Online Ethics Center
FOR ENGINEERING AND SCIENCE

Safety Subject Aid

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Description

A short guide to some key resources and readings on the topic of safety.

Body

Safety involves freedom from danger. The term safety is often used loosely and without particular specification. A home may be thought of as safe for some residents and not others. Similarly, a workplace or other organizational setting may be safe for some employees, etc., and not others. A mountain hike too may be safe for well-equipped climbers and not for those less prepared.

In engineering, a property of a device or process is safe insofar as it limits the risk of accident or harm below some specified acceptable level. Acceptable levels of risk can change over time. Safety innovations can arise from public outrage about an accident such as from a gas leak in a stove or fire in a theater. For something to be judged safe, Mike W. Martin and Roland Schinzinger, authors of a widely used engineering ethics textbook, maintain its risks must be fully known and judged acceptable according to “settled value principles.” (*Ethics in Engineering*: 3rd edition p. 130).

Demonstrating the importance engineers place on safety is its place in the first or “paramountcy” principle in many codes of professional engineering societies, as in the 2007 code of the National Society of Professional Engineers: “I. Fundamental Canons - Engineers, in the fulfillment of their professional duties, shall: 1.Hold paramount the safety, health, and welfare of the public.”

A similar notion of safety informs its definition in the contexts of public and environmental health. Water supplies are safe if they keep levels of toxins and indicator species below certain levels. In the environment more generally, exposures to harmful substances must stay below levels at which they can prove harmful to biological organisms including human beings.

Medical practice and research is another arena in which safety goals and requirements in devices, processes, and drugs have the attention of public, government, and commerce. In the context of research with human subjects, numerous questions about appropriate safety and exposure to risks arise.

In all these contexts, degrees of risk and of acceptability need identification and negotiation. Identifying and quantifying risks, for instance of workplace - including laboratory - accidents, and defining the risk parameters of interest require expertise. Data collection and classification is important, as is the availability of information to interested and affected parties. Analysis of trends in such data may provide a basis for corrective action.

The social priority placed on questions of safety and risk can be seen in the political development of entire agencies devoted to answering elements of these questions. A great many reports from the National Academies of Sciences, Engineering, and Medicine take up safety questions in all the domains mentioned above and others, such as the safety of emerging technologies. Abstracts from a few of these reports

can be found in the Overview below. Yet, the question of “How safe is safe enough?” cannot be resolved through expert determination; it always involves a social negotiation, even when the public has devolved the question to expertise for response.

Material above expanded from Online Ethics Center for Engineering and Science. “Safety.” In "Glossary." Contributed 1/31/2006. Accessed: August 9, 2016. www.onlineethics.org/glossary.aspx

See also “Risk” in OEC Subject Aids.

Subject Overviews

Hollander, Rachelle D. 1997. “The social construction of safety.” In *Technology and Values,* Kristin Shrader-Frechette & Laura Westra (eds.). Rowman & Littlefield 107—114. Abstract available at: http://ethics.iit.edu/eelibrary/node/6559; brief description in editors’ introduction to book in Google books. Accessed August 29, 2016.

> Scholars of technology ought to stress collective responsibility for developing a culture of safety. By exercising due care and feasible control, humans can create safety and set legitimate expectations. Safety is not impervious to human influence.

The National Academies of Sciences, Engineering, and Medicine. 2009. Chapter 9: Laboratory Safety in Research. *On Being a Scientist*. Third Edition. Washington DC: National Academies Press. 28. http://www.nap.edu/read/12192/chapter/9 Accessed August 9, 2016.

> The publication contains a checklist of items that, when reviewed regularly, can help to assure laboratory safety.

The National Academies of Science, Engineering and Medicine. 2002. *Research Ethics in Complex Humanitarian Emergencies: Summary of a Worksho*p. Washington, DC: National Academies Press http://www.onlineethics.org/Resources/34378.aspx. Added February 10, 2016. Accessed August 10, 2016.

> Special ethical issues arise when research is undertaken in settings of conflict and on populations subjected to forced migration. This workshop summary identifies many of these issues, and delineates the many ways in which researchers, research, and research participants may be harmed or made less safe.

Griffin, Julia. 2016. "People want self-driving cars to value passenger safety over pedestrians, study says." PBS Newshour. June 23. http://www.pbs.org/newshour/rundown/people-want-self-driving-cars-to-value-passenger-safety-over-pedestrians-study-says/

> Place a passenger in danger to save a pedestrian or vice versa? A new study argues that how these vehicles respond to such ethical choices could dictate their public safety and widespread adoption by consumers. In particular, a majority of the 2,000 subjects in the study picked autonomous cars that value their lives as passengers over those of pedestrians.

Vallor, Shannon. 2016. On Artificial Intelligence and the Public Good. Markkua Center for Applied Ethics Better Choices. Internet Ethics Blog July 19. Last Accessed December 12, 2016.

> This blog post from Professor Vallor responds to a request for public feedback asking for research suggestions for AI; she lists the ethical dimensions concerning human oversight for AI systems, e.g. driverless cars, lethal robots, diagnostics.

Borenstein, Jason, Joseph Herkert and Keith Miller. 2017. Self-Driving Cars and the Ethical Responsibilities of Design Engineers. *IEEE Technology and Society*. 36:2, June. Access to issue at: http://technologyandsociety.org/technology-and-society-magazine/past-issues-2014-2016/june-2017/

Engineers are usually involved in the design, development and testing of safety-critical systems. In this article, the authors discuss the ethical responsibilities of design engineers (hardware and software) throughout the process of the design, development and testing of self-driving cars.

Policy or Guidance

The National Academies of Science, Engineering and Medicine. 2014. *Safe Science: Promoting a Culture of Safety in Academic Chemical Research.* http://www.onlineethics.org/Resources/34351.aspx Accessed August 9, 2016

The report maintains that a safety culture is crucial for meeting safety goals and results only from organizational commitment to it that goes far beyond rules and expenditures for appropriate equipment and training. Needed ingredients are open exchange of information, a commitment to improvement and learning, and giving operational priority to solving problems rather than assigning fault. Safety must be a priority at all times, not just when it is convenient or doesn't interfere with productivity goals.

The National Academies of Science, Engineering and Medicine. (2014) *Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants.* Washington DC: National Academies Press. http://www.onlineethics.org/Resources/34330.aspx

Chapters five and seven of this report contain information about lessons learned for plant operations and safety regulations and nuclear safety culture. The summary has recommendations for new approaches to promote the ability to formulate ad hoc responses to unanticipated events, for attention to the potential for beyond-design-basis large scale events and impacts, and for development of nuclear safety culture in the U.S.

The National Academies of Science, Engineering and Medicine. 2012. *A Research Strategy for Environmental, Health, and Safety Aspects of Engineered Nanomaterials.* https://www.nap.edu/catalog/13347/a-research-strategy-for-environmental-health-and-safety-aspects-of-engineered-nanomaterials. Added February 3, 2016. Accessed August 9, 2016.

> Engineered nanomaterials (ENMs) pose uncertain risks to human and environmental health and safety. This report summarizes what is known and identifies data gaps on these risks. It identifies the necessary elements in a research agenda on this subject, as well as the tools and approaches needed for research on the potential risks, and concludes with recommendations on implementing the strategy and evaluating its progress.

The National Academies of Science, Engineering and Medicine. 2012. *Ethical and Scientific Issues in Studying the Safety of Approved Drugs.* Washington, DC: National Academies Press. http://www.onlineethics.org/Resources/34243.aspx Added February 9, 2016. Accessed August 10, 2016.

> An estimated 48 percent of the population takes at least one prescription drug in a given month. The discovery of new adverse events in the post-marketing setting is part of the normal natural history of approved drugs, and timely identification and warning about drug risks are central to the mission of the Food and Drug Administration (FDA). This report evaluates the strengths and weaknesses of various approaches to generate evidence about safety questions, and makes recommendations for appropriate followup studies and randomized clinical trials. It provides guidance to the FDA on how it should factor in different kinds of evidence in its regulatory decisions.

Bibliography

Safety, Responsibility, Ethics, and Engineering Bibliography at http://www.onlineethics.org/Resources/Bibliographies/SafetyBib.aspx Added Dec. 9, 2010. Accessed August 9, 2016.

This bibliography contains an annotated list of several articles on safety and on how engineers are expected to address safety.

Engineering and Legal Issues Bibliography at http://www.onlineethics.org/Resources/Bibliographies/LegalIssuesBib.aspx Added August 17, 2010.

This bibliography covers a number of legal issues that arise in engineering. It includes subsections on Animal Subjects, The Bidding Process, Bribery and Extortion, Accessible Design, Environmental Laws, Expert Witnesses, Intellectual Property & Patents, Human Subjects in Research, Product Liability, Public Safety, and Standards.

OEC Bibliographies Concerning Human Subjects Research:

The National Academies of Science, Engineering and Medicine. 2007. Ethical Considerations for Research Involving Prisoners. Washington, DC: National Academies Press. Added Feb. 9, 2016. Accessed August 10, 2016. http://www.onlineethics.org/Resources/34246.aspx

Prisoners face special restrictions and constraints, so they require specific protections when involved in research, particularly in correctional settings. This analysis emphasizes five broad actions to provide prisoners involved in research with critically important protections: expand the definition of 'prisoner'; ensure universally and consistently applied standards of protection; shift from a category-based to a risk-benefit approach to research review; update the ethical framework to include collaborative responsibility; and enhance systematic oversight of research involving prisoners.

The National Academies of Science, Engineering and Medicine. 2004. Intentional Human Dosing Studies for EPA Regulatory Purposes: Scientific and Ethical Issues. Washington, DC: National Academies Press. http://www.onlineethics.org/Resources/34557.aspx Added Feb. 11, 2016. Accessed August 10, 2016.

> This report provides advice to the EPA about whether and when to allow intentional human dosing studies conducted by sources outside the agency (so-called third parties) relating to the risks of a chemical or the conditions under which exposure to it could be judged safe. This report recommends that several strict conditions be met, including the following: The study is necessary and scientifically valid, addressing an important regulatory question that can't be answered with animal or non-dosing human studies. The societal benefits of the study outweigh any anticipated risks to participants and, even when benefits beyond improved regulation exist, the human dosing study is not anticipated to cause lasting harm to study participants. All recognized ethical standards and procedures for protecting the interests of study participants are observed. In addition, EPA should establish a Human Studies Review Board (HSRB) to evaluate all such studies at their beginning and upon completion, if they are carried out with the intent of affecting the agency's policy-making.

The National Academies of Science, Engineering and Medicine. 2004. The Ethical Conduct of Clinical Research Involving Children. Washington, DC: National Academies Press. http://www.onlineethics.org/Resources/34240.aspx Added Feb. 9, 2016. Accessed August 10, 2016.

> This report provides background and makes recommendations regarding (1) the regulation of clinical research involving children; (2) the evaluation of the risks and benefits to children; (3) the use of informed consent; (4) the use of payments related to research participation; (5) the enforcement of regulations on this are of research; and (6) the roles and responsibilities of those involved.

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Bibliography

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OEC Subject Aids

Topics

Lab and Workplace Safety
Product Liability
Public Health and Safety
Research and Practice
Safety

Discipline(s)

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Social and Behavioral Sciences
Computer, Math, and Physical Sciences
Authoring Institution
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