DOES CONTROL OF ANIMAL INFECTIOUS RISKS OFFER A NEW INTERNATIONAL PERSPECTIVE?

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ASSURING THE SAFETY OF ANIMAL SOURCE PRODUCTS IN DEVELOPING COUNTRIES – THE POTENTIAL OF RISK-BASED APPROACHES

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ABSTRACT
Food-borne disease is a major cause of morbidity and mortality in developing countries. We present two recent case-studies in Africa and Asia piloting risk analysis as a means of assuring food safety in informal markets, where the majority of the poor buy and sell. The qualitative and quantitative risk assessment methods used are described as well as the challenges experienced in obtaining information and generating meaningful results. Risk communication and management issues are considered and we propose integrating social-science based methodologies, such as participatory learning and action, with risk analysis to increase uptake and application.

INTRODUCTION
Risk analysis is the systematic use of available information to identify possible sources of harm, assess their likelihood of occurrence and impact, and implement methods to avoid or reduce them. Originally applied to engineering and actuarial problems, it is now considered best practice for food safety management. As such, risk analysis complements other tools such as Good Manufacturing Practice and HACCP (Hazard Analysis Critical Control Points). Informally marketed food in developing countries is believed to be a major contributor to the overall disease burden and animal-source foods are probably its most important source. However, there have been few applications of risk-based approaches to this problem.

In this paper, we illustrate some fundamental principles of risk-based approaches and compare and contrast these to conventional methods of food safety management using case studies of milk informally marketed

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in Africa and Asia. We also discuss the challenges to applying risk-based approaches in developing countries and ways to overcome these.

EVALUATION OF ENTEROTOXIGENIC ESCHERICHIA COLI IN INFORMALLY MARKETED MILK IN NAIROBI, KENYA AND KAMPALA, UGANDA

Conventional food safety studies typically determine the prevalence of disease-causing pathogens in marketed food. This tends to be widely reported by the media and results in panic among consumers and policy-makers alike. The responses are dramatic drops in consumption, adversely affecting the livelihoods of farmers and traders and the nutrition of consumers. Recent outbreaks of avian influenza in Asia and Rift Valley Fever in Africa are cases in point. Risk-based approaches shift the focus from hazards (sources of harm) to risk (the combination of probability of occurrence and consequence of a specified hazard). As such they better address the concerns of consumers and decision makers, who are more interested in the impacts of pathogens on human health than in their presence per se. Knowledge of impacts is also much more useful in deciding resource allocation for management of hazards and appropriate levels of protection.

*E. coli* O157:H7 is an enterotoxigenic serotype which has emerged in the last 30 years as a serious hazard. It causes a severe, bloody diarrhoea and up to 10% of those affected develop hemolytic uremic syndrome, which can result in renal failure. Cattle are the main reservoirs, and unpasteurised milk an important transmission route: several outbreaks in Africa have been linked to food and water. We carried out a quantitative microbial risk assessment on the presence of *E. coli* O157:H7 in informally marketed milk in Nairobi and Kampala in East Africa. This followed the Codex Alimentarius guidelines, comprising hazard identification, hazard characterisation, exposure assessment and risk characterisation. Data were derived from 3 field studies carried out between 1999 to 2004. Information included: prevalences of *E. coli* O157:H7 on farms (n=725 cows), as well as in marketed and household milk (n=235 samples); farmer and trader milk-handling practices (qualitative survey); and consumer behaviour, consumption and susceptibility (n=860 questionnaires). Data on attack rates were derived from the literature. A scenario pathway model was developed and Monte Carlo simulation used to assess risk to consumers from drinking raw milk. This showed that although *E. coli* O157:H7 was present in as much as 1% of household milk samples, only
Does control of animal infectious risks offer a new international perspective?

Two symptomatic infections could be expected for every 10,000 raw milk portions consumed; with a possible range of from 0 to 22 symptomatic cases. Sensitivity analyses showed that consumers’ widespread practice of boiling milk dramatically reduce the risk of disease, while the small volumes of milk produced and handled per informal sector agent decreased risk of cross-contamination.

In this case, the advantages of risk assessment over conventional methods were a much more realistic assessment of the harm posed by informally marketed milk and insights into how consumer behaviour could dramatically reduce risk. This study was part of a broader research project with the objective of supporting small-holder dairying production. By generating credible evidence on the harms and benefits associated with small-holder production and marketing, the project helped move policy in a direction that was more supportive of poor farmers, traders and consumers.

EVALUATION OF THE QUALITY OF INFORMALLY MARKETED MILK IN ASSAM, INDIA

An important feature of risk analysis is the ‘stable to table’ or ‘farm to fork’ perspective which systematically considers the movement of hazards from point of origin to consumption; this contrasts with a more piecemeal and unstructured approach of conventional studies. Observing how pathogens decrease or increase on the pathway allows the identification of Critical Control Points (i.e. steps at which control can be applied and is essential to prevent or eliminate a food safety hazard or to reduce it to an acceptable level). It is also better at capturing the multi-source character of risk, allowing all possible sources of exposure to be considered when making management decisions. (For example, halving the number of cases of salmonellosis from poultry will have little impact on the disease burden if 99% of the cases are transmitted through contaminated waste water). A third advantage over conventional methods is the ability to make predictions of changes in pathogen populations based on knowledge of microbial growth dynamics (e.g. Modular Process Risk Model); this is particularly useful in developing countries where data is scarce.

We carried out a pathway analysis on raw milk produced by smallholders and informally marketed in Assam, India in 2006 (see figure 1 for an example of a pathway followed). Ultrasonic lactometers and rapid microbiological tests based on dehydrated media were used to assess milk quality. Twelve raw milk pathways, starting with an individual cow and ending with
the consumer were evaluated. Pathways were purposively chosen to represent the diversity of chains. Extensive adulteration with water was present in 5 pathways, but for all 12 the milk was of acceptable quality in terms of total bacteria counts at the point of consumption. However, for 7 pathways coliform counts were not acceptable at point of consumption (suggesting faecal contamination). The point of greatest risk amplification was the transfer of milk between ultimate or penultimate vendor and consumer.

DISCUSSION AND CONCLUSIONS

Developing country informal markets are characterised by non-linear, unregulated, heterogeneous and self-organising food value chains. In this difficult context, conventional food safety based on command and control regulation often fails and risk-based approaches are considered better bets. The challenges we encountered of applying risk-based approaches included: the lack of pre-existing information; great diversity of structures and practices; difficulties of working with informal sector participants due to poor relations with officials; and problems of carrying out laboratory analyses given extreme environmental conditions and lack of equipment and skilled staff. We responded to these challenges by extensive use of qualitative analyses to capture uncertainty, diversity and complexity; incorporation of Participatory Learning and Action methods to engage study respondents and generate ownership; and adoption of novel rapid and robust laboratory tests for quality assessment. The results generated, though with wide margins of error and limitations to generalisability, represented a major improvement on the pre-existing situation, where stakeholders had essentially no information on the harms present in informally marketed milk. These case-studies support the hypothesis that risk-based approaches may be a useful way of addressing food safety problems in informal markets. However, these approaches will need continued adaptation, testing and dissemination.

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Figure 1. Changes in quality along the raw milk pathway from cow to consumer.