multiply in food but can be controlled by good practice. Systematic and continuous monitoring of these points requires commitment by management and education and training of employees at all levels. A large investment in training may be offset by abandoning obsolete and ineffective procedures. An approach called the Hazard Analysis Critical Control Point system is being introduced in several countries, and the example worked out in detail in the World Health Organisation report for salmonellosis illustrates the analysis and identification of control points for different foods.[7] Investment in education and training with detailed monitoring of critical points in the production and processing of food may be a more effective approach to safety than legal measures to allocate blame after things have unnecessarily gone wrong. The two strategies are not incompatible and can be mutually supportive. Can we hope to remove human error? Probably not, but at least we could try harder.

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1 Grist NR. The first ten years—self-inflicted epidemics. *J Infect* 1989;19:1-3.
2 Velimirovic B. *Do infections occur only in Scotland?* In: Velimirovic B, ed. *Infectious diseases in Europe, a fresh look.* Copenhagen: World Health Organisation, 1984:50-1.
3 Forbes GI. Microbial contamination of food: control measures. *Analytical Proceedings* 1989;26:431-9.
4 Scottish Home and Health Department. *Health in Scotland 1988.* Edinburgh: HMSO, 1989:52-5.
5 Pollock AM, Whitty PM. Crisis in our hospital kitchens: ancillary staffing levels during an outbreak of food poisoning in a long stay hospital. *Br Med J* 1990;**300**:383-5.
6 World Health Organisation Technical Group. Health surveillance and management procedures for food-handling personnel. *WHO Tech Rep Ser* 1989; No 785.
7 International Commission on Microbiological Specifications for Foods. Prevention and control of food-borne salmonellosis through application of hazard analysis critical control point (HACCP). *International Journal of Food Microbiology* 1987;4:227-47.

Low level radioactive waste

Public perceptions do not equate with scientific assessments

A recently published report of a symposium on low level radioactive waste held in New York quoted some "opportunity costs" of radioactive waste disposal. The cost for each eventual life saved by protecting Americans from nuclear waste by building deep disposal centres was $200 million; this was contrasted with the $20 000 needed to save a life from lung cancer by reducing exposure to naturally occurring radon.[1]

Nevertheless, the potential health hazard from burial of low level and intermediate level radioactive waste in shallow disposal sites continues to cause public concern in Britain and elsewhere. By the year 2030 sites will have been needed for the disposal of an estimated one million cubic metres of low level waste and 0·3 million cubic metres of intermediate level waste. At present these wastes are buried in shallow sites such as that at Drigg in Scotland. A deep disposal site would last for 50 years and the current construction cost would be £1650 million (United Kingdom Nuclear Industry Radioactive Waste Executive, annual report 1987-8).

The accepted principle of underlying policies to limit exposure to radiation is that it should be kept as low as is reasonably achievable in order to minimise the risk.[2] Often the public perceives this risk as considerably greater than the reality as determined from mortality and morbidity data. Clearly, decisions on the balance of risk versus the cost of averting that risk need to be based on correct assessments of the risk. One study in the United States found that the public saw the risks from nuclear power as greater than those from chest radiography—the opposite of the observed conclusion from mortality and morbidity data.[3] Nuclear power was seen as a greater health risk than smoking by non-professional women voters and students but not by business and professional people.

In measuring the risks to health from radioactive waste the first step is assessing the effects of other factors, including natural radiation. The mean annual dose of radiation received in Britain is in the order of 2-5 mSv, of which 87% is from natural sources—and half of that is from radon, which is present only in limited areas. The rest is from man made sources. Radiation of medical origin contributes 12%, and the remaining 1% includes a small amount of occupational exposure and exposure from fall out, and so on.[4]

Independent bodies, including the International Commission on Radiological Protection, the United Nations scientific committee on the effects of atomic radiation, and the United States National Academy of Sciences committee on biological effects of ionising radiations have made recent estimates of the effects of radiation. They set dose limits that are based on the different susceptibilities of various organs. In 1977 the International Commission on Radiological Protection set a limit of 5 mSv a year for members of the public.[2] In 1985 it recommended a lifetime exposure not exceeding 1 mSV a year.[5] There is at present an international debate taking place as to whether the annual limits should be decreased further.

How much does waste contribute to this exposure? Low level radioactive waste consists mostly of lightly contaminated rubbish such as discarded protective clothing, used wrapping materials, and worn out or damaged plant and equipment. It contains mostly short life radionuclides, and no shielding is needed when it is being transported. Intermediate waste contains, for example, sludges and gas filters from nuclear power stations. It is more concentrated, tends to be 1000 times more active than low level waste, and does need shielding. More than three quarters of waste in both the low and intermediate categories comes from the nuclear industry. Disposal of intermediate waste that has a long half life is not included in this discussion.

The use or disposal of radioactive substances anywhere in Britain has to be registered to facilitate inspection and monitoring by Her Majesty's Inspectors of Pollution, part of the Department of the Environment. For commercial nuclear installations the task falls on the Nuclear Installations Inspectorate, which is part of the Health and Safety Executive. These inspectors measure discharges and environmental levels to provide independent data and to determine compliance with and the adequacy of the regulations.[6] Aerial and liquid discharges are included in these responsibilities. In England the Department of the Environment and the Ministry of Agriculture, Fisheries, and Food are responsible for agreeing waste management arrangements and share responsibility for developing a strategy for managing radioactive waste. The total discharges from the nuclear industry are estimated by the National Radiological Protection Board to be of the order of 1μSv a person a year if spread out over the whole population.[7] Solid waste from the nuclear industry, hospitals, industry, universities, and the Ministry of Defence is disposed of by the United Kingdom Nuclear Industry Radioactive Waste Executive (Nirex). Both the National Radiological Protection Board, which is an independent body, and Nirex have research programmes that not only estimate ground water flow, gaseous discharges, and other natural events such as earth movement but also human interference with waste deposits.[8] The symposium held in New York made it clear that such assessments need to look not only at the quantitative aspects of risk assessment but also at the responses of policy to informed public opinion.[9] Plenty of information is made available from the various agencies and other experts to fuel public debate.[10]

Yet in both the United States and Britain, though the incidence of death and ill health from low level radioactive waste seems very small, "for the public, perceptions frequently have greater reality than the epidemiologists' risk assessments and statistical models."[11] The National Radiological Protection Board is on record as saying, "we have to reconcile two objectives, one of protecting against radiation and the other of protecting against fear" and "The crisis is not one of health but of social and political confidence" (National Radiological Protection Board, corporate plan 1989/90 to 1993/94, 1989). The agencies continue to hope that their presentation of factual information will remove some of the novelty from radiation and so alter false perceptions. The most contentious issue, however, is the possible hazard from human factors, which in the past have led to the failure of technical systems thought to be safe. Any continuing public debate must include the place of human error and interference, including industrial development of other actions. This may be the most difficult and painful issue in the making of a policy.

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1 Hall EJ. Radiation and life science and society. *Bull NY Acad Med* 1989;**65**:430-8.
2 International Commission on Radiological Protection. *Recommendations of the International Commission on Radiological Protection (1977): ICRP Publication 26—a summary.* Didcot: National Radiological Protection Board, 1977. (NRPB—R63.)
3 Sorensen JA. Perception of radiation hazards. *Semin Nucl Med* 1986;**16**:158-70.
4 Hughes JS, Shaw KB, O'Riordan MC. *Radiation exposure of the UK population. 1988 Review.* Didcot: National Radiological Protection Board, 1989. (NRPB—R227.)
5 International Commission on Radiological Protection. Statement from the 1985 Paris meeting of the International Commission on Radiological Protection. *Radiation-Protection-Dosimetry* 1985; **11**:131-2.
6 Her Majesty's Inspectorate of Pollution. *Report 1987-88.* London: HMSO, 1989.
7 National Radiological Protection Board. *Work of the NRPB 1984/86.* Didcot: NRPB, 1987.
8 Department of the Environment. *Disposal facilities outlined for low and intermediate level radioactive wastes: principles for the protection of the human environment.* London: HMSO, 1984.
9 Curran AS. Low level radioactive waste: the public health response. *Bull NY Acad Med* 1989;**65**:497-500.
10 Chudleigh R, Cannell W. *Radioactive waste: the gravedigger's dilemma.* London: Friends of the Earth, 1984.
11 Becker DV. Science and society: low level radioactive waste controversy and resolution committee on public health. *Bull NY Acad Med* 1989;**65**:553-4.

Dyspepsia in general practice

Try empirical treatment first and investigate patients who do not respond

Dyspepsia, an ill defined collection of upper abdominal symptoms,[1,2] affects 25% to 30% of the community and accounts for 3% to 4% of general practitioner consultations.[3] Despite a substantial decline in the prevalence of peptic ulceration over the past 20 years the incidence of dyspepsia has remained constant.[3] It continues to pose a diagnostic and therapeutic challenge to the clinician: faced with limited resources but increased public expectations of health care he or she has to decide who to investigate.

Lord Moynihan's optimistic prediction that in most patients with dyspepsia a diagnosis could be made from the history alone has not withstood the test of time.[4] Even experienced clinicians achieve a diagnostic accuracy of only 45% to 50%. This accuracy may be increased to 70% to 80% by using a predefined, structured questionnaire, but such an approach is unlikely to be adopted by many busy general practitioners.[5] One solution is to refer all dyspeptic patients for investigation before starting treatment. Upper gastrointestinal endoscopy has a high diagnostic accuracy for peptic ulcer and cancer (over 90%), a low complication rate (less than 1%), and is available in most British hospitals. During the past 10 years the rate of referral of dyspeptic patients for upper gastrointestinal endoscopy has shown a dramatic rise.[6] Unfortunately, in most hospitals this growth in demand for the service has outstripped the resources available, and the result has been the creation of waiting lists or at best saturation of existing clinics. The system does not have the capacity to absorb more work so the answer must be a re-evaluation of the selection of patients with dyspepsia for investigation.

The first point to make in such an evaluation is that while an accurate diagnosis of the cause of dyspepsia may be academically desirable it is not essential for managing most patients. Many will respond well to a short course of treatment with antacids or H_2 receptor antagonists; those suspected of having serious disease may still be referred for early investigation. Several studies have examined the discriminant value of various dyspeptic symptoms and have attempted to provide scoring systems for identifying the "high risk" patients for early referral.[1,5,7-9] None of these systems is ideal, being either too cumbersome for routine use or lacking in sensitivity.[7] Some symptoms—such as severe or persistent pain, vomiting, anorexia, and loss of weight—clearly load the dice in favour of a diagnosis of peptic ulcer or cancer. Age is important when screening patients with dyspepsia for cancer. Below the age of 45 the incidence of oesophageal and gastric cancer is very low, and there is no justification for the use of endoscopy in these patients merely to detect early cancer.[6,10] Only 1% of all dyspeptic patients will be found to have oesophageal or gastric cancer, and in only six per 10 000 patients will "early" gastric cancer be detected at endoscopy.[10]

Most dyspeptic patients can be treated for four to six weeks with antacids before any investigation needs to be performed. Those who respond to such treatment may be reassured, while those who fail to improve should be referred for investigation. Is there any evidence that such a delay could harm patients with peptic ulcer or upper gastrointestinal cancer? Many controlled trials of treatment with placebo or antacid have shown that patients in both groups rarely develop serious complications over four to six weeks of observation.[11] Nor is there any evidence that a four to six week delay in diagnosis will adversely affect the natural course of or surgical cure rate for oesophageal or gastric cancer.[10] Furthermore, if all dyspeptic patients were referred for endoscopy and no additional resources were made available then waiting lists of over four weeks would become increasingly common, defeating the whole object of early investigation.

Are there any patients who should be investigated as soon as possible? Patients with symptoms very suggestive of cancer—such as dysphagia, anorexia, and loss of weight—clearly require urgent diagnosis. Those patients with ulcers who have evidence of recent substantial gastrointestinal haemorrhage should be referred early. Finally, patients who are taking non-steroidal anti-inflammatory drugs should be considered for early endoscopy; these patients are often elderly and if they develop complications have increased overall and surgical mortality.[12]

Over half of all dyspeptic patients respond well to an empirical trial of treatment coupled with reassurance, allowing those at higher risk to be defined and so given ready access to early investigation. Acceptance of such a referral code may also lead to general practitioners being given more