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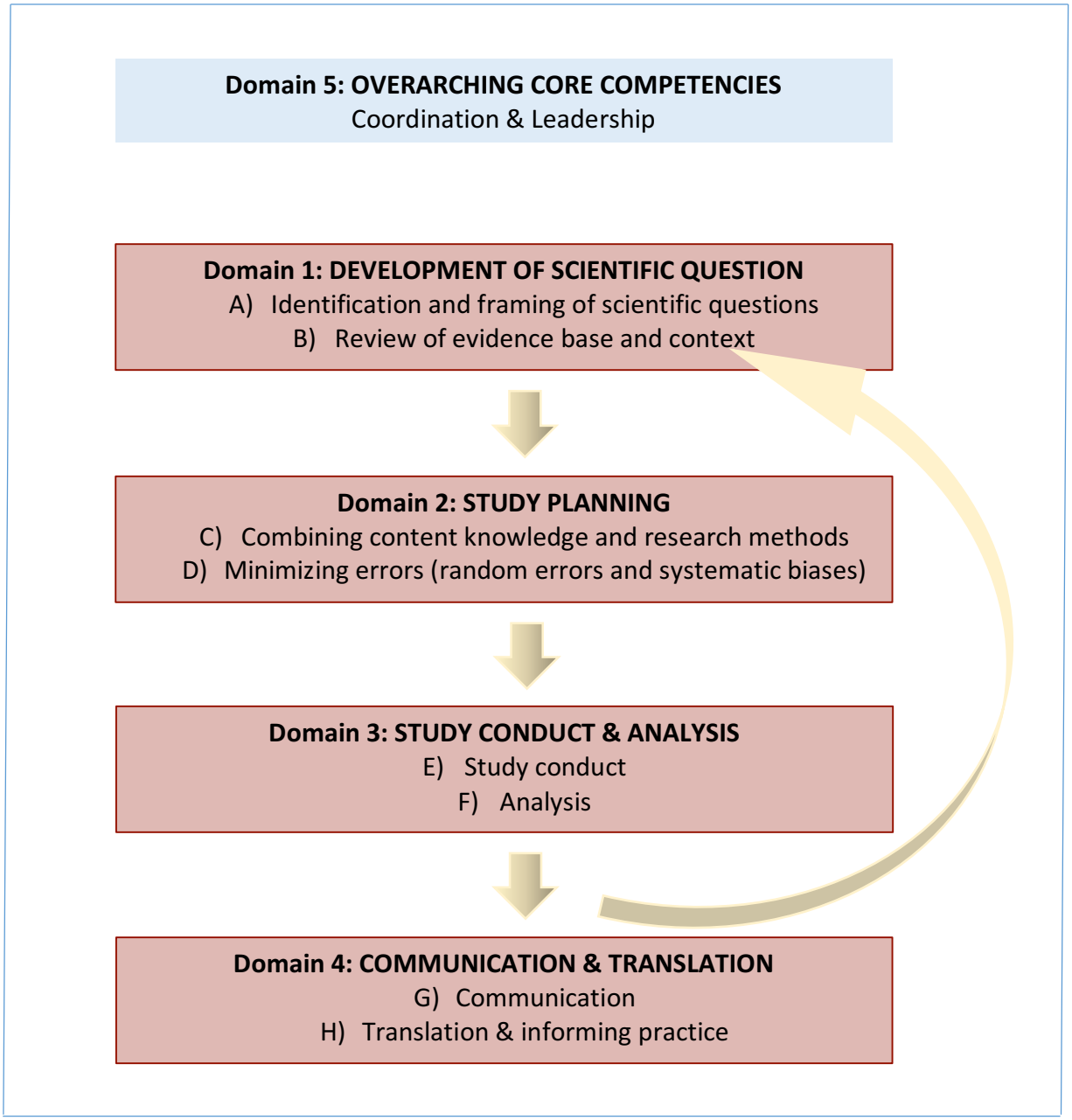
Domains of core competencies of Epidemiologists (over the study life-cycle)



S U M M A R Y

Domain 1: Development of scientific question

A) Identification and framing of scientific question

A1. Competency to engage with stakeholders and the public to identify relevant health needs from their perspective.

A2. Competency to formulate a scientific question and to justify the relevance of the question given the state of the evidence and a specific population health problem.

A3. Competency to define and justify the target population for addressing a given scientific question and to delineate an appropriate source population from which the study population may be sampled or recruited.

B) Review of evidence and context

B1. Competency to plan and conduct a review of the existing, peer-reviewed literature and of other sources in order to describe the current evidence for a specific scientific question.

B2. Competency to systematically appraise the methodological quality of existing research findings for a specific scientific question using appropriate tools and guidelines.

B3. Competency to critically evaluate the suitability, quality, and validity of existing data sources for a specific research question.

B4. Given the existing evidence, competency to describe the need for new research and research to reduce uncertainty, both with respect to the specific scientific question and the methodological approach.

Domain 2: Study planning

C) Combining content knowledge and research methods

C1. Competency to describe the distribution and occurrence of health conditions and associated risk factors, and develop the evidence regarding the population impact of associated risk factors and interventions.

C2. Competency to distinguish between prediction, and a causality framework, and plan a study and analysis accordingly.

C3. Competency to identify emerging technologies or methodologies in other fields and evaluate their utility for a specific study question.

C4. Competency to evaluate the appropriateness of and to plan qualitative and/or quantitative health research methods for a given study context.

D) Minimizing errors (random error and systematic biases)

D1. Competency to anticipate bias (i.e. information bias, selection bias, confounding) when planning a study and to minimize its consequences for inferences through optimal study design and data analysis.

D2. Competency to establish optimal methods for measurement, ascertainment and validation of primary study exposures and outcomes of interest, as well as important confounders and effect modifiers.
D3. Competency to adopt and apply new methods and study designs that may more effectively minimize inferential threats in particular study contexts.

Domain 3: Study conduct & analysis

E) Study conduct

E1. Competency to conduct health research including the set-up, coordination, data collection, monitoring and data quality control.
E2. Competency to responsibly conduct research and to align with all relevant ethical standards and laws.
E3. Competency to collect valid and relevant, high quality data or to compile existing data deemed sufficiently valid for answering a specific research question.
E4. Competency to assess the data quality in newly collected data or existing databases and extract the data deemed sufficiently valid for answering a specific research question.
E5. Competency to design and work with databases.

F) Analysis

F1. Competency to select appropriate statistical methods for a specific scientific question and the available data.
F2. Competency to work with various types of data, taking account of all relevant issues around content, database structure, quality, privacy issues and coding (meta-data).
F3. Competency to calculate and interpret epidemiologic measures of disease occurrence and measures of association and their precision, and explain the importance in various specific decision-making contexts.
F4. Competency to assess the strength of evidence for a causal relationship.
F5. Competency to apply appropriate analytical approaches to make causal inference based on implicit and explicit assumptions.
F6. Competency to employ qualitative and mixed methods in health research.
F7. Competency for appropriate use for a specific diagnostic or prediction model and to develop and validate multivariable prediction models accordingly using internal or external model validation methods.

Domain 4: Communication & Translation

G) Communication

G1.Competency to effectively communicate the results of health research to health care professionals, lay public and various media and thus contribute to debates concerning health and health care.

H) Translation & informing practice

H1. Competency to translate current evidence and knowledge to public health and health care and to appraise and guide health related questions in society from a population perspective.

Domain 5: Overarching core competencies

Coordination & leadership

1. Competency to prepare, obtain and manage successful grant proposals, including all scientific and administrative steps needed for submission.
2. Competency to identify partners from various disciplines necessary to conduct health research, align partners' skills with research tasks, and act as a bridge between wide-ranging health and data disciplines.
3. Competency to recognize when to seek additional expert support.

D E T A I L E D E X P L A N A T I O N S

Domain 1: Development of scientific question

A) Identification and framing of scientific question

Background: A relevant, clearly formulated scientific question is key for health research and the advancement of knowledge. Relevance is determined by the health needs and already existing evidence. Clarity of a scientific question is achieved if each component of the question, for example the population, exposure and outcome of interest, is explicitly defined so that the appropriate methods and the conduct of a study can be deduced accordingly (see Domains Study Planning and Study Conduct & Analysis).
Goal of core competencies of this domain: Epidemiologists need to understand the health needs and know the existing evidence in order to frame a scientific question that fills (some of) the evidence gap. The combination of core competencies in this domain enables Epidemiologists to frame relevant and clearly formulated scientific questions that address a health need.

A1. Competency to engage with stakeholders and the public to identify relevant health needs from their perspective.
Explanations: Stakeholders may be citizens, patients, clinicians or any other group who may have requirement for additional evidence for a decision in health care or public health or a need that may be addressed by health research. A health need may be anything from determining the burden of a disease or of a risk factor, the identification of a cause of a disease, the need for a diagnostic or prognostic test, a preventive or a therapeutic intervention. Health needs may also be related to the access to health care and public health services, their safety, effectiveness and efficiency.
In order to engage with stakeholders, Epidemiologists need to find a common language to understand the stakeholders and their health needs and to discuss what type of information is desired to address the health need. The engagement with stakeholders may be formal or informal, use qualitative and quantitative methods, use platforms for citizen science or any other opportunity to engage with stakeholders. The outcome of such interaction is the identification and understanding of the health need but does not necessarily have to be a framed as a specific research question.

A2. Competency to formulate a scientific question and to justify the relevance of the question given the state of the evidence and a specific population health problem.
Explanations: A scientific question must include a few key components. The extent to which these key components are specified may be briefly described in the PICO format (Patients, Intervention, Comparator, Outcome) commonly used for questions on interventions. A scientific question can also be framed more formally for example, as a regression equation where the specific outcome and its functional form and the coefficients (e.g. exposure of interest, confounders, effect modifiers) are explicitly defined a priori. Whatever approach to formulate a research question is used, the question should be framed in a way that it can be addressed by research (i.e. it needs to be testable) and that the methods can be specified in a research protocol subsequently. Also, it is

important to consider the context and evidence base when formulating a research question in order to make sure the research addresses the health need and narrows an evidence gap.
That is, the relevance of the research question should become evident by laying out and building upon previous research.

A3. Competency to define and justify the target population for addressing a given scientific question and to delineate an appropriate source population from which the study population may be sampled or recruited.
Explanations: The target population is defined as the population for whom the evidence is generated or synthesized and to whom the results should apply. The source population is the population from whom the study population is recruited. The source population should represent the target population with respect to characteristics that have an influence on the results. Moreover, the actual study population needs to be sampled and recruited in a way that it reflects the source population well with respect to factors that influence the results. The reason for this requirement is obvious: If the study population does not represent the source population well, there is uncertainty about applicability of the results to the target population.
Epidemiologists need to be able to define a target and source population and to select and implement the appropriate recruitment strategy for the study population. They need to foresee (when planning the study) and recognize (after obtaining the data) differences between the target, source and study population and select and implement means to minimize selection bias and to maximize the interpretation and applicability of results.

B) Review of evidence and context

Background: Epidemiologists must understand the available evidence for a specific scientific question to define the evidence gap and the information needed to address a health need. Understanding the evidence includes to what extent specific questions were addressed by previous research and what methods were used, but also the recognition of limitations of previous research (e.g. validity of existing studies). The available evidence base is key to define the study question and the methods for a new study.
Goal of core competencies of this domain: To characterize the evidence gap and to formulate the research need to address the gap both in terms of the scientific question and the methods.

B1. Competency to plan and conduct a review of the existing, peer-reviewed literature and of other sources in order to describe the current evidence for a specific scientific question.
Explanations: Planning of a review refers to the definition of a scientific question and writing of a protocol that lays out how the literature is going to be reviewed. The conduct refers to carrying out such a protocol either by doing the review work or by supervising the team that conducts the review. While systematic reviews are the gold standard for reviewing the literature, there are situations where it is more sensible (e.g. given the topic, timeliness and resources) to plan and conduct rapid reviews, scoping review or other structured ways of reviewing the literature. Thus, it is on purpose that this core competence is not focused just on systematic reviews but includes other types of reviews. Epidemiologists do not necessarily need to be experts in systematic reviews but they should acquire the core competency to plan and conduct a review of the evidence in a

structured and reproducible way. In addition, it is important to note that sometimes the scientific literature falls short of providing the necessary evidence base. Reports of public, private and regulatory agencies and specific databases sometimes provide additional evidence that needs review.

B2. Competency to systematically appraise the methodological quality of existing research for a specific scientific question using appropriate tools and guidelines.
Explanations: The critical appraisal refers to the assessment of the methodological quality. For many types of studies, standardized approaches exist to assess their methodological quality (e.g. Cochrane Risk of Bias, QUADAS, PROBAS, ROBIS, ROBINS, etc.). Epidemiologists need to have this competency with respect to specific studies but also the entire set of existing studies that assessed a specific scientific question. The competency includes the informed application of single criteria of a critical appraisal but also the synthesis and conclusion about the methodological quality of existing research for a specific scientific question.

B3. Competency to critically evaluate the suitability and validity of existing data sources for a specific research question.
Explanations: Sometimes, it is more efficient to pursue a specific scientific question based on existing data rather than collecting new data. Under such circumstances, it is important to identify potential data sources and select the one(s) most appropriate for the specific scientific question. The critical evaluation requires a review of the available variables in order to judge if the necessary outcomes measures, exposures, predictors, diagnostic tests, confounders etc. (depending on the type of scientific question) are available, of the quality with which they were obtained and of the extent of missing data. Also, other criteria such as accessibility of data, internal and external resources to work with and other factors need to be considered. Together with a review of existing evidence (i.e. beyond the reviewed data sources) for the specific scientific question, the critical evaluation of existing data sources should allow one to make a judgement on whether to pursue a specific scientific question based on existing data or to collect new data.

B4. Given the existing evidence, competency to describe the need for further research, both with respect to the specific scientific question and the methodological approach.
Explanations: Research needs can include entirely new scientific questions or address specific components such as the need to address a specific scientific question in a particular population or to include outcomes not sufficiently considered in previous research. Needs in terms of the methodological approach may refer to a specific study design that is needed to strengthen the evidence base or to specific methodological aspects (in terms of planning or analysis) in order to minimize biases of previous studies.

Domain 2: Study planning

C) Combining content knowledge and research methods

Background: Study planning is a critical step in health research to assure a valid and meaningful end product. Even with a well-defined study question and a well-designed analytic plan, a study will fail if the data source and design are poorly planned. Study planning requires foresight with regard to the potential for biases (and associated losses in precision) that can creep into the study through inadequate study recruitment or sampling, or through poor measurements.
Goal of core competencies of this domain: Epidemiologists need to be flexible to new contexts and health trends in order to understand the importance of risk factors and interventions in specific populations, and to appropriately identify high quality data sources to answer relevant scientific questions. An epidemiologist will anticipate biases to which their study may be susceptible and implement preventative strategies including a clever study design and better instruments.

C1. Competency to describe the distribution and occurrence of health conditions and associated risk factors, and judge the evidence regarding the population impact of associated risk factors and interventions.
Explanations: The absolute frequency and relative distribution (burden) of risk factors for a disease in a particular target population of interest is critical knowledge for planning a study that will address a meaningful research question. Rare determinants of disease, even if they are strongly causal, will not have a large impact on population health and will be difficult to study. Along the same lines, highly common determinants of a disease will be similarly challenging to study as there will be few who are unexposed, though they may have a large impact on population health. An epidemiologist must have broad knowledge of determinants of disease, even those not of primary research interest, as they could be important confounders of relationships of interest. The ability to consider determinants of disease in the context of feasible interventions is also an important skill for planning meaningful research.

C2. Competency to distinguish between a prediction and a causality framework, and plan a study and analysis accordingly.
Explanations: Study questions can often be categorized around two distinct goals: etiological investigation and prediction. The former seeks to improve our understanding of causal factors that may be amenable to intervention. The latter seeks to identify vulnerable individuals prior to disease onset or some other outcomes when timely intervention could be of benefit. An epidemiologist should be able to identify the broad goal of a scientific question and place the study in either a causality or a prediction framework. This decision is critical as it bears on later analytic choices and the strategy for validation of results.

C3. Competency to identify emerging technologies or methodologies in other fields and evaluate their utility for a specific study question.
Explanations: An epidemiologist needs to look more broadly at the science literature beyond the narrow scope of epidemiology or even the slightly larger arena of public health research. Many methods now considered common tools in epidemiological research were originally developed in

diverse fields such as ecology, economics and computer science. The ability to extrapolate the utility of a new method or technology to health research is a valuable skill not only for the richness it brings to the field of epidemiology but also as a means to a more sustainable and adaptable career path as health trends and societal priorities shift.
Moreover, Epidemiologists may be called upon to appraise studies conducted with new data collection methods and/or analysis tools. Such an appraisal often includes judgments of the internal and external validity, and it is therefore a crucial skill for Epidemiologists to be able to apply and adapt these concepts to previously unfamiliar methods.

C4. Competency to evaluate the appropriateness of and to plan qualitative and/or quantitative health research methods for a given study context.
Explanations: Quantitative and qualitative methods are complementary strategies for elucidating patterns of health behavior, patient motivations and preferences and other disease relationships. An epidemiologist must be able to perceive when qualitative versus quantitative methods might be better suited to a particular research question, or when preliminary qualitative work is required for instrument development or formulation of more precise study questions.

D) Minimizing error (random error and systematic biases)

Background: In epidemiology, biases refer to threats to internal validity and are commonly grouped into three main categories (selection bias, information/measurement bias, confounding). Many core activities of Epidemiologists concern the prevention of biases.
However, bias definitions vary across research fields (e.g. social sciences, economics) and sometimes even between Epidemiology textbooks. In multidisciplinary settings, it is therefore key to translate back and forth between concepts or to settle on common definitions.
Goal of core competencies of this domain: Epidemiologists should not only acquire a thorough understanding of biases and apply these concepts to different research questions and settings, they should also be able to take preventive actions in study design, conduct, analysis, and interpretation.

D1. Competency to anticipate bias (i.e. information bias, selection bias, confounding) when planning a study and to minimize its consequences for inferences through optimal study design.
Explanations: One of the important contributions that an epidemiologist makes to a study team is through the anticipation of bias. Training in epidemiology should instill in a fundamental understanding of the circumstances that lead to non-exchangeable comparison groups and biased inferences. An epidemiologist should also have the skills and training to identify preventative strategies, many of which involve refinement of the sampling strategy or study design.

D2. Competency to define and implement optimal methods for measurement, ascertainment and validation of primary study exposures, important confounders and outcomes of interest.
Explanations: An important source of study bias arises from measurement error. Measurement error is more broadly referred to as information bias, highlighting the degree to which poor information on variable values such as confounders, participant responses and recall, or event timing can lead to biased inferences. Measurement error can take many complicated forms and

the direction of bias is often hard to predict. An epidemiologist should have broad understanding of measurement error mechanisms and be prepared to implement strategies to minimize measurement error or estimate its impact. The addition of a validation component to a study design is one valuable tool in estimating and correcting for measurement error. However, robust protocols and data checking are also important strategies for minimizing errors.

D3. Competency to adopt and apply new methods and study designs that may more effectively minimize inferential threats in particular study contexts.
Explanations: New study designs, analytic strategies, or data collection technologies are constantly under development. An epidemiologist who continues to use tools learned during early training will be less effective in their work as newer and more effective tools rise to prominence. An epidemiologist must be able to adapt and learn as new study designs are advanced and improvements in methods are developed. Therefore, this competency requires a solid foundation in statistics, as well as a thorough understanding of epidemiological methods and concepts, and/or the ability to effectively interact with experts in these novel methods.

Domain 3: Study conduct & analysis

E) Study conduct

Background: Study conduct is usually the phase of data collection and measurement. This phase entails numerous activities in order to gather the required data in a timely and efficient manner, as well as to control possible biases and to attain the study goals in terms of data quality and size of study population. These activities not only require organizational, managerial, and leadership skills, they also need to be paired with a thorough understanding of epidemiological methods, subject knowledge, as well as of legal and ethical regulations.
Goal of core competencies of this domain: Epidemiologists should be able to contribute to or be responsible for successful study operation and data collection, thereby meeting pre-defined qualitative and quantitative goals through active implementation of epidemiological concepts and proven measures.

E1. Competency to conduct health research including the set-up, coordination, data collection, monitoring and data quality control.
Explanations: Epidemiologists should be able to contribute to successful conduct and operation of health studies within their areas of expertise. This competency emphasizes that a blend of organizational and managerial skills, combined with an in-depth understanding of epidemiological concepts is needed to fulfill these goals. Epidemiologists should ideally bring in their expertise into all study steps and therefore be engaged in the "big picture" (as leader or expert), as well as in specific tasks.

E2. Competency to responsibly conduct research and to align with ethical standards and laws.
Explanations: Health research must comply with regulations and ethical standards. Therefore, knowledge of those rules and their integration in study planning, as well as adherence during study

conduct is essential. It is equally important to recognize, however, when special expert advice is needed, e.g. legal advice or technical expertise regarding IT security.

E3. Competency to collect valid, high quality data or to compile existing data deemed sufficiently valid for answering a specific research question.
Explanations: Most Epidemiologists will be involved in data collection at some time during their career and need to understand the process of establishing protocols to optimize data collection and rigorous quality control procedures. The quality of study data has an impact on any and all subsequent stages of health research. A well-known phrase in study conduct is 'garbage in, garbage out', which highlights the importance of assuring data collection procedures receive careful attention. Data collection may comprise many skills depending upon the scope and size of the study: instrument or survey development and validation for the target population, protocol development for standardizing collection methods and instruments across study sites and staff, development of oversight mechanisms and built in data quality checks, database and data entry system design for inputting and storing study data and staff training to ensure consistency. An epidemiologist may not be skilled in all aspects of data collection but must be familiar with them so that appropriate expertise can be identified.

E4. Competency to assess the data quality in newly collected data or existing databases and extract the data deemed sufficiently valid for answering a specific research question.
Explanations: The ability to assess data quality is a critical skill for an epidemiologist. Data quality goes beyond data entry errors to the underlying constructs of interest. A data element may have no obvious errors but may have been captured with an invalid instrument for the target population or with an assay that has poor reproducibility. Therefore an assessment of data quality must start with the construct of interest for the specific research question and establish that the measurement method was appropriate (accurate and precise within an acceptable tolerance) and the process of data collection yielded an acceptable error rate.

E5. Competency to design and work with databases.
Explanations: It is advisable for most studies to collect and store data in some kind of data capturing or database system to maintain data integrity, to increase data quality, and to ensure data storage in a secure environment and reusable/interoperable format. While in many instances a database will be set up by IT experts, Epidemiologists should be able to contribute to database specifications (e.g. variable and table definitions, table relations) and therefore possess a basic working knowledge of databases and understanding of basic principles.

F) Analysis

Background: Statistical analysis plays an important role in most projects where quantitative data have been collected. Unless experienced statisticians are team members, Epidemiologists often play a key role in data analysis or advise on it. Epidemiologists have a key role in ensuring that a formal statistical analysis plan is written (and, with an eye to transparency, put in to the public domain prior to the start of the analyses whenever possible).

Goal of core competencies of this domain: To be able to use statistics as a powerful tool in data description, exploration, including clever data visualization, bias reducing techniques (e.g. multiple imputation) and inferential methods (often regression analysis).

F1. Competency to select appropriate statistical methods for a specific scientific question and the available data.
Explanations: If an epidemiologist is involved at the design phase of a study, his or her task is to ensure a proper discussion about the consequences of design choices for the statistical analysis and to highlight that certain design choices may be incompatible with a proper analysis. If the epidemiologist gets involved only after the data have been collected, his or her task is to help ensure that a proper analysis will be conducted. This may occasionally involve collection of additional information. In general, Albert Einstein's motto should be kept in mind: "Make everything as simple as possible, but not simpler."

F2. Competency to work with various types of data taking account of all relevant issues around content, database structure, quality, privacy issues and coding (meta-data).
Explanations: As the world moves to the availability of ever increasing amounts of (partly unstructured) (big) data, Epidemiologists should have a working knowledge about approaches for their visualization and more formal analysis, keeping in mind issues of selection (representativeness), quality of collection (validity) and legal issues. These are skills on top of the more classic ones needed for structured data (spread sheets) and relational databases.

F3. Competency to calculate and interpret epidemiologic measures of disease occurrence and their precision, and explain the importance in their specific decision-making context.
Explanations: Epidemiologists should be able to select, calculate, and interpret measures of disease occurrence appropriate for a specific study questions (e.g. incidence measures). They should be able to discuss pros and cons for specific measures (in terms of ease to obtain required data, calculation, or interpretation), as well as be aware of each measure's limitations. Along the same lines, Epidemiologists should also be familiar with corresponding multivariable regression frameworks, their implementation, model diagnostics and interpretation (e.g. Poisson regression), or direct/indirect standardization in order to achieve comparability of measures across different populations.

F4. Competency to assess the strength of evidence for a causal relationship.
Explanations: Epidemiologists should be familiar with different measures for exposure-outcome associations (e.g. odds ratios, risk ratios, etc.), be competent to choose and apply the most appropriate measure for a given study question, and be able to interpret them correctly. In addition, Epidemiologists should be able to judge the validity of such measures and, combined with existing evidence from other studies, appraise the overall evidence for a possible causal relationship between exposure(s) and an outcome, for example based on the Bradford-Hill criteria. This evidence appraisal not only requires statistical expertise but also subject knowledge and the ability to assess the strength of evidence stemming from given study or systematic review (e.g. according to the GRADE criteria). Epidemiologists should be able to justify their appraisal and

derive specific research questions in order to meet further evidence needs to firmly establish causality.

F5. Competency to apply appropriate analytic approaches to make causal inference based on implicit and explicit assumptions.

Explanations: In general, causal inference assumes that confounding (Z is a common cause of X and Y) and selection bias (conditioning on common effect) have been eliminated. There are nowadays a few formal frameworks to approach causal inference in epidemiology and statistics of which the counterfactual (potential outcomes) framework appears the best known. Epidemiologists should familiarize themselves with (at least) this framework. Causal inference should not be confused with the more general concept of statistical inference and the discussions around the use of hypothesis testing, p-values and Bayesian approaches to inference.

F6. Competency to employ qualitative and mixed methods in health research.

Explanations: An informal approach to qualitative research (a field perhaps as wide as statistics) is that one takes the time to ask (groups of) people intelligent questions and carefully listens to their opinions. Qualitative approaches can be useful in engaging stakeholders at the stage identifying health needs, designing appropriate and acceptable interventions, and examining the uptake e.g. of preventive measures. For example, the design of many surveys or psychometric instruments (e.g. quality of life questionnaires) involving questions can be improved by a qualitative approach to see what issues are relevant and to check comprehensibility. In addition, surveys may benefit from a qualitative study afterwards to enhance interpretation of the survey's results.

F7. Competency to define the context of appropriate use for a specific diagnostic or prediction model and to develop and validate multivariable prediction models accordingly using internal or external model validation methods.

Explanations: Multivariable diagnostic and prediction models have many applications in science and health care. There are a number of essential phases in their development, validation and reporting. These models are often confused with 'associational' models that often have no proper focus either on causality or multivariable prediction (or diagnosis).

Unlike for most etiologic studies, validation is an integral part of diagnostic and prediction model development and should ideally also include a thorough test of a new diagnostic or prediction method in routine care (e.g. through impact studies). Validation studies should prevent model overfitting, demonstrate the applicability of models in different populations with differing risk factor distributions, and aid the development of optimal analytical thresholds for risk predictions (i.e. threshold levels for a diagnostic test). Epidemiologists should also be aware of specific biases that are pertinent to diagnostic and prediction studies (e.g. spectrum bias).

Domain 4: Communication & Translation

G) Communication

Background: The work of researchers in epidemiology should not stop after scientific publication. Increasingly, scientists are confronted with the need to explain and justify their work to the public in an understandable language and to discuss implications of their findings. However, science communication requires a delicate balance between simplifying key findings, conveying the strength of evidence, and deriving implications, but without omitting relevant facts.
Moreover, interactions with media are challenging. Media favor short messages that grab attention and disfavor statements that convey uncertainty. However, overly simplistic messages may ultimately be harmful to the scientific community, for example, because an audience can lose trust if (seemingly) contradictory results are publicized.
Goal of core competences of this domain: Epidemiologists should be able engage in science communication of their own and other results and bear (co-)responsibility for correct representation of facts, assessment of the evidence base, and appropriateness of conclusions. At the same time, Epidemiologists should also be able to convey messages that are solid, yet attractive to journalists and informative to the public. Epidemiologists should develop an understanding for the basic rules and mechanisms of different media outlets (print, internet, television).

G1. Competency to effectively communicate the results of health research to health care professionals, lay public and various media and thus contribute to debates concerning health and health care.
Explanations: Key stakeholders are virtually all individuals in society: taxpayers, patients, voters, but also health care professionals and decision makers (e.g. politicians, hospital managers). Each stakeholder group should be addressed through appropriate channels (newspaper, internet, talks) with stakeholder-specific messages, and ideally with inclusion of public relations specialists. This competency also refers to all kinds of media, each of which has different requirements. A possible role of Epidemiologists is not only to communicate their own findings but also to take stance on health-related questions in public debates. This includes a critical assessment of the validity of arguments in light of the existing evidence, as well as bringing new suggestions into debates.

H) Translation & Informing Practice

Background: Often, Epidemiologists are called upon to inform or recommend public health policies. The translation of epidemiological evidence into practice goes well beyond communicating study results. It requires a deeper understanding of political and/or societal mechanisms. Moreover, Epidemiologists should be able to anticipate viewpoints and opinions of different stakeholders and have a basic understanding of what arguments they will be susceptible to.
Goal of core competencies of this domain: Epidemiologists should be able to effectively support the implementation of public health actions in society and politics.

H1. Competency to translate current evidence and knowledge into public health and health care and to appraise and guide health-related questions in society from a population perspective.

Explanations: From knowledge gained in research, Epidemiologists should be able to derive possible recommendations and develop stakeholder specific messages. Moreover, Epidemiologists should be able to effectively interact and collaborate with politicians, citizens and health care professionals in order to move their implementation forward in the political or organizational process. This includes a critical appraisal of the evidence, as well as possible knowledge gaps or the implications for society or patient care. Epidemiologists should be able to critically assess arguments from different stakeholders and contribute to the debate by adding an evidence-based public health perspective. Epidemiologists should further be able to reveal and correct false arguments and "fake news".

Domain 5: Overarching core competencies
Coordination & leadership

Background: One particular challenge of multidisciplinary health research is to bring together researchers and health care professionals from different cultures and backgrounds. Epidemiologists often find themselves in a middle position where they act as translators and facilitators between the different actors (e.g. between statisticians and physicians). This middle role is often not limited to study conduct, but often starts as early as during hypothesis development and grant writing.

Goal of core competencies of this domain: In the fast changing and increasingly connected health research domain, Epidemiologists should be comfortable in interacting with various professions and contribute to aligning research interests and skills towards a shared goal. Epidemiologists should further be able to identify and apply for suitable funding sources for research projects.

1. Competency to prepare, obtain and manage successful grant proposals, including all scientific and administrative steps needed for submission.

Explanations: Epidemiologists should be familiar with the dos and don'ts of funding applications and be able to provide critical methodological and other input in their area of expertise. Moreover, Epidemiologists should also be able to critically appraise and communicate the benefits and implications of the proposed research for the field and patient care and public health at large.

2. Competency to identify partners from various disciplines necessary to conduct health research, align partners' skills with research tasks, and act as a bridge between wide-ranging health and data disciplines.

Explanations: Epidemiologists should strive to build a bridge between different disciplines and professionals, for example by being able to understand and apply the vocabulary of other research disciplines. Epidemiologists should further be able to identify and align skills needed for successful study conduct. Partners may also come from outside the research world. For example, the increasing emphasis on patient involvement in studies (e.g. also within the frameworks of citizen science) requires interactions and communication with laypersons, as well as a sincere effort to align their interests and experiences with the research goals.

3. Competency to recognize when to seek additional expert support.

Explanations: Epidemiologists should, as every professional, be keenly aware of the limits of their expertise. Health research is an immensely wide field and one cannot be a partial expert on even a fraction of approaches. An additional complexity is that other experts (e.g. statisticians) to which one may go for advice often disagree about the best approach. Nevertheless, talking to different experts helps to get more orientation on where (their) science changes into an art. It may in particular be important to approach clinicians of the field and/or patient experts at an early stage in the study as their involvement may influence the study question and they need to be willing to provide data.