (Bisset et al., 2004; Castleden, 2008; Garwick and Auger, 2003; Jacklin and Kinoshameg, 2008; Kyoon-Achan et al., 2018; Lee et al., 2008) 2. (Edge and McCallum, 2006; Jacklin and Kinoshameg, 2008; Legaspi and Orr, 2007; Rasmus, 2014) 3. (Garwick and Auger, 2003; Heffernan et al., 2015) 4. (Hopkins, 2012) 5. (Elias and O'Neil, 2006; Esler, 2008; Jardine and Furgal, 2010; Jernigan, 2010; Jernigan et al., 2015; Laycock et al., 2019)
KT Approaches and Methods Used: What did people report?		
Process-oriented focus	<ol style="list-style-type: none"> 1. integrated KT approach of involving/meeting with key stake/rightsholders (including community leadership) throughout study 2. strategic meetings with target audiences (e.g. policy and decision makers) – post study 3. other community-based initiatives 	<ol style="list-style-type: none"> 1. (Abonyi and Jeffery, 2006; Alonso et al., 2019; Anticono et al., 2013; Avey et al., 2018; Bailie et al., 2013; Baldwin, 1999; Banks, 2003; Baydala et al., 2014; Bisset et al., 2004; Douglas et al., 2013; Edge and McCallum, 2006; Elias and O'Neil, 2006; Heffernan et al., 2015; Jacklin and Kinoshameg, 2008; Jernigan, 2010; Jernigan et al., 2015; Kyoon-Achan et al., 2018; Laycock et al., 2019; Prince et al., 2019; Pufall et al., 2011; Rasmus, 2014; Santhanam et al., 2006; Venner et al., 2007) 2. (Alonso et al., 2019; Anticono et al., 2013; Banks, 2003; Barclay et al., 2014; Beans et al., 2018; Brown et al., 2002; Counil et al., 2012; Esler, 2008; Garwick and Auger, 2003; Hopkins, 2012; Jacklin and Kinoshameg, 2008; Jardine and Furgal, 2010; Kyoon-Achan et al., 2018; Manderson and Hoban, 2008; McCalman et al., 2015; Prince et al., 2019; Rivkin et al., 2013; Salsberg et al., 2007; Venner et al., 2007) 3. (Alonso et al., 2019; Banks, 2003; Camargo Plazas et al., 2019; Castleden, 2008; Dickson, 2000; Douglas et al., 2013; Farrin et al., 2004; Jernigan, 2010; McCalman et al., 2015; Prince et al., 2019; Salsberg et al., 2007)
KT tools and mediums	<ol style="list-style-type: none"> 1. visual imagery 2. community/public presentations 3. products/materials for community to use 4. radio 5. television 6. newspaper/newsletter 7. online media/videos 8. reports, webinars, workshops and seminars 9. academic papers & conferences (mentioned in articles) 10. plain language materials 	<ol style="list-style-type: none"> 1. (Abonyi and Jeffery, 2006; Avey et al., 2018; Baydala et al., 2014; Beans et al., 2018; Carry et al., 2011; Castleden, 2008; Douglas et al., 2013; Lee et al., 2008; Legaspi and Orr, 2007; Pufall et al., 2011; Smylie et al., 2006a, b; Venner et al., 2007; Webkamigad et al., 2020) 2. (Abonyi and Jeffery, 2006; Allen et al., 2006; Alvarez et al., 2016; Anticono et al., 2013; Bailie et al., 2013; Barclay et al., 2014; Brown et al., 2002; Dieter et al., 2018; Douglas et al., 2013; Hopkins, 2012; Jardine and Furgal, 2010; Kyoon-Achan et al., 2018; Manderson and Hoban, 2008; Prince et al., 2019; Pufall et al., 2011; Rivkin et al., 2013) 3. (Abonyi and Jeffery, 2006; Counil et al., 2012; Garwick and Auger, 2003; Lee et al., 2008; McCalman et al., 2015; Prince et al., 2019; Smylie et al., 2006a, b; Venner et al., 2007; Webkamigad et al., 2020) 4. (Alvarez et al., 2016; Carry et al., 2011; Counil et al., 2012; Jardine and Furgal, 2010; Manderson and Hoban, 2008; Pufall et al., 2011) 5. (Carry et al., 2011; Jernigan, 2010) 6. (Banks, 2003; Kyoon-Achan et al., 2018; Manderson and Hoban, 2008) 7. (Bradford and Bharadwaj, 2015; Garwick and Auger, 2003; Prince et al., 2019) 8. (Anticono et al., 2013; Avey et al., 2018; Beans et al., 2018; Dieter et al., 2018; Farrin et al., 2004; Garwick and Auger, 2003; Heffernan et al., 2015; Jardine and Furgal, 2010; Manderson and Hoban, 2008; McCalman et al., 2015; Rivkin et al., 2013; Salsberg et al., 2007) 9. (Barclay et al., 2014; Douglas et al., 2013; Heffernan et al., 2015; Manderson and Hoban, 2008; Salsberg et al., 2007) 10. (Beans et al., 2018; Bisset et al., 2004; Brown et al., 2002; Carry et al., 2011; Kyoon-Achan et al., 2018; Lee et al., 2008; Legaspi and Orr, 2007; Rivkin et al., 2013; Smylie et al., 2006a, b; Venner et al., 2007; Webkamigad et al., 2020)

(continued on next page)

Table 3 (continued)

Research team composition	<ol style="list-style-type: none"> 1. hired or involved community researchers/members to be involved KT 2. involved Elders and/or grandparents 	<ol style="list-style-type: none"> 1. (Allen et al., 2006; Avey et al., 2018; Baldwin, 1999; Barclay et al., 2014; Bisset et al., 2004; Bradford and Bharadwaj, 2015; Camargo Plazas et al., 2019; Heffernan et al., 2015; Jernigan et al., 2015; Kyoona-Achan et al., 2018; Legaspi and Orr, 2007; Pufall et al., 2011; Rasmus, 2014; Rawson, 2016; Santhanam et al., 2006; Stefanich et al., 2005) 2. (Alvarez et al., 2016; Banks, 2003; Baydala et al., 2014; Bradford and Bharadwaj, 2015; Carry et al., 2011; Dickson, 2000; Douglas et al., 2013; Edge and McCallum, 2006; Kyoona-Achan et al., 2018; Prince et al., 2019; Rasmus, 2014; Rivkin et al., 2013; Salsberg et al., 2007; Smylie et al., 2006a, b)
Traditional knowledge	<ol style="list-style-type: none"> 1. traditional knowledge 2. local Indigenous language use 	<ol style="list-style-type: none"> 1. (Banks, 2003; Baydala et al., 2014; Bisset et al., 2004; Bradford and Bharadwaj, 2015; Douglas et al., 2013; Jernigan, 2010; Rawson, 2016; Rivkin et al., 2013; Smylie et al., 2006a, b; Venner et al., 2007; Webkamigad et al., 2020) 2. (Baydala et al., 2014; Council et al., 2012; Edge and McCallum, 2006; Kyoona-Achan et al., 2018; Lee et al., 2008; Legaspi and Orr, 2007; Pufall et al., 2011; Rivkin et al., 2013; Smylie et al., 2006a, b; Venner et al., 2007; Webkamigad et al., 2020)
Effective KT Based on Evaluation		
<i>Meaningful involvement of rights holders and stakeholders</i>	<ol style="list-style-type: none"> 1. Indigenous leadership throughout project (including Elders) 2. Indigenous involvement in KT initiatives led by Indigenous researcher 3. hired Indigenous community researchers 4. created networks (with diverse roles) to enhance knowledge sharing 5. identified, engaged, and included key rightsholders and stakeholders throughout study 6. identified aims of project and KT goals at the project development stage 	<ol style="list-style-type: none"> 1. (Alonso et al., 2019; Barclay et al., 2014; Baydala et al., 2014; Camargo Plazas et al., 2019; Edge and McCallum, 2006; Esler, 2008; Prince et al., 2019) 2. (Allen et al., 2006; Baldwin, 1999; Barclay et al., 2014; Bisset et al., 2004; Carry et al., 2011; Castleden, 2008; Council et al., 2012; Dickson, 2000; Dieter et al., 2018; Esler, 2008; Hopkins, 2012; Jacklin and Kinoshameg, 2008; Jernigan, 2010; Jernigan et al., 2015; Lee et al., 2008; Legaspi and Orr, 2007; Manderson and Hoban, 2008; McCalman et al., 2015; Rivkin et al., 2013; Santhanam et al., 2006; Smylie et al., 2006a, b; Stefanich et al., 2005; Venner et al., 2007) 3. (Allen et al., 2006; Baldwin, 1999; Banks, 2003; Barclay et al., 2014; Bisset et al., 2004; Jernigan et al., 2015; Kyoona-Achan et al., 2018; Prince et al., 2019; Smylie et al., 2006a, b) 4. (Avey et al., 2018; Bailie et al., 2013; Edge and McCallum, 2006; Elias and O'Neil, 2006; Kyoona-Achan et al., 2018; Prince et al., 2019; Salsberg et al., 2007; Smylie et al., 2006a, b) 5. (Bailie et al., 2013; Baldwin, 1999; Barclay et al., 2014; Beans et al., 2018; Camargo Plazas et al., 2019; Kyoona-Achan et al., 2018; Manderson and Hoban, 2008) 6. (Manderson and Hoban, 2008)
<i>KT materials, tools and mechanisms</i>	<ol style="list-style-type: none"> 1. used multimedia with visual and/oral components 2. held community events 	<ol style="list-style-type: none"> 1. (Allen et al., 2006; Bisset et al., 2004; Brown et al., 2002; Carry et al., 2011; Castleden, 2008; Council et al., 2012; Lee et al., 2008; Pufall et al., 2011; Smylie et al., 2006a, b; Stefanich et al., 2005) 2. (Alvarez et al., 2016; Avey et al., 2018; Brown et al., 2002; Council et al., 2012)
<i>Communicating intentions and culturally relevant knowledge</i>	<ol style="list-style-type: none"> 1. transparent (clear, transparency around intentions) communication 2. messages and products reflecting values, culture, and strength 	<ol style="list-style-type: none"> 1. (Bisset et al., 2004; Dieter et al., 2018; Garwick and Auger, 2003; Jacklin and Kinoshameg, 2008; Jardine and Furgal, 2010; Kyoona-Achan et al., 2018; Legaspi and Orr, 2007; Manderson and Hoban, 2008; Prince et al., 2019; Rivkin et al., 2013) 2. (Dieter et al., 2018; Prince et al., 2019; Rawson, 2016; Rivkin et al., 2013; Smylie et al., 2006a, b; Stefanich et al., 2005; Webkamigad et al., 2020)
<i>Research principles and practices</i>	<ol style="list-style-type: none"> 1. followed Indigenous-partnered principles and practices (CBPR principles) 2. maintained consistent research team members 3. built collaborative working relationships that follow local community protocols and practices 4. non-local researchers learned about local community & build relationships 	<ol style="list-style-type: none"> 1. (Dieter et al., 2018; Jacklin and Kinoshameg, 2008; Jernigan, 2010; Kyoona-Achan et al., 2018; Manderson and Hoban, 2008; Prince et al., 2019; Rasmus, 2014; Santhanam et al., 2006) 2. (Bisset et al., 2004) 3. (Baldwin, 1999; Bisset et al., 2004; Dieter et al., 2018; Elias and O'Neil, 2006; Jacklin and Kinoshameg, 2008; Jardine and Furgal, 2010; Laycock et al., 2019; Legaspi and Orr, 2007; Manderson and Hoban, 2008; Rasmus, 2014; Salsberg et al., 2007) 4. (Bisset et al., 2004; Legaspi and Orr, 2007)
<i>Organizational change and sustainability</i>	<ol style="list-style-type: none"> 1. Indigenous organizations incorporating research into structure 2. Increased support to incorporate/embed cultural practices and knowledge (including language) 3. supported program(s), implementation, and maintenance beyond scope of research study 4. developed sustainable Indigenous community resources 	<ol style="list-style-type: none"> 1. (Elias and O'Neil, 2006) 2. (Barclay et al., 2014; Baydala et al., 2014; Castleden, 2008; Rivkin et al., 2013; Stefanich et al., 2005; Venner et al., 2007) 3. (Bisset et al., 2004; Garwick and Auger, 2003; Smylie et al., 2006a, b) 4. (Garwick and Auger, 2003; Jernigan et al., 2015; Rasmus, 2014; Rivkin et al., 2013; Smylie et al., 2006a, b)
<i>Evaluation</i>	evaluated process, outcomes (including capacity enhancement)	(Baldwin, 1999; Bisset et al., 2004; Garwick and Auger, 2003; Heffernan et al., 2015; Laycock et al., 2019; Smylie et al., 2006a, b)

engaging or partnering with the people, organizations, and institutions who a) want to use the findings, or b) have the power to implement new or change existing practices, programs, or policies (Jull et al., 2017, 2018; Kothari and Wathen, 2017).

Studies that evaluated KT in the form of rightsholder and stakeholder involvement throughout a research project included meeting with Indigenous community leaders to seek input and provide updates (Abonyi and Jeffery, 2006; Anticono et al., 2013; Avey et al., 2018; Bailie et al., 2013; Baldwin, 1999; Banks, 2003; Baydala et al., 2014; Bisset et al., 2004; Douglas et al., 2013; Edge and McCallum, 2006; Elias and O'Neil, 2006; Heffernan et al., 2015; Jacklin and Kinoshameg, 2008; Jernigan, 2010; Jernigan et al., 2015; Laycock et al., 2019; Pufall et al., 2011; Rasmus, 2014; Santhanam et al., 2006; Venner et al., 2007); connecting with strategic policy and decision makers that could implement changes based on research findings (Anticono et al., 2013; Bainbridge et al., 2015; Banks, 2003; Barclay et al., 2014; Beans et al., 2018; Brown et al., 2002; Counil et al., 2012; Esler, 2008; Garwick and Auger, 2003; Hopkins, 2012; Jacklin and Kinoshameg, 2008; Jardine and Furgal, 2010; Manderson and Hoban, 2008; Rivkin et al., 2013; Salsberg et al., 2007; Spangaro et al., 2015; Venner et al., 2007); and embedding community-based events, such as feasts, fairs, forums, youth networks, and presentations (Banks, 2003; Castleden, 2008; Douglas et al., 2013; Farrin et al., 2004; McCalman et al., 2015), and other cultural gatherings between communities throughout the study (Dickson, 2000; Jernigan, 2010; Salsberg et al., 2007). Embedding such community-based events, and building on kinship and social networks are foundational and often inherent within Indigenous ways of knowing and doing, and are commonly missed or undervalued in academic research. Further, such events can be the material manifestations of kin and social networks, and providing accountability for researchers in Indigenous settings.

Specific KT tools used to share knowledges ranged from very common academic and Euro-Western-informed forms of dissemination to community-identified and preferred ways of sharing knowledges to target specific people. Common academic forms of KT included reports, webinars, workshops, seminars, publications, and conference presentations (Anticono et al., 2013; Avey et al., 2018; Beans et al., 2018; Dieter et al., 2018; Farrin et al., 2004; Garwick and Auger, 2003; Heffernan et al., 2015; Hopkins, 2012; Jardine and Furgal, 2010; Manderson and Hoban, 2008; McCalman et al., 2015; Rivkin et al., 2013; Salsberg et al., 2007). Communities involved in studies also identified sharing knowledges through community presentations (Allen et al., 2006; Alvarez et al., 2016; Anticono et al., 2013; Bailie et al., 2013; Barclay et al., 2014; Dieter et al., 2018; Douglas et al., 2013; Hopkins, 2012; Jardine and Furgal, 2010; Manderson and Hoban, 2008; Pufall et al., 2011; Rivkin et al., 2013; Smylie, 2011), toolkits or manuals (Abonyi and Jeffery, 2006; Brown et al., 2002; Counil et al., 2012; Garwick and Auger, 2003; Lee et al., 2008; McCalman et al., 2015; Smylie et al., 2006a, b; Venner et al., 2007), radio (Alvarez et al., 2016; Carry et al., 2011; Counil et al., 2012; Jardine and Furgal, 2010; Manderson and Hoban, 2008; Pufall et al., 2011), television (Carry et al., 2011; Jernigan, 2010), factsheets (Jardine and Furgal, 2010), whiteboard animations and project websites (Bradford and Bharadwaj, 2015; Garwick and Auger, 2003), newspapers and bulletins (Banks, 2003; Jacklin and Kinoshameg, 2008; Jernigan, 2010; Manderson and Hoban, 2008), and popular theatre (Camargo Plazas et al., 2019). For the non-academic KT content, many authors indicated that efforts were made to make information written in accessible (English) language, free of disciplinary jargon, and include imagery to minimize literacy barriers and maximize engagement with the content.

A key part of the KT strategy in many studies was hiring researchers from the Indigenous community and/or involving community members, including Elders, Knowledge Keepers, and grandparents. In most studies, the researchers and community members involved in the study were also involved in the KT material development and activities (Allen et al., 2006; Avey et al., 2018; Baldwin, 1999; Barclay et al., 2014; Bisset et al., 2004; Bradford and Bharadwaj, 2015; Heffernan et al., 2015; Jernigan

et al., 2015; Legaspi and Orr, 2007; Pufall et al., 2011; Rasmus, 2014; Rawson, 2016; Santhanam et al., 2006). Twelve studies highlighted the importance and role of Elders, Knowledge Keepers, and/or grandparents in KT (Alvarez et al., 2016; Banks, 2003; Baydala et al., 2014; Bradford and Bharadwaj, 2015; Carry et al., 2011; Dickson, 2000; Douglas et al., 2013; Edge and McCallum, 2006; Rasmus, 2014; Rivkin et al., 2013; Salsberg et al., 2007; Smylie et al., 2006a, b).

In ten studies, Indigenous knowledges that have been passed on through countless generations and sometimes referred to as *traditional knowledges*, was an important part of the research KT content (Banks, 2003; Baydala et al., 2014; Bisset et al., 2004; Bradford and Bharadwaj, 2015; Douglas et al., 2013; Jernigan, 2010; Rawson, 2016; Rivkin et al., 2013; Smylie et al., 2006a, b; Venner et al., 2007). For example, an interactive CD was developed as a health promotion tool for urban Inuit in Ottawa whereby the an Inuk Elder was featured sharing prenatal health information, using cultural references and explanations, in Inuktitut and English (McShane et al., 2013; Smylie et al., 2006a, b). Nine studies indicated using local Indigenous language in the KT activities and initiatives such as presentations, radio shows, and DVDs with English subtitles (Baydala et al., 2014; Counil et al., 2012; Edge and McCallum, 2006; Lee et al., 2008; Legaspi and Orr, 2007; Pufall et al., 2011; Rivkin et al., 2013; Smylie et al., 2006a, b; Venner et al., 2007).

3.4. KT results: what worked?

KT efforts that led to desired outcomes were diverse in nature, ranging from who was involved and when, to communication methods, principled practices, and process. The following seven categories broadly describe what KT methodologies and methods were effective, based on the evaluation: 1) meaningful involvement of rightsholders and stakeholders; 2) KT materials, tools, and mechanisms; 3) communicating intentions and culturally relevant knowledges; 4) guiding research principles and practices; 5) focus on organizational change and sustainability; 6) developmental evaluation during the project; and 7) planning and developing KT goals early in the project (Table 3).

3.4.1. Meaningful involvement of rightsholders and stakeholders

In four studies, local Indigenous leadership, including Elders, guided, advised, and informed the research by asserting protocols. This included culturally-specific protocols, and understanding of the research topic (Barclay et al., 2014; Baydala et al., 2014; Edge and McCallum, 2006; Esler, 2008). Further, five studies used an integrated KT approach whereby key rightsholders and stakeholders, such as elected Indigenous community leaders, health authorities, and services providers were identified at the start of the study. These rightsholders were engaged and included throughout parts of the study, and were then involved in implementing or making changes, based on study findings (Bailie et al., 2013; Baldwin, 1999; Barclay et al., 2014; Beans et al., 2018; Manderson and Hoban, 2008). The authors in seven studies identified that hiring local Indigenous Peoples as community researchers or research assistants were critical to the success of KT efforts (Allen et al., 2006; Baldwin, 1999; Banks, 2003; Barclay et al., 2014; Bisset et al., 2004; Jernigan et al., 2015; Smylie et al., 2006a, b). Hiring local researchers offered effective ways to reach community members who could relate to the local researchers' lived experiences (Banks, 2003), build skills and capacity for the "non-members" and for the local researchers (Barclay et al., 2014; Jernigan et al., 2015; Smylie et al., 2006a, b), and advise outside researchers on how information can reach the community (Allen et al., 2006; Baldwin, 1999; Bisset et al., 2004). Twenty-three studies attributed KT effectiveness to the involvement and leadership of local Indigenous community members in facilitating KT initiatives or creating KT materials (Allen et al., 2006; Baldwin, 1999; Barclay et al., 2014; Bisset et al., 2004; Carry et al., 2011; Castleden, 2008; Counil et al., 2012; Dickson, 2000; Dieter et al., 2018; Edge and McCallum, 2006; Esler, 2008; Hopkins, 2012; Jacklin and Kinoshameg, 2008; Jernigan, 2010; Jernigan et al., 2015; Lee et al., 2008; Legaspi and Orr, 2007;

Manderson and Hoban, 2008; Rivkin et al., 2013; Santhanam et al., 2006; Smylie et al., 2006a, b; Stefanich et al., 2005; Venner et al., 2007). In six studies, knowledge sharing networks were created to include people in decision and policy making positions within organizations, communities, and institutions. These knowledge sharing networks assisted to facilitate the ease of knowledge and information sharing that would benefit the Indigenous community(ies) (Avey et al., 2018; Bailie et al., 2013; Edge and McCallum, 2006; Elias and O'Neil, 2006; Salsberg et al., 2007; Smylie et al., 2006a, b). In a study about Indigenous women's access to care related to cervical cancer, Manderson (2008) explained how identifying and planning KT goals at the outset of the project was instrumental in creating "a vehicle for [their own] advocacy, resulting in important and program changes" (Manderson and Hoban, 2008).

3.4.2. *KT materials, tools, and mechanisms*

Using multimedia to translate knowledges from the study allowed for information to be shared across time and space as well as include a lot of visual and/or oral components. Multimedia tools such as DVDs, online videos, and television offered people various ways to engage with knowledges that could be self-guided, incorporated into trainings and programs, viewed multiple times, and occasionally, produced in a local language/dialect and English. Ten studies created and used KT products that had visual and oral components (Allen et al., 2006; Bisset et al., 2004; Brown et al., 2002; Carry et al., 2011; Castleden, 2008; Counil et al., 2012; Lee et al., 2008; Pufall et al., 2011; Smylie et al., 2006a, b; Stefanich et al., 2005). Although community events cannot be experienced across time and space, four studies reported that holding open community events were highly effective at sharing, discussing, and facilitating change (Alvarez et al., 2016; Avey et al., 2018; Brown et al., 2002; Counil et al., 2012). Generally, the community events were largely planned, facilitated, and led by local researchers or research assistants.

3.4.3. *Communicating intentions and culturally relevant knowledges*

The effectiveness of KT communication highly depended on *what* was said and *how* it was said. Clear messaging and clarity around the intentions of the study and KT were deemed very important (Bisset et al., 2004; Dieter et al., 2018; Garwick and Auger, 2003; Jacklin and Kinoshameg, 2008; Jardine and Furgal, 2010; Legaspi and Orr, 2007; Manderson and Hoban, 2008; Rivkin et al., 2013). Similarly, in order to have clear communication and intentions, it was important that the messaging reflected the local and relevant values, practices, and strengths (Dieter et al., 2018; Rawson, 2016; Rivkin et al., 2013; Smylie et al., 2006a, b; Stefanich et al., 2005).

3.4.4. *Following Indigenous research principles and practices*

While many of the studies referenced and followed community participatory research principles and practices, several of the studies reported that it was the overall research approach that made the KT efforts successful. Several studies referenced following the ownership, control, access, and possession (OCAP®) principles (Dieter et al., 2018; First Nations Information Governance Centre, 2014) or varied tenets of participatory action research (PAR) (Jacklin and Kinoshameg, 2008; Ornelas, 1997; Santhanam et al., 2006) and community-based participatory research (Israel et al., 2003; Jernigan, 2010; Manderson and Hoban, 2008; Rasmus, 2014). As part of following community and Indigenous research principles and practices, the included papers highlighted that KT was successful in part due to a) maintaining consistent research team members throughout the study (Bisset et al., 2004); b) building collaborative and good working relationships within the community that adhered to locally-specific protocols and practices (Baldwin, 1999; Bisset et al., 2004; Dieter et al., 2018; Elias and O'Neil, 2006; Jacklin and Kinoshameg, 2008; Jardine and Furgal, 2010; Laycock et al., 2019; Legaspi and Orr, 2007; Manderson and Hoban, 2008; Rasmus, 2014; Salsberg et al., 2007); and c) ensuring non-local

researchers learned about the community, its history, culture, and activities and well as prioritized building relationships with community members (Bisset et al., 2004; Legaspi and Orr, 2007).

3.4.5. *Organizational change and sustainability*

In one study, the success of KT efforts were to generate research findings useful for health planners, directors, and providers that serve in and with First Nations communities in Manitoba. This was partially attributed to having Indigenous health organizations incorporating research into their mandate (Elias and O'Neil, 2006). Six studies highlighted ways that culturally-specific practices and knowledges, including language, were embedded and sustainably increased within organizations (Barclay et al., 2014; Baydala et al., 2014; Castleden, 2008; Rivkin et al., 2013; Stefanich et al., 2005; Venner et al., 2007). For example, an existing school-based substance use prevention program in a First Nations community was successfully adapted to draw on Indigenous and Euro-Western worldviews, and resulting in positive health outcomes for Aboriginal people (Baydala et al., 2014). Several studies reported that the KT was effective because of the attention in supporting and/or developing sustainable programs, services, and resources (Bisset et al., 2004; Garwick and Auger, 2003; Jernigan et al., 2015; Rasmus, 2014; Rivkin et al., 2013; Smylie et al., 2006a, b).

3.4.6. *Developmental evaluations and KT evaluations*

Studies that included developmental evaluations in their studies, providing iterative feedback to the research team and community members, proved to be helpful in planning and implementing KT initiatives (Baldwin, 1999; Bisset et al., 2004; Garwick and Auger, 2003; Heffernan et al., 2015; Laycock et al., 2019; Smylie et al., 2006a, b). In a study that resulted in developing interactive KT videos featuring prenatal teachings by an Inuit Elder in Inuktitut for prenatal education purposes, the video was evaluated to identify peoples' interest and value of the resource (McShane et al., 2013). In another study, developmental evaluation was used to engage stakeholders to ensure that the KT efforts would be achieving the multi-level improvements in the primary health systems Indigenous Peoples (Laycock et al., 2019).

3.5. *Impact on health and wellness outcomes*

This systematic review was focused on KT efforts that demonstrated positive health and wellness outcomes for the Indigenous Peoples that the studies were intended to benefit. The range of health and wellness outcomes were as broad as the studies themselves and were thematically organized as follows 1) increase or change in knowledges and awareness by community members; 2) change in behaviours or actions; 3) changes in health care practices; 4) sustainable new programs; and 5) increased self-determination and self-governance.

The increased knowledges or change in knowledges by community members were specific to the study topic, such as tuberculosis testing (Alvarez et al., 2016), nutritional content of store-bought foods (Counil et al., 2012), asthma (Douglas et al., 2013), Māori-specific terms and definitions of "good health" (Rawson, 2016), harmful effects of environmental contaminants (Anticono et al., 2013), and pharmacogenetics (Beans et al., 2018) among others (Baldwin, 1999; Baydala et al., 2014; Carry et al., 2011; Edge and McCallum, 2006; Farrin et al., 2004; Manderson and Hoban, 2008). Behaviours and actions that were impacted by KT increased tuberculosis testing (Alvarez et al., 2016), increased breastfeeding (Banks, 2003), decreased use of alcohol and substance use among youth (Baydala et al., 2014), led to changes in diet (Counil et al., 2012), and increased pre- and post-natal care (McCallum et al., 2015).

Changes in the health care field were highlighted in seven studies. Studies led to the use of motivational interviewing (Venner et al., 2007) and trauma-informed care practices (Avey et al., 2018); improved alcohol-specific services (Brown et al., 2002) and depression screening, policies, and related practices (Esler, 2008); increased practitioner

training and hiring of Indigenous staff to provide women's cancer screening (Manderson and Hoban, 2008); improved collaboration between health practitioners, Indigenous health workers, and families in the community (McCalman et al., 2015); and the scaling up of quality improvement practices within Indigenous primary health services (Baillie et al., 2013).

Two studies indicated that the KT resulted in sustainable programs and approaches. One study implemented a sustainable intervention focused on reducing suicide and substance use by creating intergenerational, conflict resolution, and Elder involved processes (Rasmus, 2014). Another study implemented a sustainable healthcare model to provide pregnant women in rural communities with more culturally safe care with midwives and Indigenous healthcare workers (Barclay et al., 2014). Two studies indicated that the KT increased self-determination and self-governance by improving the data collection within an Indigenous child and youth mental health service (Santhanam et al., 2006) and Indigenous primary health care contexts (Laycock et al., 2019).

3.6. Recommendations and lessons learned

Many of the authors identified recommendations for KT in Indigenous health research, from a combination of successes and lessons learned from challenges or failures during the study. Thematically, they are organized into six broad categories: 1) Indigenous involvement in research; 2) non-Indigenous involvement in research; 3) research methodologies and approaches; 4) documentation of KT successes and lessons learned; 5) responsibilities to Indigenous communities involved in research; and 6) communication and planning of KT.

All studies included in this systematic review involved Indigenous Peoples in meaningful ways for parts or all of the study (Aboriginal Ethics Working Group, 2010; Jull et al., 2019). Baldwin (1999) recommended that the number of Indigenous principal investigators, advisors, reviewers, advocates, mentors, and trainees needs to be increased to better serve Indigenous communities. Jardine and Furgal (2010) highlighted that hiring local Indigenous researchers is crucial to holding outside researchers accountable for erroneous interpretations of research. McCalman et al. (2015) suggested that if communities know what they want or expect from KT, communities can assert what they require of researchers in advance of the project being conducted. In addition to supporting KT events and resources in the Indigenous community(ies), Salsberg et al. (2007) indicated the importance of ensuring Indigenous community members have opportunities to benefit from attending conferences, meetings, and network events that are often attended by researchers.

Authors of two papers asserted that non-Indigenous researchers and institutions are responsible for learning about the Indigenous communities they are working with before and during the study (Blodgett et al., 2011; Dieter et al., 2018). This should include the local context and history. Furthermore, non-Indigenous peoples involved in research must be trained and educated in the area of cultural humility (Dieter et al., 2018; Jernigan et al., 2015). Cultural humility is a concept and trait that reflects one's ability to view themselves with a sense of humility about being able to understand another person's cultural understandings and experiences (Northern Health: Indigenous Health, 2016). Jacklin and Kinoshameg (2008) suggested that non-Indigenous researchers and institutions, including academic journals, demonstrate the legitimacy of findings by clearly documenting the foundation and validation of their research methods by allowing an appropriate word count in published journals.

Research approaches and methodologies impact the appropriateness and impact of KT efforts. Several authors offered specific recommendations. This includes budgeting time and funding to plan and develop trust with communities before a study is conducted (Abonyi and Jeffery, 2006), ensuring KT is central to studies for sustainability and capacity building (Elias and O'Neil, 2006), incorporating reflective and iterative research cycles (Esler, 2008; Laycock et al., 2019), and adopting diverse

and multi-dimensional evaluation methods that work for Indigenous communities (Santhanam et al., 2006). Several authors identified a need for longer funding periods to allow for projects to be completed in an appropriate way that can be vetted by communities, often requiring processes that may slow down or speed up, depending on community needs (Legaspi and Orr, 2007; Rivkin et al., 2013; Smylie et al., 2006a, b). Further, geographical distance between research team members and Indigenous communities should be considered. When there are substantial distances for example, considerations must be made for how KT is evaluated and depending on the people from outside of the community, as this process may be resource intensive, including time and financial costs (Alvarez et al., 2016). In one study, the authors identified that non-Indigenous researchers involved in participatory action research with Indigenous communities can find themselves having to advocate, as part of the KT efforts, with or for the community to industry, governments, or other organizations (Anticono et al., 2013). Authors of two studies articulated that when prioritizing culturally safe and Indigenous informed research, Euro-Western-informed research methodologies may be replaced or changed. However, that does not compromise the methodological rigour and should not be purported to be less rigorous, and can actually be more robust, valid, reliable and appropriate (Dieter et al., 2018; Heffernan et al., 2015).

The need to archive community experiences of research (Blodgett et al., 2011a, b) as well as document and report on the success and challenges of KT planning, development, actions, and outcomes was recognized (Jardine and Furgal, 2010; Laycock et al., 2019). Several authors highlighted the importance of reciprocity, giving back to community by responding to community-articulated needs, identifying funding sources that meet community needs based on study findings, linking community with existing resources, and helping relay messages to appropriate policy and decision makers (Dieter et al., 2018; Garwick and Auger, 2003). Lastly, authors of included studies identified that culturally important symbols must be used with caution (Bradford and Bharadwaj, 2015); when presenting knowledges from studies, research team members must discuss and anticipate probable questions and reactions to the research messages and information (Anticono et al., 2013); and there is merit to inviting external (to the project) experts to critique KT tools and materials before they are finalized (Venner et al., 2007).

4. Discussion

4.1. Indigenous science and KT methods

Indigenous Peoples have a rich history of evidence-based research and science (Smith, 2012; Smith et al., 2018). However, the education system has played a strong role in colonization, attempting to separate and minimize Indigenous Peoples (Government of Canada, 1996; Truth and Reconciliation Commission of Canada, 2015a, b). Science, as a discipline is based on careful observations, trials and errors, and testing. Indigenous Peoples have thrived and have advanced knowledges in areas that modern science is still catching up to, and yet, Indigenous sciences, knowledges, and knowledge systems have not been recognized as scientific by non-Indigenous institutions and many non-Indigenous researchers (Battiste et al., 2002). Non-Indigenous institutions have dominated and written forms of documented knowledges, established research methods and methodological rigour standards that must be met to grant educational degrees, receive research grant funding, and publish academic papers. Academic institutions have historically, and presently, served as tools of colonization that predominantly privilege peoples, curriculum, and pedagogies that conform to colonial ways of thinking and performing (Battiste et al., 2002).

Evaluated KT methods in our systematic review often included a) combinations of imagery, that is photographs or images, with text; b) audio and visual components; and/or c) teachings or story telling by Elders and Knowledge Guardians. Including audio and visual

components highlights the importance and value of using KT methods beyond common Euro-Western academic forms of KT, such as text-heavy and jargon-filled reports, presentations, and papers. Research in social science and humanities disciplines such as history, sociology, education, and social work have advanced Indigenous KT work in forms such as theatre, dance, storytelling, and artwork. As the commitment to, and range of Indigenous KT in research continues, there are ways in which Indigenous communities and researchers alike may consider integrating more accessible communication mediums. Considering that Indigenous Peoples would not have survived without effective KT and transmission practices for time immemorial, Indigenous KT methods must be considered, recognised and celebrated, including in research contexts.

If research is intended to be *with* and *for* Indigenous communities, consistent with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (The United Nations General Assembly, 2007), ethical research guidelines outline that research must be conducted in a way that the community has control over, the rights to, and the final say as how research findings are shared. In reality, there are rarely any accountability measures or structures in place for researchers to adhere to such guidelines or for Indigenous communities to assert their rights without incurring a lot of their own time and resources. At the time of writing this paper, the *Canadian Journal of Public Health* implemented a policy that requires all authors who submit a manuscript that focuses on Indigenous Peoples or populations to clearly identify how relevant Indigenous Peoples or populations were involved in the study and the preparation of the manuscript (Canada Public Health Association, 2020; Marsden et al., 2020). Implementing such policies in the publication sphere of KT creates space for Indigenous Peoples to assert their rights as to how their data and knowledges are represented in the literature while raising the conscienceness of researchers who do not prioritize or understand Indigenous Peoples rights. Indigenous Peoples involved in research have every right to access, engage, and understand knowledges that are revealed and as such, information must be shared in a way that can be understood. This includes but is not limited to visual imagery, local Indigenous cultural references and worldviews, local languages, and cultural practices such as sharing circles and oral teachings (Blodgett et al., 2011a, b; Gifford et al., 2021; Kaplan-Myrth and Smylie, 2006; Morton Ninomiya, 2017; Smylie et al., 2006a, b; Tobias and Richmond, 2016).

4.2. Indigenous KT is alive and thriving, though masked and missing in published literature

From Indigenous “inside” perspectives, Indigenous knowledges and KT are alive and well (Big-Canoe and Richmond, 2014; Mikraszewicz and Richmond, 2019; Radu et al., 2014; Smylie, 2011). For example, during the COVID-19 pandemic, leaders in a First Nation community in Ontario reviewed and discussed the risks and needs of community members and decided to limit the number of trips households could make outside of the community while also restricting non-members from visiting the community. One of the initiatives that was immediately implemented was a coloured-paper-in-the-window system for elderly members and members without transportation means to indicate if they needed groceries, medication, or a visit (George, 2020). Community members driving by a home with a coloured paper in the window were responsible for checking in and responding to the household’s needs.

Discussions and debates about how diverse Indigenous knowledges are passed on, revitalized, preserved, and ever-changing are ongoing. There is concern for how Indigenous KT links the past with the present and future, connects health to all living things in the environment, and represents contextually relevant identities and culture among other things (Jack et al., 2010; Parks Canada, 2015; Roy and Campbell, 2015). A revitalization of Indigenous knowledges, knowledge systems, cultures, values, and rights are evident when historical and highly publicized events occur, such as the 2015 Truth and Reconciliation Commission’s

Report (Truth and Reconciliation Commission of Canada, 2015a, b) with 94 Calls to Action (Truth and Reconciliation Commission of Canada, 2015a, b) applicable to all major institutions, organizations, and populations across Canada.

While Indigenous knowledges and KT are thriving, they are largely excluded and absent in published literature, educational curriculum, popular culture, media and social media, and in governments which are dominated by Euro-Western and colonial ways of knowing, being, and doing (Allan and Smylie, 2015; Battiste et al., 2002; Shultz et al., 2009; Smith, 2012). In the context of disseminating research findings through publications, it is clear that there are publication biases that limit who and how research includes Indigenous knowledges. Published literature rarely reflects how KT practices are – or must be – decided, implemented, and belong within the Indigenous communities involved in the research. When research papers are written in and for academic contexts, and when the (co-)authors are from outside the Indigenous communities, the language used to describe the research is inherently biased. For example, in papers that stated that sharing and discussing research findings at a feast or community event as a form of KT did not see or mention how effective KT is made possible through kinship and social networks, as well as the associated community protocols. Foundational or key constructs of Indigenous knowledge systems that make Indigenous KT effective are frequently missing in published and grey literature.

We found in our systematic review that authors of included studies did not necessarily self-identify as being Indigenous or non-Indigenous, or their connection to the community. When authors identify their lived experience and connection to the Indigenous community(ies) in the respective papers, it can demonstrate cultural humility and provide insight to the lens in which the research is being undertaken. Further, by disclosing and locating who the authors are, in relation to the context that they are writing, the authors are acknowledging potential biases, limitations and providing accountability mechanisms. Similarly, we suggest that writing about Indigenous health research requires clearly acknowledging community and community leaders who informed and made valuable contributions as rightsholders. In a paper by Waa et al. (2020), the authors identified themselves by their Indigenous identity and affiliation, in addition to their institutional affiliation to explicitly recognize and transparently highlight their identity upfront in the paper.

4.3. Indigenous research KT is part of Indigenous research methodologies and ethics

Studies included in our systematic review that scored high on the Well Living House quality appraisal tool generally conducted community-based participatory research or Indigenous community-partnered methods, used an integrated KT approach, and articulated how they followed culturally-specific research principles. In other words, studies that scored high indicated that Indigenous community members determined, led, and/or governed how the research and KT was embedded, conducted, analyzed, and shared from the beginning to the end of the study. The same high scoring papers also described and demonstrated how the research was led, governed, and staffed by people within the Indigenous community(ies) or people that the community (ies) chose to involve.

Training and teaching in Indigenous health and wellness, research ethics, methodologies, and worldviews is not mandatory or standard part of introductory or advanced research methods courses or training at many universities, colleges, and research institutions (Battiste et al., 2002; Bull, 2019). Even after a project is funded, research ethics boards that review proposals prior to conducting research have limited Indigenous reviewers, or reviewers that are familiar with Indigenous research ethics values and principles (Bull et al., 2019). Our findings demonstrate how dominant pedagogy and research processes within our teaching and training institutions can silence or block meaningful Indigenous research KT from taking place. Our review includes limited examples of

effective Indigenous KT, partly due to the inherent biases of who facilitates, funds, writes and publishes Indigenous health research.

4.4. Few studies evaluate KT

Our review revealed that KT is rarely evaluated using a concerted, Indigenous-led, clear, or rigorous methodology. Included papers that detailed the impetus, process, method, and outcomes of KT initiatives – as evaluated KT through observational methods – because without including such papers, there would have been very few papers to include and draw on for meaningful results. KT in any research context is not commonly evaluated in part because it is not required in funding applications. Researchers and research partners are rarely prompted or encouraged to evaluate the process or outcome of KT efforts, and it is rarely funded. Many health funding calls require grant applicants to articulate how their proposed research will be applied and used to implement change. However, few grants or budgets expect research teams to evaluate how the research findings or process improve health and wellbeing. One of the early conversations in many Indigenous health research projects, or in the conceptualization and development of a research project, is about how the research will benefit the Indigenous community(ies) involved (Brands and Gooda, 2006; Kristen and Kinoshameg, 2008; Jull et al., 2019). However, there is rarely funding available to show how the project, through KT, benefited the Indigenous community(ies) as deemed by the Indigenous community(ies) themselves (Kinchin et al., 2017; Smylie, 2011).

We assert that Indigenous health research KT must be designed and evaluated *in context*, where the KT is taking place. Indigenous scholars and authors of this paper are concerned with *how* KT in health research is attending to and revitalizing transmission of knowledges and practices, including intergenerational transmission – including language and culture – which are critical to Indigenous Peoples' identity, health, wellbeing, rights and ways of knowledging, being and doing. Our review demonstrates that when KT is planned and implemented in context, the shared knowledges will reflect the local protocols, conditions, history, culture, languages and worldviews of the community. Marlene Brant-Castellano (2016), an influential and respected Indigenous (Mohawk) scholar and Elder stated that “if you create knowledge in true partnership, it does not need translation.” This statement speaks to KT being undertaken in a good way when Indigenous community members, including Elders and knowledge holders, are authentically engaged and informing research knowledges, the translation process is inherent and does not require translating.

4.5. Strengths and limitations

Three key strengths of our systematic review are 1) we used a systematic review processes and involved Indigenous scholars in development and throughout the review; 2) we used an Indigenous critical appraisal tool that prioritized studies that engaged Indigenous communities as critical rights holders, assisting to balance the power dynamic using an ethical wise-practice approach; and 3) we embedded Indigenous knowledge sharing principles and practices by virtue of this review's governance, tool development, and analysis guided by Indigenous team members' knowledge systems and worldviews. One could say that this review itself used an integrated KT approach. Our review was limited by the lack of studies that used a rigorous evaluation method to assess their KT effectiveness. In defining the scope of this research, we included studies that evaluated KT methods or the KT process which limited our ability to compare evaluation methods, KT methods, and KT approaches across all included studies, but excluded implementation science studies as implementation science was outside the scope of this research. This review is limited by the inherent biases that stem from the reality that most health research is written, reviewed, and published by

non-Indigenous scholars and journals in a historically and continuing colonial system. As more Indigenous researchers conduct health research and Indigenous research methodologies are used, wise KT practices in Indigenous health research contexts will be unmasked and become more visible. The Indigenous health research landscape and discussions have shifted since commencing this review. There has been discussion about how our findings would compare with studies that used Indigenous research methodologies that do not explicitly mention or evaluate KT.

5. Conclusion

Our review highlights that even Indigenous health research conducted in collaborative partnership between academic researchers and Indigenous communities rarely evaluates KT with rigour and community-defined measures of success. If KT is intended to benefit Indigenous Peoples and lead to improved health and wellness, it is imperative that a) there be awareness and funding to support the evaluation of how health and wellness was impacted by earlier research (Kinchin et al., 2017); b) we hold researchers, research funders and journals accountable to Indigenous communities; c) Indigenous research ethics, methodologies, and approaches, including KT, be included in research training, and d) that research upholds and follows nation-based Indigenous ways of doing KT. We assert that successes and lessons learned on KT in research be shared in accessible and transparent ways with Indigenous communities and academic researchers.

Our commitment to “walking the talk” of doing KT on KT is multi-fold. We have started to share preliminary findings at conferences attended by people who are involved and invested in Indigenous health research. We will widely share our findings with Indigenous communities, researchers, and research funders. To disseminate our findings, we will engage with multiple rights- and stakeholders who have wide-reaching and relevant networks to identify what types of materials will most effective. At the very least, we will develop summary materials in a variety of mediums that will engage, reach, and have currency in different contexts including short videos, a short summary report with visually engaging content, and a podcast. In addition to conducting KT on KT, we will develop an evaluation framework for KT in Indigenous health research that can be used by Indigenous communities involved or interested in research, researchers, and funders.

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