CAHS Menu of Preferred Indicators and Metrics of Impact - Appropriate indicators and metrics are arranged according to CAHS framework impact category. They should be selected in sets and mapped onto the CAHS framework to address different evaluation questions. They were selected for this menu from over 300 current indicators that were considered by the panelists. The subset of numerical indicators is called 'metrics' of impact. Note: this table contains our "starting menu" of preferred indicators and metrics - we recommend that they should be expanded over time.

ADVANCING KNOWLEDGE					
Category	**Indicator**	**Description**	**Level of Application**	**Comments**	**Pillars that indicators are relevant to**
QUALITY	Relative citation impact	* Average citations received by the unit being analyzed, compared to the world citation rate for the discipline(s) * World citation rates per discipline should be made widely available to interested parties	* Individual - not recommended * Group/department/grant - recommended * Institution/funding agency - recommended * National - recommended	* Must use discipline-specific benchmarks to account for different citation practices across disciplines * Only robust if based on a sufficient set of publications (individual researchers generally produce too few for robust analysis)	All pillars
	Highly cited publications	Individual publications are assessed against world citation thresholds to determine if they are in the top 1%, 10%, etc. of most highly cited publications in the world in that research area	Recommended at all levels	Must use discipline-specific benchmarks to account for different citation practices across disciplines	All pillars
	Publications in high-quality outlets (or desired outlets)	* Proportion of publications (publishers, conferences, journals) that appear in outlets judged to be of high quality * Could also include outlets that target specific stakeholders, such as those used by health practitioners	Recommended at all levels	Activity in a number of countries where disciplines are engaged in ranking the outlets of their discipline, including ranking publishers as well as journals (e.g. ESF Humanities project; Australia ERA journal and publisher rankings)	All pillars, but likely to be more important for pillars III and IV, where a smaller proportion of knowledge production is in journals
ACTIVITY	Share of publications	Number of publications from the unit under study as a proportion of a reference output (usually the level of aggregation above the unit under study)	* Individual - not recommended * Group/department/grant - recommended (share of institutional/funding body output) * Institution/funding agency - recommended (share of national output) * National - recommended (share of world publications)	* Normally done for field of research, rather than total publications * Can currently be easily calculated for indexed journal articles, but not for other types of publications	All pillars
	Publication counts	* Simple counting of outputs * Can be useful for new researchers who have no publication record allowing citation analysis	* Individual - recommended (number of publications by type: journal articles, books, book chapters, conferences, etc.) * Group/department/grant - not recommended * Institution/funding agency - not recommended * National - not recommended	* Counts by themselves are a poor indicator * The data are routinely collected in order to calculate other indicators (e.g. publication share, relative citation impact) * There needs to be a comparative aspect (e.g. is the level of output above or below that expected in that discipline)	This indicator is more important in pillar III and IV where a smaller proportion of knowledge production is in the journal literature. We strongly recommend that this indicator not be used as an indicator of quality in pillars I or II

ADVANCING KNOWLEDGE					
Category	**Indicator**	**Description**	**Level of Application**	**Comments**	**Pillars that indicators are relevant to**
OUTREACH	Co-author analysis	Determining the proportion of publications that are co-authored internationally, nationally, with industry, with other disciplines, etc.	Recommended at all levels	The selection of type of co-authorships to be analyzed will depend on the focus of the analysis	All pillars
	Field analysis of citations	Determining the proportion of citations that come from articles in the same field, and which other fields	Recommended at all levels	Gives an indication of the interdisciplinarity of the research by demonstrating the pick-up of research outside the core discipline	All pillars
CONTEXTUAL / STRUCTURAL	Relative activity index	* Determining the fields of research in which a unit is most strongly focussed * Uses the number of HCPs in each research area to show activity that is highest quality only	* Individual - not recommended * Group/department/grant - not recommended * Institution/funding agency - recommended * National - recommended	The benchmark for assessment will vary according to the research question, e.g. an institution may wish to compare its output to the national distribution, while at the national level the comparison might be to the world distribution or to similar countries	All pillars
ASPIRATIONAL INDICATORS	Expanded relative citation impact	Expanding citation analysis to cover a greater range of publications, including book-to-book citations	Aspirational at all levels except for the individual	There is work going on to try to improve the citation databases to include additional resources such as books, and this could be in place in the near future	Could prove especially important for pillars III and IV where a greater proportion of output is in the non-journal literature
	Relative download rate	Average number of downloads per publication compared to discipline benchmark	Aspirational at all levels except for the individual	* Ideally, downloads should differentiate between audiences, i.e. downloads from academic institutions, government agencies, general public, etc. * An equivalent indicator to highly cited publications for individuals could be “most downloaded”	Could prove especially important for pillars III and IV where a greater proportion of output is in the non-journal literature
	Research diffusion	Based on end-of-grant reports, which should include named individual researchers who should benefit from the research, and a sample of such individuals and their assessments of the actual usefulness of the research results, qualitative assessment of diffusion / uptake of research results	Aspirational at all levels	Requires thorough end-of-grant reports and follow-up	All pillars

CAPACITY BUILDING					
Category	**Indicator**	**Description**	**Level of Application**	**Comments**	**Pillars that indicators are relevant to**
PERSONNEL	Graduated research students in health-related subjects	* Numbers of graduated PhD/MSc/MDs, year on year * Should be able to disaggregate to subjects, gender, etc.	* Not recommended at the individual level * Can be used at institutional level * Most useful provincially or nationally	* As an aspiration we would also like to track the success of training programs in producing outstanding scientists and the progress that all research graduates make * Could be done in part using the Statistics Canada National Graduate Survey	All pillars
	Numbers of research and research-related staff in Canada	* Split into researchers, research assistants, and other staff * Can be disaggregated by province, research sector, etc.	* Not recommended at the individual level * Can be used at institutional level * Most useful provincially or nationally	Data already collected by Statistics Canada	All pillars
FUNDING	Levels of additional research funding	Funding from "external" sources that can be attributed to the capacity built in an organization, institution, or region. Could also include matched funding	Only recommended for funders, provinces, and nationally	Difficult to attribute to research funded by that province/organization, since researchers tend to be funded by multiple funding bodies (risks double counting)	All pillars
INFRASTRUCTURE	Infrastructure grants ($)	The amount in dollars of infrastructure funding pulled in by a research project, group, organization	Only recommended for institutions, organizations, provincially, and nationally	Captures the different aspects of infrastructure (kit, databases, buildings) since they all come from infrastructure grants, but misses out on infrastructure from other sources (e.g. university re-allocation of space, etc.) NOTE: This can be perverse if not aligned with operating money	All pillars
	% of activity grants with infrastructure support	Co-ordination of infrastructure grants with activity grants by identifying which activity grants have received additional infrastructure support to allow the research to occur	Only recommended for institutions, organizations, provincially, and nationally	* Does not account for research that has no new infrastructure costs or ones that are covered by universities * Data collection may be difficult and may have to be through surveying activity grant holders	All pillars
ASPIRATIONAL INDICATORS	Receptor capacity	Ability of those in policy and administrative positions to take research findings on board	Unlikely to be able to link to specific research findings, but could track the development of receptor capacity in Canada	There are surveys available to test receptor capacity, although these tend to be associated with specific training schemes	All pillars, particularly III and IV
	Absorptive capacity	Ability of researchers to take on other research from outside their organization, country, etc. and exploit that knowledge	Could address absorptive capacity for organizations, provinces, or nationally	Most commonly attributed through collaborations (particularly industry - academia collaborations) or R&D funding intensity	All pillars

INFORMING DECISION MAKING						
Category	**Subcategory**	**Indicator**	**Description**	**Level of Application**	**Comments**	**Pillars that indicators are relevant to**
HEALTH RELATED[1]	***Health care***	Use of research in guidelines	Analyzing citations to research in clinical and service guidelines	* Can be applied for individual researchers * More practical at aggregate levels (group/institution/ province/nation)	Allows identification of specific research informing health care and proportion of Canadian research informing health care	Mainly pillars I, II, and III
	Public health	Survey of public health policy makers	Asking public health policy makers what research has been used to inform their policies.	* Unlikely to be useful for individuals * May be useful for groups * Dependent on level of detail provided by policy makers	Surveying may be difficult unless policy makers are incentivized to take part	Likely to be pillars III and IV
	Social care	Use of research in guidelines	Analyzing citations to research in social care service guidelines	* Can be applied for individual researchers * More practical at aggregate levels (group/institution/ province/nation)	Allows identification of specific research informing social care and proportion of Canadian research informing social care	Likely to be pillars II, III, and IV
	Other	Researcher reported use of findings outside health	Example: health research findings could be picked up by transport or employment policy to improve safety or working conditions	* Could be applied to individuals * Better used at institution/funder levels	Since there are many different areas within "other," no single top-down indicator can collect all impacts, however, researchers may not know if their research is used outside their area of research	All pillars
	Health-related education	Research cited in ongoing health professional education materials produced cite research to support new practices	Continuing health professional education materials produced cite research to support new practices	* Can be linked to individuals but likely to be small numbers * More appropriate at group/institution/funder levels * Recommended at provincial and national levels	* There may be issues accessing the references for these materials * Early health professional education covered in "research education"	All pillars
RESEARCH	***Research funding***	Citation analysis of successful funding applications	Identifying cited research in successful funding applications to identify underpinning research informing new research direction	* Can be used for groups and larger aggregations * Not recommended for individuals since number of citations is likely to be small	* Accessing references in successful applications can only be performed by research funders themselves * Data would have to be shared between funders	All pillars
	Research policy	Consulting to policy	Number of consultations to policy makers (from organizational to national policy) by researchers - year-on-year analysis	* Recommended for individuals; can help to identify which individuals are strongly linked into policy circles * Can be aggregated to groups above, but since there is no desired level of consultation is less useful at higher aggregations	* Needs to be addressed through surveying researchers * Top-down approach will miss "un-official" consultation	All pillars
		Requests for research to support policy	Number of requests for research for policy makers; primarily systematic reviews	* Only relevant at a provincial or national scale * Determines the level of interest in research, therefore not something research funders can influence directly	Can be addressed through official requests for research (systematic reviews commissioned) or through researchers' responses to requests	All pillars

[1] Within the four subcategories that represent the different aspects of a broad health system (health care, public health, social care, and other health related systems), there is a three-layer hierarchy of data sources for informing decision making metrics. The top level involves published evidence that identifies research; the middle level, surveying decision makers to identify what has influenced them; and the bottom level, asking researchers to report on how their research has informed decisions. The "most appropriate" indicators identified here are based on the most likely available information for each aspect of health-related decision making (so, if higher levels of information are not readily available, we recommend collecting information at the level below).

INFORMING DECISION MAKING						
Category	**Subcategory**	**Indicator**	**Description**	**Level of Application**	**Comments**	**Pillars that indicators are relevant to**
	Research Education	Research used in curricula for new researchers	Citation of research in textbooks and reading lists for university students in health-related disciplines	* Not recommended for individuals * Most useful at group/institution/funder/ province/national levels	Reliant on accessing lists of textbooks and papers used in teaching, as well as mining citation data from them	All pillars
HEALTH PRODUCTS INDUSTRY	***n/a***	Number of patents licensed	* Counts of licensed patents * Can be benchmarked against previous years or against internationally held patents	* Can be used for individuals * Most useful at group/institution/province and national level where sample sizes are larger	Data already maintained on patents licensed in Canada and reported on by Treasury Board	Likely to be pillars I and II
		Clustering/ co-location	Co-location analysis to show where industry is located in relation to academic centres	Only useful at provincial and national levels	Can provide an overview of where innovation and knowledge transfer is likely to occur	Likely to be pillars I and II
		Consulting to industry	Number of researchers consulted by industry; year-on-year values	* Can be used for individuals to identify those translating to industry * For group/institution/provincial levels can show environments conducive to knowledge translation (KT)	Data can be gathered through company reports or through researchers (as part of expanded CV or end of grant reporting)	Likely to be pillars I and II
		Collaboration with industry	Co-author analysis (bibliometric) of collaboration between industry and academia	* Not recommended for individuals (sample size too small) * Recommended for groups/institutions/ provinces/nationally	Reliant on industry publishing research findings in journals	Likely to be pillars I and II
		Use of research in stage reports by industry	Citation analysis of stage reports in development of products by industry	* Not recommended for individuals (sample size) * Recommended for groups/institutions/ provinces/nationally	Relies on accessing stage reports for industry (should be publicly accessible) and the ability to mine citations from them	Likely to be pillars I and II
GENERAL PUBLIC	***Advocacy groups***	Research cited in advocacy publications	Research mentions in publications (leaflets etc.) produced by advocacy groups, including patient organizations	* Not recommended for individuals (sample size) * Recommended for groups/institutions/ provinces/nationally	Misses other work for advocacy groups that is not cited, but consultations for advocacy can be captured in an expanded CV	All pillars
	Public education	Public lectures given	Number of lectures given to public audiences	Individual levels and above	Data could be collected through an expanded standard CV or through end-of-grant reporting	All pillars
ASPIRATIONAL INDICATORS	***Media***	Media citation analysis	Analyzing mentions of research in newspapers	Recommended at the individual level and aggregations above since media tends to mention individuals	* Potential international database of major national newspapers being developed * Requires individuals to identify research mentions in newspapers on a daily basis	All pillars
	Public policy use	Citations in public policy documents	Analyzing citations to research in public policy documents (grey literature)	* Could be applied at the individual level or above * More useful at the group level and above	The advent of Google Scholar as an analysis tool that can access citations in grey literature may help to analyze research informing policy decisions	All pillars

Indicators and metrics in the above sections of the table have a direct link to research. In the *health impacts* and *broad economic and social impacts* tables below, where links to research findings are much harder to identify, we list the information that is most important to capture to identify changes in health, wealth, well-being, and social circumstances. It is necessary to perform additional studies to determine the link between research and the indicators below.

HEALTH IMPACTS						
Category	**Subcategory**	**Indicator**	**Description**	**Level of Application**	**Comments**	**Pillars that indicators are relevant to**
HEALTH STATUS	***Morbidity to include functional impacts***	Prevalence	Number of cases for a condition in a population (shown as a percentage)	Population level (from subgroups to full population)	Useful to show the impact of a condition on a population	Applicable to all pillars
		Incidence	Number of new cases for a condition per 100,000 population	Population level (from subgroups to full population)	Useful for identifying the new cases of a condition	Applicable to all pillars
	Mortality	PYLL	* Potential Years Life Lost * Number of years of life lost due to premature death (before 75)	Population level (from subgroups to full population)	Already collected across Canada through CIHI and Statistics Canada	Applicable to all pillars
	Quality-adjusted mortality	QALYs	* Quality-adjusted Life Years * Provides a value between 1 (perfect health) and 0 (death) of quality of life for each year lived after an intervention	Can be applied to specific interventions provided that data are collected, and can be used to describe populations	* Useful for linking to research impact since QALYs are linked to interventions (which can be more easily traced to research findings) * At the population level, data source is Canadian Community Health Survey	Applicable to all pillars
		PROMs	* Patient-reported Outcome Measures * Using a standardized questionnaire to determine patient views on quality of care and quality of life pre and post-treatment	Individual patients for clinical practice, but aggregations (e.g. hospital; disease state) for evaluation of research impacts	* Being developed to be more widely used in the UK NHS * Relies on patient reporting of their well-being	Applicable to all pillars
DETERMINANTS OF HEALTH	***Modifiable risk factors***	Example: obesity; alcohol consumption	Measures of prevalence of specific factors; e.g. for obesity, prevalence of BMI>30 for different population groups	* Can be at individual level * More useful for populations or sub-populations	Must be specific for the health problem under investigation	All pillars, but mainly pillar IV
	Social determinants	Example: education levels; social cohesion	Measures must be specific for the determinant; e.g. literacy levels for education	Needs to be by region (as aggregation could lose information)	Linking these social determinants to health research is difficult and requires additional research	All pillars, but mainly pillar IV
	Environmental determinants	Example: air pollution levels	Level of known toxic pollutants in the air (parts per million)	Needs to be by region (as aggregation could lose information)	Dependent on environmental risk factor under study	All pillars, but mainly pillar IV
DETERMINANTS OF HEALTH	***Acceptability***	Example: self-reported patient satisfaction	Surveying patients to identify their experience of the health service	* Could be applied from health care provider level to regional * Not useful beyond regional levels since information would be lost in aggregation	Some self-report surveys are not rigorous data collection tools and should be used with caution	Particularly pillar III
	Accessibility	Example: wait times	Wait times for specific conditions and/or interventions	Useful at provider, region, or population levels	Only applicable to secondary care	Particularly pillar III
		Example: appointment statistics	Time to appointments for different groupings (e.g. socio-economic, gender, ethnicity)	Useful at provider, region, or population levels	Potentially difficult to access disaggregated statistics from physicians	Particularly pillar III
	Appropriateness	Example: adherence to clinical guidelines	Identifying whether practice conforms to the most up-to-date evidence base	* Can be used in audit for individuals * For evaluation it is most useful at provider, region, or national levels	Requires an audit of clinical practice, which needs to be based on a standardized survey	Particularly pillar III
	Competence	Example: civil law suits against the health system	Counts of civil law suits by clinical area over time	Could be used to show data from individuals upwards, depending upon the defendant involved in the suit	Civil law suits only identify the most extreme examples of incompetence, but measures of competence itself are difficult to come by	Particularly pillar III

HEALTH IMPACTS						
Category	**Subcategory**	**Indicator**	**Description**	**Level of Application**	**Comments**	**Pillars that indicators are relevant to**
	Continuity	Self-reported continuity of care	Surveying patients to identify their perception of the continuity of their care	Could be applied for individuals, health care providers, or regions	Self-reported data relies on standardized data collection across Canada	Particularly pillar III
	Effectiveness	Example: re-admission rates	Numbers of re-admissions by condition over a set time period; year-on-year change	Useful at provider, region, or population levels	Can only provide information on conditions that require secondary care	Particularly pillar III
	Efficiency	Actual vs. expected hospital stay	Length of stay for a patient compared to the expected stay for the condition	Not useful for individuals, only for provider, region, or national comparisons	Only provides data on secondary care and cannot take into account individual complications or co-morbidity	Particularly pillar III
		Cost input versus output	* Data on the inputs to health care services and on the different factors identified as outputs (e.g. available beds, emergency admissions, etc.) * Can be fed into a stochastic model to identify efficiency	Provider-level analysis only	Much of the data for any analysis is already collected for health care providers	Particularly pillar III
	Safety	Example: adverse drug effects	Numbers of adverse drug effects; year-on-year change	Provider, provincial, and federal levels	Adverse drug effects are an easily measurable safety issue, and one of the most visible	Particularly pillar III
		Example: hospital-acquired infections	Levels of HAI; year-on-year change	Provider, provincial, and federal levels	HAIs are a very current safety issue and are easy to measure and link to specific policies and research findings	Particularly pillar III

BROAD ECONOMIC AND SOCIAL IMPACTS					
Category	**Indicator**	**Description**	**Level of Application**	**Comments**	**Pillars that indicators are relevant to**
ACTIVITY IMPACTS	Economic rent (Labour rents)	The economic benefit (in $) of employing people in health research rather than in another capacity	* May be applicable at the funder or disease area level * Most useful at a provincial/national level	More comprehensive than simple employment benefits since it accounts for the counterfactual of what individuals would do if they weren't involved in research	All pillars
COMMERCIALIZATION	Licensing returns ($)	Dollars spent on licensing patents held by Canadian organizations/individuals	* Not recommended for individuals * Recommended for groups/ institutions/ provinces/ nationally	Can be linked to specific research findings	All pillars, likely to be emphasis on pillars I and II
	Product sales revenues ($)	Sales revenues of products developed in Canada	* Recommended for provinces and nationally – could be used for specific funders * Not recommended for individuals; groups or institutions	Difficulty in linking to research findings means not useful for assessing research groups	All pillars, likely to be emphasis on pillars I and II
	Valuation of spin-out companies ($)	Using the valuation of portfolios of new spin-out companies and the sales of spin-outs to provide the value to the economy of spin-outs at any given point (annually)	* Recommended for provinces and nationally – could be used for specific funders * Not recommended for individuals; groups or institutions	Accessing valuation of new spin-outs may be difficult but are presumably available through venture capital firms that support the spin-out companies	All pillars, likely to be emphasis on pillars I and II
	Economic rent (Producer rent and spillover effects)	* Producer rent is the economic benefit to a company on top of expected revenues * Spillover effects are the external effects of investing in R&D on groups not invested in (e.g. investment from abroad in private R&D having benefits in Canada)	* Recommended for provinces and nationally – could be used for specific funders * Not recommended for individuals; groups or institutions	Calculating producer rent and spillovers has been performed for health R&D, but requires understanding of economic techniques underpinning analysis	All pillars, likely to be emphasis on pillars I and II
HEALTH BENEFIT	Health benefit in QALYs per health care dollar	Improvement in health measured through QALYs gained and divided by the cost of achieving that health gain	* Not recommended for individuals or groups * Useful for institutions/funders/ provinces/ nationally	QALYs can be monetized (controversial methodology) so a monetary net benefit could be compared to other uses of capital	All pillars
	Health benefit in PROMs per health care dollar	Improvement in health measured through PROMs gained and divided by the cost of achieving that health gain	* Not recommended for individuals or groups * Useful for institutions/funders/ provinces/ nationally	PROMs have not been monetized so this measure can only be compared to other PROMs measures	All pillars
WELL-BEING	Annual report of HRSDC	Human Resources and Social Development Canada (HSRDC) has multiple indicators of well-being that can be used to identify well-being	* National level only as difficult to attribute changes to research findings	* No links to research (health or otherwise) except through the "health" section of the well-being indicators, which are covered in the Health Impacts category * Data already collected and publicly accessible	All pillars, emphasis likely on pillar IV
	Happiness	As measured using established survey techniques for happiness-depression	* Recommended for provinces and nationally * Not recommended for individuals, groups, or institutions	* Self-report happiness scales used by Statistics Canada * Very difficult to make any link to health research findings currently	All pillars
	Level of social isolation	Loneliness scales for measuring social isolation of individuals	* Recommended for provinces and nationally * Not recommended for individuals, groups, or institutions	* Tools exist for measuring * Very difficult to make any link to health research findings currently	All pillars
SOCIAL BENEFITS	Socio-economic status	Identifying socio-economic status of individuals in Canada	* Recommended for provinces and nationally * Not recommended for individuals, groups, or institutions	* Causality of socio-economic status to health outcomes is well known * Not understood if health research can alter socio-economic status * Collected to identify if changes in socio-economic status correlate with research impacts	All pillars, emphasis likely on pillar IV