Interventions that facilitate sustainable development by preventing toxic exposure to chemicals: an overview of systematic reviews (Protocol)

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Background

What is sustainable development?

History of sustainable development, including key conferences
The United Nations Conference on the Human Environment (also known as the Stockholm Conference) was an international conference convened under United Nations auspices held in Stockholm, Sweden from June 5-16, 1972. It was the UN's first major conference on international environmental issues, and marked a turning point in the development of international environmental politics.

The need for the integration of economic development, natural resources management and protection and social equity and inclusion was introduced for the first time by the 1987 Brundtland Report – Our Common Future (World Commission on Environment and Development 1987), and it became central in framing the discussions at the 1992 United Nations Conference on Environment and Development also known as the Earth Summit.

In 1992, sustainable development was formally endorsed by the international community at the historic United Nations Conference on Environment and Development (known informally as the Earth Summit) held in Rio de Janeiro, Brazil from 3-14 June. The Earth Summit resulted in the creation of Agenda 21, an ambitious action plan for global sustainable development, and the Rio Declaration, which outlined 27 principles for global sustainability.

The United Nations Commission on Sustainable Development was established by the UN General Assembly in December 1992, as the UN high level political body entrusted with the monitoring and promotion of the implementation of the Rio outcomes, including Agenda 21.

The 2002 World Summit on Sustainable Development advanced the mainstreaming of the three dimensions of sustainable development in development policies at all levels through the adoption of the Johannesburg Plan of Implementation. The conference was held in Johannesburg, South Africa from 26 August to 4 September, 2002.
From 22-26 June 2012, world leaders and participants from government, NGOs, the private sector, and civil society gathered again in Rio de Janeiro for the UN Conference on Sustainable Development (commonly referred to as Rio+20) to advance sustainable development—20 years after the 1992 Earth Summit that resulted in agreement on important principles but insufficient action. The conference resulted in a focused political outcome document – The future we want – which contains clear and practical measures for implementing sustainable development (UN 2012). In Rio, Member States decided to launch a process to develop a set of Sustainable Development Goals, which will build upon the Millennium Development Goals and converge with the post 2015 development agenda.

Definition of sustainable development
The term sustainability comes from the concept of sustainable development defined in the 1987 report Our Common Future by the Brundtland Commission of the United Nations as:

“development which meets the needs of current generations without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development 1987).

Though this definition is ambiguous, as have been all subsequent alternative definitions which scholars have come up with, it is widely accepted and used (Kates et al. 2005). Sustainable development is supported by three pillars—the economic, social, and environmental —where health is both an outcome of, and a precondition for, all three pillars (UN 2012).

An integrated framework for realizing the “future we want for all”
Prior to Rio+20 the UN System Task Team on the Post-2015 UN Development Agenda proposed an integrated framework for realizing the “future we want for all” in the post-2015 UN development agenda (Figure 1) (UN System Task Team 2012). The framework includes the core values of human rights, equality and sustainability and four key dimensions of: (1) inclusive social development; (2) inclusive economic development; (3) environmental sustainability; and (4) peace and security. These four dimensions build on the three pillars of sustainable development. The fourth dimension recognizes peace and security, or “freedom from fear” as an important element in realizing the “future we want for all” (UN System Task Team 2012). There are also four broad areas of “enablers” in the framework, which are indicative of each of the four dimensions, yet understood as supportive to all (UN System Task Team 2012). Policies for these “enablers” should be seen as not just effective towards achieving goals related to one dimension, but rather across all dimensions and are designed to bring coherence among policies at different levels, e.g. national, regional, global (UN System Task Team 2012).

How does toxic exposure to chemicals fit into the integrated framework for sustainable development?
Toxic exposure to chemicals can threaten human health, which is part of the key dimension of “inclusive social development”. It can also impact on the key dimension of “peace & security” through threats to health security as well as to national or international security, e.g. chemical weapons or acts of terrorism, or chemical incidents affecting or displacing large populations or contaminating sources of food and/or water, and/or disturbing trade and tourism. In addition, the manufacture and use of chemicals can have adverse environmental impacts, thus threatening the key dimension of “environmental sustainability”. Further, toxic exposure to chemicals at work has implications for “inclusive economic development”, especially the aspect of this dimension - Ensuring decent work and productive employment. In regards to the enablers, the most relevant is ‘managing disaster risk and improving disaster response’.
Figure 1. An integrated framework for realizing the “future we want for all” in the post-2015 UN development agenda

Toxic exposure to chemicals

Chemical incidents and emergencies
Chemical releases arising from technological incidents, natural disasters, conflicts and terrorism are common. The International Federation of Red Cross and Red Crescent Societies has estimated that between 2000 and 2009, there were nearly 3,200 technological disasters with approximately 100,000 people killed, and more than 1.5 million people affected. Through the International Programme on Chemical Safety (IPCS):

- WHO maintains functions to rapidly detect, verify/assess, alert and respond to chemical events of international public health concern as part of the revised International Health Regulations.
- WHO provides guidance for strengthening the role of public health in chemical incident and emergency prevention, preparedness, detection, alert, response and recovery, particularly for developing countries and those with economies in transition (WHO 2014b).

International Health Regulations (IHR)
Since 15 June 2007, the world has been implementing the International Health Regulations (2005) (WHO 2008), revised from the previous 1969 version. This legally-binding agreement significantly contributes to global public health security by providing a new framework for the coordination of the management
of events that may constitute a public health emergency of international concern, and to improve the capacity of all countries to detect, assess, notify and respond to public health threats. The revised IHR innovate in many ways. First and most importantly, it changes the scope of the IHR to now include any “illness or medical condition, irrespective of origin or source that presents or could present significant harm to humans”. Management of chemical risks and events, among others, are now an agreed component of the core capacities in public health that are critical to protect human health and to guarantee health security. The IHR apply to incidents involving natural, accidental or deliberate release of chemical materials (WHO 2008).

Chemical safety agreements
There are a number of international chemical safety agreements in place that govern various aspects of the importation, use and transboundary movement and disposal of chemicals. These agreements have different levels of ratification and enforcement within the signatory countries, which may influence chemical safety at national and international level. These include: the Rotterdam Convention (Secretariat of the Rotterdam Convention 1998), the Basel Convention (Secretariat of the Basel Convention 1989), the Strategic Approach to International Chemicals Management (SAICM Secretariat 2006), the Stockholm Convention (Secretariat of the Stockholm Convention 2001), the Minamata Convention on Mercury (UNEP 2013), the Chemical Weapons Convention (OPCW 1997), and the International Convention for the Prevention of Pollution from Ships – MARPOL (IMO 1973/78).

Toxic exposure to chemicals in daily life
As well as incidents and emergencies, humans can encounter toxic exposures to chemicals as part of their work, e.g. during industrial processes such as agriculture, mining or manufacturing, and in their daily life. Other sources of toxic exposure include soil, contaminated food and water, and non-food consumer products, e.g. toys, jewelry and decoration items, textiles, or food containers, and consumer chemical products (Pruss-Ustun et al. 2011). Intentional (suicide) and unintentional exposure to pesticides is a particular issue in workers and their families in the agriculture industry, including in migrants (Gunnell et al. 2007, WHO 2004, WHO and International Association for Suicide Prevention 2006).

Linkages between prevention of toxic exposure to chemicals and better public health
The known burden due to chemicals is considerable. In total, 4.9 million deaths (8.3% of total) and 86 million Disability-Adjusted Life Years (DALYs) (5.7% of total) were attributable to environmental exposure and management of selected chemicals in 2004.⁠¹ The largest contributors include indoor smoke from solid fuel use, outdoor air pollution and second-hand smoke, with 2.0, 1.2 and 0.6 million deaths annually. These are followed by occupational particulates, chemicals involved in acute poisonings, and pesticides involved in self-poisonings, with 375,000, 240,000 and 186,000 annual deaths, respectively (Pruss-Ustun et al. 2011). New estimates on the burden of disease of air pollution show that these numbers are higher than thought before, with 7 million deaths annually attributed to ambient and household pollution (WHO 2014a).

¹ The systematic literature review revealed burden of disease estimates for the following chemicals or groups of chemicals: (a) chemicals involved in unintentional acute poisonings, (b) chemicals involved in unintentional occupational poisonings, (c) pesticides involved in self-inflicted injuries, (d) asbestos, (e) occupational lung carcinogens, (f) occupational leukaemogens, (g) occupational particulates, (h) outdoor air pollutants, (i) indoor air pollutants from solid fuel combustion, (j) second-hand smoke, (k) lead, and (l) arsenic in drinking water.
Available information for industrial and agricultural chemicals and acute poisonings only (i.e. without air pollution or arsenic-contaminated drinking-water) amounts to a global burden of disease of at least 1.2 million deaths (25 million DALYs), corresponding to 2.0% of the total deaths and 1.7% of the total burden of disease worldwide (Pruss-Ustun et al. 2011). However, these figures present only a number of chemicals for which data are available; therefore, they are more likely an underestimate of the actual burden. Chemicals with known health effects, such as dioxins, cadmium, mercury or chronic exposure to pesticides could not be included in the burden of disease assessment due to incomplete data and information (Pruss-Ustun et al. 2011).

Focus of this overview – prevention of toxic exposure to chemicals
The focus of this overview will be on policies and interventions to prevent and manage chemical incidents or emergencies of national or international concern, as covered by the IHR 2005 (WHO 2008). It will also include interventions to prevent and manage toxic exposure to industrial and agricultural chemicals (including pesticides) during their production and use, including their use in suicide. These interventions can be at a local, national or international level. It will not include interventions aimed at reducing air pollution in general. Naturally occurring chemicals (e.g. arsenic and fluoride in water, natural toxins) will not be included unless their levels have increased to toxic levels due to industrial or agricultural processes.

The focus of this overview goes beyond the IHR and the concept of global public health security\(^2\) – as defined and perceived by WHO (Aldis 2008, WHO 2007) – because the focus of the series of overviews is on interventions that facilitate sustainable development, a concept that is relevant at all levels: local, national and international. Further, toxic exposure to chemicals is a serious health and sustainable development issue at all levels: local, national and international. Policies and interventions that increase chemical safety could be enablers of sustainable development.

To classify as ‘sustainable’ interventions need to aim (explicitly or implicitly) to positively impact on at least two dimensions of the integrated framework, e.g. peace & security and inclusive social development (which includes health) or environmental sustainability and peace & security (but where impact on health is also measured).

Prevention of toxic exposure to chemicals – some examples of interventions
In the international chemical safety agreements listed previously (see section: ‘Chemical safety agreements’) a range of interventions/actions are suggested that relate to the importation, use and transboundary movement and disposal of chemicals. Types of interventions covered include:

- Information exchange between countries on potentially hazard chemicals (Secretariat of the Rotterdam Convention 1998).
- The reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;
- The restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and
- A regulatory system applying to cases where transboundary movements are permissible (Secretariat of the Basel Convention 1989).

\(^2\) Global public health security is defined as the activities required, both proactive and reactive, to minimize vulnerability to acute public health events that endanger the collective health of populations living across geographical regions and international boundaries (WHO 2007).
The restriction, prohibition and/or elimination of the production and use, as well as the import and export, of listed intentionally produced Persistent Organic Pollutants (POPs) covered by the Stockholm Convention; and

Ensure that stockpiles and wastes consisting of, containing or contaminated with POPs are managed safely and in an environmentally sound manner (Secretariat of the Stockholm Convention 2001).

- Measures to support risk reduction;
- Strengthening knowledge and information;
- Governance: strengthening of institutions, law and policy;
- Enhancing capacity-building;
- Addressing illegal international traffic; and
- Improved general chemicals management practices (SAICM Secretariat 2006).

International Convention for the Prevention of Pollution from Ships (MARPOL), IMO

United Nations Economic Commission for Europe (UNECE) has 5 environmental treaties, all of which are now in force:

- Convention on Long-range Transboundary Air Pollution;
- Convention on Environmental Impact Assessment in a Transboundary Context;
- Convention on the Protection and Use of Transboundary Watercourses and International Lakes;
- Convention on the Transboundary Effects of Industrial Accidents; and

International trade: Food and Agricultural Organization (FAO) - The Codex Alimentarius Commission, established by FAO and WHO in 1963 develops harmonized international food standards, guidelines and codes of practice to protect the health of the consumers and ensure fair practices in the food trade. The Commission also promotes coordination of all food standards, including on type of pesticide that can be used by each type of crop, and the acceptable level of residues; WTO has agreements that recognize countries’ rights to adopt the standards they consider appropriate — for example, for human, animal or plant life or health, for the protection of the environment or to meet other consumer interests.

Some specific interventions:

- USA - Emergency Planning and Community Right-to-Know Act
- EU – Implementation of the Seveso Directive.³

In his systematic review of the effectiveness of interventions to reduce pesticide overexposure and poisonings in worker populations Keifer considered the following interventions:

- pesticide safety training,
- applicator training and licensure,
- field re-entry restrictions,
- use of personal protective equipment,
- use of isolation techniques such as closed tractor cabs,
- pesticide handling (mixing, loading or storage) techniques or procedures, and

bio monitoring programs (Keifer 2000).

To prevent suicide from pesticides, interventions that have been suggested include:
- reduced availability of highly toxic pesticides through national policy and regulation,
- reduce the toxicity of pesticides taken in overdose through changes to their formulation,
- public education campaigns,
- better labelling of products with advice regarding dangers and need for safe-keeping, and
- safer storage (Gunnell and Eddleston 2003, WHO and International Association for Suicide Prevention 2006).

Objectives
The objective of this overview is to answer the following questions using the best available evidence:
1. What are the interventions that promote sustainable development by preventing toxic exposure to chemicals, including pesticides, and have a positive impact on health?
   a. What is their impact on health inequalities?
   b. What evidence is there for their cost-effectiveness?
   c. Which dimensions of the integrated framework are affected by the intervention and how?
2. Given the interdisciplinary and inter-sectorial nature of sustainable development, which sectors should the health sector engage with in order to prevent toxic exposure to chemicals to preserve and promote public health and equity?

Methods
Criteria for considering reviews for inclusion
Publications in English, Spanish or Portuguese and published in the last 15 years (from 1997 to present) will be included.

Types of studies
Systematic reviews of studies of effectiveness, including reviews of randomized controlled trials (individuals or clusters), quasi-randomized controlled trials, controlled before-and-after studies, interrupted time series, and analytic observational studies (cohort, case-control, cross-sectional studies) will be included. A systematic review is characterized by (Higgins and Green 2011):
- a clearly stated set of objectives with pre-defined eligibility criteria for studies;
- an explicit, reproducible methodology;
- a systematic search that attempts to identify all studies that would meet the eligibility criteria;
- an assessment of the validity of the findings of the included studies, for example through the assessment of risk of bias;
- a systematic presentation, and synthesis, of the characteristics and findings of the included studies.

Economic evaluations (cost-effectiveness, cost-utility, and/or cost-benefit) and systematic reviews of economic evaluations will also be included.

Types of participants
Studies of individuals, groups, communities, countries or regions will be included. Both developed and developing countries will be included.
Types of interventions
Interventions include programs, policies, strategies, legislation, regulation, and courses of action aimed at promoting sustainable development by preventing toxic exposure to chemicals. All relevant interventions related to global public health security (as defined by the core public health capacities of the IHR 2005) with measured (or intended) impact on health will be included. The core public health capacities identified in the IHR 2005 (WHO 2008) include surveillance and response:
- Surveillance – detect, assess, notify and report events
- Public health response - capacity to respond promptly and effectively to public health risks and public health emergencies of international concern.

Interventions at the community or national level that are not within the scope of the IHR 2005 will also be included where they concern the prevention of toxic exposure to industrial and agricultural chemicals (e.g. occupational exposure), including their use in suicide. Only population-level prevention interventions will be included (e.g. policy, regulation). Individual-level interventions will be excluded (e.g. local-level education, psychosocial interventions).

Interventions aimed at reducing air pollution in general will not be included. Naturally occurring chemicals (e.g. arsenic and fluoride in water, natural toxins) will not be included unless their levels have increased to toxic levels due to industrial or agricultural processes.

To classify as ‘sustainable’ interventions need to aim (explicitly or implicitly) to positively impact on at least two dimensions of the integrated framework, e.g. environmental sustainability and inclusive social development (which includes health) or environmental sustainability and inclusive economic development (but where impact on health is also measured).

Types of comparisons
Suitable comparisons include:
- No intervention
- Another intervention
- Current practice

Types of outcome measures

Primary outcomes
Health measures at the level of the individual, group, community, country, region, and/or globally, including:
- Disease incidence, prevalence, burden – includes suicide.
- Mortality
- Morbidity
- Health service use
- Health-related costs
- Health-inequalities, including by gender, age, life stage, area of residence, etc.

Measures of chemical incident severity or frequency such as number of chemical incidents, number of individuals affected by the incident.
Measures that show reduced risk of toxic exposure to chemicals.
Search methods for identification of reviews

Sources

Databases
The following sources from 1997 to the present will be searched:

- PubMed (which includes Medline content)
- EMBASE - Excerpta Medica database
- CINAHL - Nursing & Allied Health Literature
- ASSIA - Applied Social Sciences Index and Abstracts
- PsycINFO
- ScienceDirect
- LILACS (http://lilacs.bvsalud.org/en/)
- SciELO - Scientific Electronic Library Online (http://www.scielo.org/php/)
- GreenFILE
- AGRICOLA
- AGRIS (http://agris.fao.org/)

Specialized sources of systematic reviews and syntheses of systematic reviews:

- The Cochrane Library, including the Database of Abstracts of Reviews of Effectiveness (DARE) and the Health Technology Assessment (HTA) database
- The Campbell Library (http://www.campbellcollaboration.org/)
- Health-evidence Canada (http://health-evidence.ca/articles/search)
- Effective Public Health Practice Project (http://www.ephpp.ca/)
- Evidence for Policy and Practice Information and Coordinating Centre (EPPI-Centre) (http://eppi.ioe.ac.uk/cms/Default.aspx?tabid=61)
- 3ie – International Initiative for Impact Evaluation (http://www.3ieimpact.org/)

Specialized sources of economic evaluations:

- EconLit - Economics Literature
- NHS Economic Evaluation Database (NHSEED) database - available through the Cochrane Library

Grey literature / manual search
Some of the selected databases index a combination of published and unpublished studies (for example, doctoral dissertations and conference abstracts) therefore unpublished studies will be partially captured through the electronic search process. In addition key websites will be searched:

- World Health Organization, including WHOLIS (a bibliographic database that contains publications from the World Health Organization http://www.who.int/library/databases/en/) and IRIS (WHO’s Institutional Repository for Information Sharing http://apps.who.int/iris/)
- Google

⁴ This library contains rapid reviews of the evidence on selected topics – the reference list of relevant rapid reviews will be searched for systematic reviews and economic evaluations that meet the inclusion criteria for this ‘overview’.
The reference list of included systematic reviews will also be searched.

**Search strategy**

Databases will be searched using the following keywords (Table 1) – searched for in title and abstract, except where otherwise stated. Keyword areas will be joined using ‘AND’. Searches will be limited to Humans and with a publication date between 1st January 1997 and the present.

Databases will be searched using keyword areas 1, 2 and 4. The search will be extended to keyword area 3 if the number of records found is more than 50. Specialized sources of systematic reviews and economic evaluations will be searched using keyword area 1, 2 and 3, starting with 1 and adding 3 and 2 where the number of results returned is greater than 50.

**Table 1. Keyword areas for searching**

<table>
<thead>
<tr>
<th>Keyword Areas</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chemical emergency or incident; toxic exposure to chemicals, including pesticides</td>
<td>chemic* OR CBRN OR pesticide* OR insecticide* OR rodenticide* OR paraquat or organophosphate* OR organophosphorus OR agrochemical* OR arsenic OR asbestos OR benzene OR cadmium OR dioxin* OR lead OR mercury OR Chemical Hazard Release[MeSH Terms] OR Chemical safety[MeSH Terms]</td>
</tr>
<tr>
<td>2. Interventions</td>
<td>program OR policy OR policies OR strategy OR legislation OR law* OR intervention OR technique OR regulation OR procurement OR incentive OR prevention OR surveillance OR monitor*</td>
</tr>
<tr>
<td>3. Outcomes</td>
<td>disease OR injury OR burden OR incidence OR prevalence OR mortality OR morbidity OR suicid* OR health* OR severity OR frequency OR quality OR risk</td>
</tr>
<tr>
<td>4. Systematic reviews</td>
<td>“systematic review” OR &quot;meta-analysis&quot;</td>
</tr>
</tbody>
</table>

If additional relevant key words are detected during any of the electronic or other searches the electronic search strategies will be modified to incorporate these terms – any changes will be documented.

Searches for economic evaluations will be limited to the databases listed under “Sources of economic evaluations” (above) using keywords from areas 1 and 2. For EconLit, keyword area 1 will be combined (using ‘AND’) with SUBJECT (cost-effectiveness OR cost-utility OR cost-benefit analysis).

Results will be downloaded into the EndNote reference management program and duplicates removed. The search strategy for PubMed can be found in Appendix 1. This will be modified for other databases as appropriate.
Data collection and analysis

Selection of reviews and economic evaluations
Searches will be conducted and screened according to the selection criteria by one review author (MH). The full text of any potentially relevant papers will be retrieved for closer examination. The inclusion criteria will be applied against these papers by two reviewers. All studies which initially appear to meet the inclusion criteria but on inspection of the full text paper do not meet the inclusion criteria will be detailed in a table ‘Characteristics of excluded systematic reviews’ together with reasons for their exclusion. Disagreements regarding eligibility of studies will be resolved via consensus.

The results of the review selection process will be presented in a flow chart using the format suggested in the PRISMA statement (Moher et al. 2009) – Figure 2.

Data extraction
One reviewer will extract all relevant data from included papers and a second reviewer will verify the extracted data. Differences will be resolved by discussion and consensus. Data extracted for each included systematic review will include:

- Objectives
- Inclusion criteria for the systematic review (Participants, Interventions, Comparisons, Outcomes, Study types - PICOS)
- Date of search
- Number of studies included
- Details of the included interventions
- Country of studies
- Sectors involved in each of the interventions studied
- The dimensions of the integrated framework that the individual studies attempted to impact.
- Summary of findings – including impact on health and impact on any of the four dimensions of the integrated framework
- Limitations
- Research gaps
- Impact on human rights

Information cited in the systematic review on factors that influence the effectiveness of the interventions (‘critical success factors’) will also be noted.

Assessment of methodological quality of included reviews
The quality of included systematic reviews will be assessed by two reviewers using AMSTAR: A MeaSurement Tool to Assess Reviews (Shea et al. 2007). AMSTAR assesses the degree to which review methods avoided bias by evaluating the methods against 11 distinct criteria. Each item on AMSTAR is rated as yes (clearly done), no (clearly not done), can’t answer, or not applicable. Disagreements regarding scores will be resolved through discussion and consensus. A review that adequately meets all of the 11 criteria is considered to be a review of the highest quality. For this overview we will consider reviews that achieve scores of between 8 to 11 high quality; scores of 4 to 7 medium quality; and scores of 0 to 3 low quality. The review quality assessment will be used to interpret the results of reviews when synthesized in this overview and in the formulation of conclusions.
Data synthesis
Descriptive summaries about the efficacy of the interventions will be generated.

Results
Among other tables, a matrix showing the connection between the interventions and the four dimensions of the integrated framework will be included:

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Inclusive economic development</th>
<th>Environmental Sustainability</th>
<th>Inclusive Social Development</th>
<th>Peace and Security</th>
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</thead>
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<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Among other sections, there will be a sub-heading for each of the four dimensions of the integrated framework – which will include a description (and quantitative data where available) of the impact of the interventions.
Figure 2. Systematic review selection flow chart
References


WHO and International Association for Suicide Prevention 2006. Safer access to pesticides: community interventions. Geneva: Department of Mental Health and Substance Abuse, World Health Organization.

# Appendix 1 – Detailed search strategy

## PubMed – 18 June 2014

<table>
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<tr>
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</tr>
<tr>
<td>#7</td>
<td>Search #5 AND #6</td>
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</tr>
<tr>
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</tr>
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</tr>
<tr>
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