

***E. coli* Foodborne Disease**

Research Paper 97/63

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Recent tragic outbreaks of *E. coli* foodborne disease in Scotland have focused attention on an increasing world wide problem of foodborne disease. This paper discusses the nature and extent of the public health problem and measures necessary to ensure food safety recommended in the Pennington Group report.

Alex Sleator
Science and Environment Section

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Summary

The recent tragic food poisoning outbreaks in Scotland caused by the virulent *E. coli* 0157 bacterium have focused attention on an increasing world-wide problem. This organism is a particular hazard to human health because contamination of food supplies by a very few bacteria can result in severe, life threatening disease, particularly in the very old or the very young. This paper describes the nature and extent of the problem; sources of infection, in particular the difficulties cause by the reservoir of infection in the intestines of healthy cattle, and possible points at which measures can be taken to control its spread ie.

- on the farm - scrupulous hygiene by those in contact with cattle, and awareness of hazards of contact of fruit and vegetables with animal manure and slurry
- pasteurisation of milk and avoidance of post pasteurisation contamination
- in the slaughterhouse - hygiene management to prevent faecal contamination of carcasses
- in butchers shops and meat processing premises - separation of raw and cooked meats to prevent cross-contamination
- in food processing and home cooking - thorough cooking to kill the bacteria and scrupulous attention to hygiene.

In response to the rise in *E. coli* infection the Working Group on Verocytotoxin-Producing *Escherichia coli* was set up in 1992 to assess the problem and advise on action to reduce foodborne disease associated with it.

The Pennington Group which was convened following the outbreak in central Scotland in November 1996 has made recommendation for further measures to ensure food safety from "farm to fork". Measures to prevent contamination of carcasses in slaughterhouses and cross-contamination of foods in butchers shops are of particular importance. The requirement for physical separation of raw and cooked meat products using separate counters, equipment and staff is an area of difficulty both financially and practically, particularly for small butchers.

I *E. coli* as a source of food poisoning

A. World wide increase in foodborne disease

The recent tragic outbreaks of *Escherichia coli* (*E. coli*) food poisoning in Scotland have highlighted an increasing worldwide incidence of foodborne disease. Food poisoning from bacteria, viruses and parasites is escalating in almost every country that gathers statistics on the subject.¹

The upsurge in food poisoning cases is explained only partially by better diagnosis and testing of foods. Experts blame a wide range of causes, including the demand for cheap meat and animal feed in the postwar years. A WHO panel on food and agriculture reporting in 1992 stated that large quantities of contaminated feed imported into the West and fed to animals had subsequently contaminated the environment. Data reported in 1990 by the United Nations Environment Programme (UNEP), from surveys conducted in 1974 and 1984 showed that 45 per cent of the world's rivers were contaminated with dangerous concentrations of faecal bacteria, like *E. coli*, which farm animals drink. Another major factor is the centralisation of food processing plants - one infected animal can now spread pathogens to many. In the West changes in our lifestyle constitute another factor in increased incidence. In recent years we have developed a culture where people eat out on a regular basis, and takeaways and fast food are part of a regular pattern of eating. Preparation of fresh food in the home for immediate consumption has given way to re-heating of pre-prepared food. Barbecuing, now a popular summer pastime has additional hazards in favouring undercooking of meats, and in allowing for raw meat and salads to be left in warm temperatures long enough for organisms to multiply.

Constant vigilance is necessary to protect our food supplies as nature adapts to existing controls. It is possible that we have become complacent over the last few decades. The era of antibiotics led us to believe that infectious disease would take a back seat. Microorganisms reproduce at a phenomenal rate and rapidly evolve to sidestep our attempts at control, and antibiotic resistance has become a world-wide problem. In the late 1950s and 1960s multi-drug resistance was reported in Europe, the US, Japan and Latin America in *E. coli*, *Salmonella* and *Shigella*, all organisms responsible for foodborne disease, about a decade after introducing drugs to combat them. By the mid 1970s the problem was widespread. In 1995 the World Health Organisation set up a new programme, the division of Emerging Viral and Bacterial Disease Surveillance and Control (EMC), aimed at surveying and controlling "communicable diseases which represent new, emerging and re-emerging public health

¹ *New Scientist* 17 December 1994

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problems, including the problem of antibiotic resistance" world-wide². In the light of antibiotic resistance and increasing difficulty in treating some infectious diseases, prevention of infection must therefore be of paramount importance.

B. Rise of *E. coli* food poisoning

The particular importance of the outbreaks of *E. coli* foodborne illness lies in the sudden recent increase of a particular strain of the bacterium, *E. coli* 0157, which produces a powerful toxin which can cause severe haemorrhagic colitis (which usually presents as bloody diarrhoea) and damage to the kidneys. Treatment is difficult, and kidney failure and fatalities may ensue, particularly amongst vulnerable groups of the population. In addition the widespread distribution of *E. coli* occurring naturally in the intestines of farm animals provides a ready source of food contamination and a considerable challenge in hygiene control.

The World Health Report for 1996 describes epidemics of foodborne and waterborne infections due to new organisms such as *E. coli* 0157:H7 as a major problem that has hit industrialised as well as developing countries.

In 1982, *E. coli* 0157 was found to be responsible for two outbreaks of bloody diarrhoea in the US, both associated with the consumption of hamburgers. Since that time there have been numerous reports of haemorrhagic colitis associated with this bacterium in North America, Japan, Europe and elsewhere. The numbers of people affected in outbreaks has varied from less than ten to several hundreds. In the Western United States in 1993 more than 700 were affected in an outbreak associated with the consumption of undercooked hamburgers bought from a fast food chain. Four people died. Outbreaks in the UK have usually affected less than 10 people but have increasingly demonstrated the ability to involve large numbers if the conditions for carriage of the infectious organism are favourable. Scotland, in particular has suffered outbreaks on a larger scale. The reasons for the comparatively high level of infection in Scotland is as yet unexplained.

Outbreaks in Scotland

In West Lothian in 1994 more than 100 people were affected by an outbreak associated with the consumption of milk probably contaminated post-pasteurisation.³ One child died.

² *Chemistry in Britain* vol 33 May 1997 "Superbugs step up the pace"

³ *Report on Verocytotoxin producing Escherichia coli* by Advisory Committee on Microbiological Safety of Food 1995 p12

In November 1996 an outbreak occurred in Lanarkshire apparently centred on a butchers shop in Wishaw which supplied fresh and cooked meats and pies over a large geographical area. This has proved to be the largest ever outbreak of infection with the organism in the UK. The total number of cases in the outbreak (confirmed, probable and possible) was 496, with 272 confirmed.⁴

There have been 18 deaths (all adults) - the second highest number of deaths associated with an *E. coli* 0157 outbreak in the world. Of these, 8 people had attended a luncheon served at the Wishaw Old Parish Church and 6 were residents of Bankview Nursing Home in Bonnybridge, Forth Valley. Those who died were between 69 and 93 years of age. A few cases were subsequently reported in Lothian and Greater Glasgow.

A further outbreak of infection (with a separate source) occurred at a nursing home in Tayside in January 1997. Of six elderly people affected three died. All the circumstances pointed to it being a point-source outbreak (associated with a single event or place) unconnected with the Lanarkshire outbreak.

In response to the devastating outbreak in central Scotland the Government commissioned an enquiry. This was headed by Hugh Pennington, Professor of Microbiology at the University of Aberdeen, and an international authority on *E. coli* infection.

The Wishaw outbreak, and the findings of the Pennington report are dealt with in greater detail in Section 111B

C. *Escherichia coli* (*E. coli*) - nature and virulence of the bacterium

Many strains of the bacterium *Escherichia coli* are normal inhabitants of the gastro-intestinal tract of man and animals, although some can cause gastro-intestinal disease. Elsewhere in the human body, for example in the genitourinary tract and in surgical wounds, *E. coli* may also be the cause of infection. Some strains have acquired additional properties conferring on them increased virulence.⁵ They are now an increasing cause of diarrhoeal disease world wide. Diarrhoea generally causes ill health through fluid loss, dehydration and imbalances in body chemistry.

⁴ Pennington Group report on the circumstances leading to the outbreak of infection with *E. coli* 0157 in Central Scotland, the implications for food safety and the lessons to be learned April 1997

⁵ The ability to cause severe symptoms in an individual

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Those *E. coli* capable of causing diarrhoeal disease in humans became known as enteropathogenic *E. coli* (EPEC)⁶. Several sub-groups of disease-causing groups of *E. coli* are now distinguished according to their specific method of attacking the host and causing disease. Some act by sticking to the gut wall, others by invading the lining of the gut. Some produce toxins which may be responsible for travellers' diarrhoea or infantile diarrhoea in developing countries.

1. Verocytotoxin-producing *E. coli* (VTEC)

A further group produce a potent inflammatory and destructive toxin called "Verocytotoxin" which can cause severe disease, particularly in infants, young children and the elderly. Although there many strains of VTEC organisms, the most important one associated with human disease is 0157.

The VTEC group has been causing increasing concern over the last 15 years. The virulence of these strains (the ability to cause serious and sometimes fatal disease) is conferred by the production of the toxin. Sporadic cases and outbreaks can be more dangerous than those caused by other common food poisoning organisms, for example salmonella.

It is thought that the gene which enables toxin production was introduced to a form of *E. coli* already capable of causing infant diarrhoea by a virus that infects bacteria (a bacteriophage). This organism now has an evolutionary advantage - the toxin splits open mammalian cells providing the bacteria with a ready food supply. The resulting bloody diarrhoea ensures the spread of the organism. One type of VTEC known as *E. coli* 0157:H7 (or VTEC 0157:H7) is particularly associated with serious disease. There are, however other strains that also carry the toxin gene and can cause the same symptoms, and it is possible that increasing numbers of strains may develop the ability to produce toxins.

It is this strain of E. coli 0157:H7 that has been responsible for the recent outbreaks of food poisoning in Scotland in recent months. However, for the sake of simplicity this paper will refer to *E. coli* 0157 or VTEC.

2. Illness resulting from infection with *E. coli* 0157

This organism can cause a range of symptoms from a mild diarrhoea to life threatening conditions:

⁶ *Oxford Textbook of Medicine* 1996

- **haemorrhagic colitis** - direct action of the cytotoxin on the gut causing severe inflammation (colitis) with bleeding (seen in both children and adults). There is usually crampy abdominal pain and bloody diarrhoea with little or no fever. The diarrhoea is usually watery at first and in mild cases remains so (many cases of VTEC infection will suffer only diarrhoea, stomach pain and perhaps vomiting).
- Up to 10%⁷ of those infected with VTEC may go on to develop the **haemolytic uraemic syndrome** (HUS) Features of this syndrome include severe blood abnormalities leading to anaemia, abnormal clotting, and kidney failure. It may occur between 1 and 14 days after the onset of VTEC infection particularly in children and the elderly. *E. coli* 0157 is particularly associated with this syndrome (although there are other causes). *VTEC are now the chief single cause of acute renal failure in children in the UK and North America.*⁸
- Some patients, usually adults, with 0157 VTEC infection develop **thrombotic thrombocytopenic purpura** (TTP) in which the clinical features of HUS are seen together with neurological complications.

The incubation period before the onset of diarrhoea can range from 1 - 14 days and is most often after 3 to 4 days. Symptoms usually resolve within two weeks except in cases of HUS or TTP. Bacteria are usually excreted for a week, but sometimes much longer - particularly in children. Asymptomatic carriage of 0157 VTEC has been reported. The fatality rate of 0157 VTEC infections is very variable and depends on the ages of the groups affected. Fatality rates ranging from 1 to 5% have been reported but may be much higher in some institutional outbreaks.⁹

3. Diagnosis and Treatment

Diagnosis is made on the basis of the clinical features of the disease and confirmed in the laboratory. Laboratory diagnosis can be made by examining faecal samples for the presence of VTEC during the diarrhoeal phase. Organisms may be excreted in the faeces for only a short period. The presence of antibodies in the blood provides additional evidence of recent infection.

⁷ Public Health Laboratory Service

⁸ *Oxford Textbook of Medicine* p 557

⁹ Public Health Laboratory Service

There is no specific treatment for these infections in humans, and each phase of the illness is treated symptomatically. Maintaining hydration of the patient is critical, as dehydration can develop very rapidly in those with diarrhoea, particularly young children and the elderly. The most important element of management is to watch for signs of haemolytic uraemic syndrome, so that the patient can be given the necessary supportive treatment at the earliest opportunity should this complication arise. Renal dialysis may be required if kidney damage is severe. There is no clear evidence of the efficacy of antimicrobial agents, either to reduce symptoms or reduce the risk of the syndrome arising.¹⁰ This makes prevention of infection vitally important.

4. Source of infection and prevention

VTEC, including 0157, exists in a wide range of animals, wild, farmyard and domestic. The main reservoir for 0157 VTEC is the intestine of healthy cattle, although there have been reports from Britain, Germany and the USA in 1996 of these organisms in sheep. Figures given by the Public Health Laboratory Service for the prevalence of 0157 VTEC in the intestines of cattle at slaughter of 0.9% to 4%¹¹ may be amended in the light of research carried out at Sheffield PHLS.¹² This has found a prevalence of up to 15.7% in a population of 4,800 cows from one abattoir which draws cattle from a wide geographical area of England. The research also sampled a population of 1000 sheep, and found a prevalence of 2.2%.

How the organism is distributed in the cattle population is poorly understood, but infection in cows may last only a short period of time.¹³ Animals affected generally show no signs of infection, other than perhaps transient diarrhoea in very young animals. Carcasses may become contaminated with faecal matter in the slaughterhouse through dirty hides, or contact with intestinal contents at slaughter.

Humans become infected through consumption of contaminated food. The organism is destroyed by thorough cooking, and thus inadequately cooked foods, contaminated raw food or food contaminated after cooking can all pose a risk. Illness has been largely associated with consumption of inadequately cooked minced beef (as in burgers) and milk¹⁴ (unpasteurised or contaminated after pasteurisation). However outbreaks have also been associated with yoghurt¹⁵, cooked meats, meat pies, cheese, dry cured salami, raw vegetables, unpasteurised apple juice and water.

¹⁰ Oxford Textbook of Medicine 1996 p557

¹¹ Public Health Laboratory Service web page <http://www.open.gov.uk/cdsc/ecoli3.htm> April 1997

¹² Personal communication. Dr Peter Chapman Sheffield Public Health Laboratory Service 15 May 1997 Not yet published

¹³ *Report on Verocytotoxin producing Escherichia coli* by Advisory Committee on Microbiological Safety of Food 1995 p. 82

¹⁴ *The Lancet* vol 344 October 8 1994 p1015

¹⁵ *British Medical Journal* vol. 314 25 January 1997 p 241

The infectious dose of *E. coli* 0157 is very low - probably less than 100 microscopic organisms can cause symptoms in an individual. (In contrast to *Salmonella* food poisoning where the infective dose is usually at least one million¹⁶.) This makes total eradication of sources of contamination sufficient to cause disease a tremendous problem. If contamination remains superficial, as in steak, the bacteria can be readily destroyed by cooking. The problem usually arises where mixing has occurred, as for instance in pies, burgers and sausages. The bacteria are now spread throughout the product and will be more likely to survive the cooking process, especially if the product is not cooked thoroughly. If appropriate hygiene measures are not taken, there can also be cross-contamination between raw meat carrying the organism and cooked or ready to eat foods. Refrigeration will prevent growth of the bacteria but the organism survives well in frozen storage, and freezing cannot be relied upon to kill it.

Raw vegetables and salad produce may be contaminated on the farm by contact with infected animal manure. Direct contact with animals and person to person spread both in families and institutions are important alternative routes of transmission. Thorough hygiene (hand washing) should be observed by those who attend cattle, and scrupulous hygiene should be observed by those who visit farms. This is now seen as a hazard by those who organise school educational trips to farms.

Dissemination of information to the public is vitally important as limiting the spread of the disease can depend upon understanding of the importance of thorough cooking, as well as basic hygiene at home. Hands should be washed before handling food and between handling raw meat and ready to eat products or cooked meat. Raw fruit and salads should be washed before consumption. Food should be kept covered and away from flies, and refrigerated to prevent multiplication of any bacteria already present. In the fridge raw meat should be kept separate from other foods. Foods should be thoroughly cooked, in particular, beefburgers should be cooked through until no pink remains, and the juices run clear.

These basic precautions will go a long way to preventing many types of bacterial and viral food poisoning and should be standard practice. Education from the nursery "now wash your hands" to school health education and domestic science is important.

D. E. coli in perspective in the UK

Outbreaks of illness due to *E. coli* 0157 are relatively uncommon in the UK compared to other food poisoning organisms. However the Public Health Laboratory Service (PHLS) state

¹⁶ *Foodborne illness - a Lancet review* 1991 IBSN 0-340-55570-X

that when allowance is made for the improvements in ascertainment in the 1980s the incidence of the disease still appears to be increasing. The PHLS has documented outbreaks since 1982 and has reported on 18 general outbreaks between 1992 and 1994. There were 11 outbreaks in 1995 and 10 were recorded in 1996.

1. Alternative sources of food poisoning

In the UK, foodborne illness is on the increase despite educational programmes and legislation to improve the general standards of food hygiene. The *E. coli* bacterium is one of a range of organisms that may be responsible for foodborne illness. In addition to bacteria, foodborne illness may be attributable to viral sources such as rotavirus, astravirus and Norwalk virus (a possible contaminant of shellfish), or to protozoan sources (single celled animals), such as *Guardia* or *Cryptosporidium*.

Important bacterial sources in the UK are:

1) *Campylobacter*: This organism is the most common cause of infectious diarrhoea in industrialised countries¹⁷. The organism is found in the gut of animals, both wild and domestic, and infected poultry is an important source. Infection may be occupational, as in the case of farmers, slaughtermen and poultry processors, or domestic where the usual source is a pet kitten or puppy with campylobacter diarrhoea. It may be transmitted directly or more often indirectly via contaminated meat, milk or water. (Campylobacters are present in almost all surface water before treatment.¹⁸) The infective dose is small (a few hundred¹⁹) but the organism does not multiply in food. Cases of foodborne infection tend to be sporadic, or in small family outbreaks, rather than in the form of larger outbreaks as in salmonella food poisoning. Larger outbreaks have however been associated with contaminated raw milk or untreated water. The infectivity of campylobacter tends to be low, probably because the bacteria cannot withstand drying.²⁰ It is often difficult to pinpoint the source of infection as the organism is so widespread in the environment - contamination has even been traced to magpies pecking at doorstep bottles of milk.

2) *Salmonella*: Again this is much more common than *E. coli*. It increased dramatically in the 1980s, particularly the sub species *S. enteriditis*, which has been attributed largely to contamination of poultry meat and eggs, and was responsible for the scare of 1989. The infective dose is governed by many factors, but in general many salmonellae (more than a million) are required to cause symptomatic infection, although the infective dose can be lower

¹⁷ Oxford textbook of Medicine 1996

¹⁸ *Foodborne illness - a Lancet review* 1991 IBSN 0-340-55570-X

¹⁹ *ibid*

²⁰ *ibid*

in some high fat foods such as cheese, hamburgers or salami.²¹ Reduced gastric acidity or reduction of the normal bacteria of the gut (as occurs in the newborn before colonisation, or in people who have recently been treated with broad spectrum antibiotics) will result in increased susceptibility to salmonella infection. The infection can be subclinical or lead to severe diarrhoeal disease, which can be debilitating or occasionally fatal, for example in the elderly. Asymptomatic carriers and persistent carriage by those who have recovered can be an additional source of contamination.

Treatment consists mainly of rehydration therapy, but antibiotic treatment is indicated if the infection has spread into the bloodstream. Antibiotic resistance can be a problem. High doses of antibiotics used to treat infections in livestock are thought to be the cause of increasing resistance to antibiotics in salmonella and campylobacter food poisoning cases in humans.²²

The organism can be killed by thorough cooking, which is vital in prevention. Chickens should be cooked through to the core following thorough defrosting if they were previously frozen. Raw or lightly cooked eggs should be avoided, particularly by the vulnerable.

3) *Listeria*: This remains a relatively rare source of foodborne disease, though the incidence reported in Britain and Ireland rose sharply in the late 1980s. In the majority of cases which are sporadic firm evidence of consumption of contaminated food is lacking. Outbreaks have been associated with a range of foods, including unpasteurised soft cheeses, cook chill foods, meat, milk, prawns and raw vegetables. Even lettuce has been implicated. The organism continues to grow at ordinary refrigeration temperatures.

When infection does occur the effects are serious, and tend to affect those who are immunocompromised due to preexisting disease or pregnancy. Infection can be asymptomatic or can lead to a range of conditions from a mild flu-like illness to septicaemia or meningitis. Infection of the pregnant mother can lead to spontaneous abortion or premature labour and delivery of an infected infant.

Others

A variety of other bacteria can cause food poisoning, including *Staphylococcus*, which can spread to food from a septic abscess on a food handler or from nasal bacteria, and *Clostridium* (which include the organism responsible for the now rare botulism.) *Vibrio parahaemolyticus* can be associated with food poisoning from sea food, and *Bacillus cereus* can be associated

²¹ *Foodborne illness - a Lancet review* 1991 IBSN 0-340-55570-X

²² *New Scientist* 18 January 1997

with a wide range of foods from meat and vegetables to dessert dishes and ice cream. A form of this infection that gives rise to vomiting rather than diarrhoea is associated with boiled or fried rice from rice prepared in bulk for Chinese restaurants or "take away" shops.

2. Incidence of infection in the UK

Cases of confirmed or suspected food poisoning are required to be notified to the local authority by the attending medical practitioner.²³ In England and Wales the body responsible for collation of statistics and issuing guidance on infection control is the Public Health Laboratory Service's (PHLS) Communicable Disease Surveillance Centre. In Scotland the same function is provided by the Scottish Centre for Infection and Environmental Health (SCIEH).

Table 1 - The number of laboratory confirmed cases of human infection with *E. coli* 0157 in Great Britain^(a) and the respective rates of infection per 100,000 population, since 1990 are:²⁴

	Scotland		England and Wales	
	Number	Rate per 100,000 pop'n	Number	Rate per 100,000 pop'n
1990	173	3.39	250	0.49
1991	202	3.96	361	0.71
1992	115	2.25	470	0.92
1993	119	2.32	385	0.75
1994	242	4.71	411	0.80
1995	247	4.80	792	1.52
1996	488*	9.5**	660*	1.26**

a) Isolates confirmed by the Public Health Laboratory Service in England and Wales and the Scottish Centre for Infection and Environmental Health.

* provisional

** provisional rates based on 1995 mid-year population estimates

The 1994 and 1996 figures for Scotland are of course heavily influenced by the West Lothian and Central Scotland outbreaks.

Because of improvements in surveillance methods it is difficult to draw conclusive comparisons year on year. However it is clear that there is an overall upward trend in rates of infection and that rates in Scotland are considerably higher than in England and Wales.

²³ *Public Health (Control of Disease) Act 1984*

²⁴ *The Pennington Group report April 1997*

The reasons for this are not understood.

Table 2 - The number of laboratory confirmed cases^(a) of salmonellas and campylobacter in Great Britain and the respective rates of infection per 100,000 population, since 1990 are:

Campylobacter:

	Scotland		England and Wales	
	Number	Rate per 100,000 pop'n	Number	Rate per 100,000 pop'n
1990	3,617	70.8	34,552	67.6
1991	3,425	67.1	32,636	63.6
1992	4,915	96.2	38,552	74.9
1993	3,999	78.1	39,422	76.4
1994	4,146	80.8	44,414	85.7
1995	4,377	85.2	43,902	84.7
1996(b)	4,655	100.3	42,344	81.7

Salmonella:

	Scotland		England and Wales	
	Number	Rate per 100,000 pop'n	Number	Rate per 100,000 pop'n
1990	2,442	47.8	26,203	51.3
1991	2,330	45.6	23,325	45.6
1992	2,992	58.5	32,171	62.7
1993	2,919	57.0	29,802	57.9
1994	2,969	57.9	30,181	58.5
1995	3,106	60.5	29,573	57.1
1996	3,266	63.6	29,057	56.1

a) Isolates confirmed by the Public Health Laboratory Service in England and Wales and the Scottish Centre for Infection and Environmental Health.

b) Scottish figure is for 47 weeks of the year; rate shown is the annual equivalent rate.

Sources: *HC Deb 2 December 1996 c551w, 3 December 1996 c622-4w, 3 March 1997 c524w*
Public Health Laboratory Service: CDR Weekly (various dates)
ONS Monitor MB2 97/1 "Infectious diseases, September quarter 1996"
ONS/OPCS: Communicable Disease Statistics (various years)

Listeria: There were 91 reported cases of human listeriosis in England and Wales during 1995, compared with 112 reports received by the PHLS in 1994.²⁵ Only 7 of the cases were pregnancy associated, the lowest figure so far recorded.

²⁵ On The State of the Public Health 1995 - Annual report of the Chief Medical Officer

II Current food safety regulation in meat product premises and butchers' shops

A. Food Safety Act 1990

This Act provides a range of powers to regulate food businesses. It does so directly, by creating specific offences or powers - for example the offence of rendering food injurious to health and powers of entry, powers to seize and condemn food and powers to close premises under certain circumstances.

The *Food Safety Act 1990* also has general requirements in section 8.

"Selling food not complying with food safety requirements":

(1) Any person who -

(a) sells for human consumption, or offers, exposes or advertises for sale for such consumption, or has in his possession for the purpose of such sale or of preparation for such sale; or

(b) deposits with, or consigns to, any other person for the purpose of such sale or of preparation for such sale,

any food which fails to comply with food safety requirements shall be guilty of an offence.

(2) For the purposes of this Part food fails to comply with food safety requirements if-

(a) it has been rendered injurious to health by means of any of the operations mentioned in section 7(1) above;

(b) it is unfit for human consumption; or

(c) it is so contaminated (whether by extraneous matter or otherwise) that it would not be reasonable to expect it to be used for human consumption in that state;

and references to such requirements or to food complying with such requirements shall be construed accordingly.

(3) Where any food which fails to comply with food safety requirements is part of a batch, lot or consignment of food of the same class or description, it shall be presumed for the purposes of this section and section 9 below, until the contrary is proved, that all of the food in that batch, lot or consignment fails to comply with those requirements.

(4) For the purposes of this Part, any part of, or product derived wholly or partly from, an animal -

(a) which has been slaughtered in a knacker's yard, or of which the carcass has been brought into a knacker's yard...

shall be deemed to be unfit for human consumption.

Food premises, including butchers' shops, have to be registered with the local authority under Section 19 (1)(a) of the *Food Act 1990*.²⁶

Section 19 (1) (b) of the 1990 Act empowers Ministers to make regulations introducing licensing of food businesses. They are expected to do so only when it appears to them necessary or expedient to secure that food complies with food safety requirements, or in the interests of public health, or to protect or promote the interests of consumers.

The *Meat Products (Hygiene) Regulations 1994*²⁷, made under the 1990 Act, apply to certain categories of premises producing meat products (this is in addition to the application to the retail part of the premises of the *Food Safety (General Food Hygiene) Regulations 1995*). The 1994 Regulations contain provisions requiring the approval of premises and prescriptive conditions relating to the construction and layout of premises, facilities provided within the premises, general conditions of hygiene and requiring the separation of raw and cooked products either by time or space. A statutory Code of Practice and Guidance Notes on enforcement deal with their application. Exemption from the 1994 Regulations can be claimed by some businesses that supply the "final consumer" with reference to these various documents. In effect, only wholesale butchers require licensing.

The *Food Safety (General Food Hygiene) Regulations 1995*²⁸ made under the 1990 Act, cover those premises not covered by the 1994 regulations. They give effect to the provisions of EC Directive 93/43 on hygiene of foodstuffs. They impose general requirements relating to structural matters, transport, equipment and food handling storage. They require that the layout, design, construction and size of premises should permit good food hygiene practices, including protection against cross contamination. They are, however, less prescriptive than the 1994 Regulations and require no approval or licensing.

The main requirements are contained in regulations 3, 4 and 5 which are described as follows in the Explanatory Note²⁹:

Regulation 3 deals with the application of regulations 4 and 5 of these Regulations : they apply to all stages of food production except primary production, but - subject to certain exceptions - they do not apply to the activities of food businesses which are regulated under the Regulations listed in regulation 3(2). The exceptions relate to circumstances where the listed Regulations make no alternative provision with respect to either the supply and use of potable water or the instruction or training of persons engaged in handling food at the business.

²⁶ *Food Premises (Registration) Regulations 1991*. (SI 1991/2825)

²⁷ SI 1994/3082

²⁸ SI 1995/1763

²⁹ *Food Safety (General Food Hygiene) Regulations 1995* (SI 1763) Explanatory note

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Regulation 4 imposes various obligations on the proprietor of a food business. Regulation 4(1) requires him to ensure that specified operations are carried out in a hygienic way. Regulation 4(2) imposes obligations on him to comply with the rules of hygiene set out in Schedule 1 to the Regulations. Chapters I to III of Schedule 1 sets out the requirements for food premises, rooms where food is prepared, treated or processed, temporary premises etc and vending machines. The rules of hygiene also cover transportation, requirements as to equipment, food waste, water supply and personal hygiene, provisions applicable to foodstuffs and training (Chapters IV to X respectively). Regulation 4(3) requires a proprietor of a food business to identify steps in the activities of the business which are critical to ensuring food safety and ensure that adequate safety procedures are identified, implemented, maintained and reviewed.

Regulation 5 is a notification requirement for certain food handlers suffering from medical conditions if there is any likelihood of them directly or indirectly contaminating any food with pathogenic micro-organisms.

B. European Community legislation

Several Council Directives operate in this field of food safety. The first three of these require premises to be either licensed or approved and enable both licences and approvals to be revoked.

- *Directive 64/433*: on fresh meat
- *Directive 94/65*: on minced meat and meat preparations
- *Directive 79/99*: on health problems affecting production and marketing of meat products etc., which lays down more specific rules applicable to certain businesses.

The fourth Directive requires registration of premises, which is given as of right and cannot be revoked -

- *Council Directive 93/43*: on the hygiene of foodstuffs and which lays down a number of general rules. This directive provides an option for further domestic legislation, although Community acquiescence is required before domestic measures are brought into force. It also encourages member states to develop industry guides to good hygiene practice. As stated above, 1995 Regulations legislate for the requirements of this Directive.

EU food law places the responsibility for ensuring the safety and protection of the consumer firmly with the individual food businesses. The Food Hygiene Directive 93/43 involved considerable deregulation in food hygiene law. A Department of Health Press Release³⁰ noted that the UK had contributed significantly to the text of the Directive and quoted the then Parliamentary Under-Secretary of State, Baroness Cumberlege:

³⁰ 21 February 1994

These new regulations take a big step forward in the deregulation of food hygiene law. They will replace and simplify food hygiene Regulations which have been in existence for over 20 years. The most effective approach to food safety is for businesses themselves to control risks. The new Regulations place this responsibility on food businesses. They set out essential principles of food hygiene, and avoid the imposition of very detailed rules which have placed unnecessary burdens on businesses in the past. In a new Code of Practice, we shall encourage a more co-operative relationship between the food industry and environmental health officers. The development of voluntary guides to good hygiene practice will assist the food industry...

The tool for businesses to fulfil this requirement takes the form of the Hazard Analysis and Critical Control Point System, described in the next section.

C. Hazard Analysis and Critical Control Point (HACCP) system

This system is internationally recognised through the Codex Alimentarius Commission³¹ and is favoured also by the FDA in the United States. It governs the both the EU and UK approach to tackling food safety issues. It is a structured approach to analysing the potential hazards in an operation, identifying the points in the operation where hazards may occur, and deciding which points are critical to ensure consumer safety. These critical points are then monitored, and remedial action is taken if conditions at any point are not within safe limits.

HACCP incorporates 7 steps³²:

1. Conduct a hazard analysis. Identify the potential hazards associated with food production at all stages up to the point of consumption, assess the likelihood of occurrence of the hazards and identify the preventive measures necessary for their control;
2. Determine the critical control points. Identify the procedures and operational steps that can be controlled to eliminate the hazards or minimise the likelihood of their occurrence;
3. Establish the critical limit(s). Set target levels and tolerances which must be met to ensure the CCP is under control;
4. Establish a system to monitor control of the CCPS;

³¹ An international organisation, created by the World Health organisation and the Food and Agriculture Organisation of the United Nations, which sets standards for food

³² *The Pennington Group Report* April 1997

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5. Establish the corrective actions to be taken when monitoring indicates that a particular CCP is not under control;
6. Establish procedures for verification to confirm that the HACCP system is working effectively; and
7. Establish documentation concerning all procedures and records appropriate to these principles and their application.

Although the merit of this system is generally approved, and can be used to ensure food safety from the slaughterhouse situation right through to consumption in the home, its implementation in food premises still has a long way to go.

Those food businesses governed by the *Meat Products Regulations 1994* are required to comply with the main HACCP principles, and licences can be withdrawn in cases of serious infringement. Those businesses that have gained exemption, and are therefore liable only to the 1995 Regulations, while they are required to make their "own checks" according to the HACCP principles have no obligation to keep records, and there is no legal basis for enforcement.

It has become evident that implementation of HACCP principles has been slow, and that even the first step in the process - the legal requirement to carry out a hazard analysis - is not being met. Findings by the Meat and Livestock Commission³³ suggest a significant number of butchers (including 40% of those manufacturing and wholesaling cooked meat products) have not carried out such an analysis.

Education is of prime importance in facilitating the implementation of HACCP principles, and a document "Risk assessment for the Smaller Food Business" has been produced by the Scottish Food Co-ordinating committee of Scottish Enterprise Tayside. A "generic" HACCP for butchers could be of tremendous help, but would need to be individually tailored to meet the needs of each individual premises, and understood by the people expected to manage the system, and record its results.

³³ Pennington Group Report April 1997 p23

III Government Response to the Public Health problem

A. Working Group on Verocytotoxin-Producing *Escherichia coli*

In 1992 awareness that *E. coli* 0157 was becoming an increasing public health problem caused MAFF to set up a working group of the Advisory Committee on the Microbiological Safety of Food. (ACMSF). The Working Group on Verocytotoxin-Producing *Escherichia coli* began meeting in 1993 and its brief was:

"To assess the significance of VTEC as a food borne pathogen and to advise on any action which could be taken to reduce foodborne disease associated with it."

The key areas of work reported on in the Working Group's review in 1995³⁴ included:

- clinical spectrum of VTEC infections
- pathogenicity and host susceptibility
- epidemiology of VTEC infections
- sources and routes of transmission
- growth and survival of VTEC
- effects of food processing on the organism in meat and other products
- current detection and isolation methods in human, animal, food and environmental samples
- retail and catering sectors' perspective

Recommendations of the working group considered control measures in detail³⁵

- the need to minimise the contamination of carcasses at slaughter - this involving improved training of staff.
- the adoption of a Hazard Analysis Critical Control Point (HACCP) approach in the food industry to prevent survival of or contamination by VTEC. This applies to both the food processing and food serving sectors.
- the need to prevent cross contamination from raw to cooked food must be emphasised.

³⁴ Report on Verocytotoxin-Producing *Escherichia coli* 1995 Advisory Committee on the Safety of Food

³⁵ For full details see Report on Verocytotoxin producing *Escherichia coli* (VTEC) Recommendations and Government's response produced by MAFF Advisory Committee on the Microbiological Safety of Food 1995

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- the need to reconsider the sale of raw cows' milk in England and Wales.
- the risks associated with cooking beefburgers. Burgers should be cooked until the juices run clear, and there are no pink bits inside. Minced beef and minced beef products should be cooked to a minimum internal temperature of 70 °C for two minutes or equivalent.

In addition they made recommendations that Government should fund further research into clinical aspects of *E. coli* 0157 infection, and improve methods of surveillance and studies of outbreaks. They recommended that clinical laboratories should routinely examine all diarrhoeal stools for surveillance methods for presence of 0157 VTEC to determine the extent of the public health problem. The Government endorsed this recommendation, but in spite of this the Pennington Group reporting on the central Scotland outbreak stated that³⁶:

Cost is (also) reported as the main reason why most laboratories do not follow the ACMSF advice to examine routinely all diarrhoeal specimens for *E. coli* 0157. Such tests are normally restricted to patients with bloody diarrhoea and possible symptoms of haemolytic uraemic syndrome.

Following the Interim Pennington Report the ACMSF reviewed its guidance on cross-contamination. This was issued in March 1997. It included the recommendation that an Industry Guide to good hygiene practice should be urgently developed under *Food Safety (General Food Hygiene) Regulations 1995* specifically for butchers and producers and retailers handling or preparing cooked meat and cooked meat products.

B. The Pennington Report

In response to the outbreak of *E. coli* food poisoning in Wishaw, Lanarkshire, the Government commissioned an enquiry. This was headed by Hugh Pennington, Professor of Microbiology at the University of Aberdeen, and an international authority on *E. coli* infection.

The apparent source of the outbreak was identified as a butcher's shop which had supplied cooked meat products to a number of retail outlets in the surrounding area. A Fatal Accident Inquiry (FAI) into the deaths associated with the Lanarkshire outbreak is to take place on completion of criminal proceedings against the proprietor of J. Barr & Sons, Butchers of Wishaw, who was charged with culpable and reckless conduct arising from the alleged supply of cooked meats in relation to a function at the Cascade Public House in Wishaw.

³⁶ *The Pennington Group Report* April 1997 p 11

Much public criticism surrounded the handling of the outbreak, relating mainly to the delay in publicising the list of outlets that had been supplied with suspect meat. The purpose of the Pennington enquiry was to investigate the circumstances leading to the outbreak, and to report on the implications for food safety and the lessons to be learned. While the report deals specifically with the Lanarkshire outbreak and took into account the Tayside outbreak and outbreaks in the Borders and Lothian in February 1997, its implications and recommendations will be applicable to management of the problems associated with *E. coli* 0157 foodborne infection on a wider scale.

The Pennington Group convened at the beginning of December 1996 until the end of March 1997. In response to the urgency of the situation it produced an interim report and priority recommendations at the end of December 1996. In the area of "the implications for food safety and the general lessons to be learned" the report identified four key areas³⁷: research, surveillance, enforcement and procedures for handling outbreaks.

1. Recommendations

The final report was issued in April 1997 following widespread consultation with consumers, health professionals, environmental health officers, food processors and retailers. It produced largely similar recommendations to the interim report for improvements in food hygiene from "farm to fork", tackling each point of danger along the food production route.

Using the HACCP system, Professor Pennington has identified areas where enforcement procedures and handling of outbreaks of *E. coli* foodborne disease can be tightened to improve food safety.

At each critical control point training and implementation of the HACCP system by workers is emphasised. The major critical points of control include:

Farms and livestock: This is the initial potential point of infection, and education and training of farm workers is necessary to increase awareness of the hazards. Care should be taken in the use of untreated slurry and animal manure, and most importantly, there should be an absolute requirement for presentation of clean animals for slaughter.

Slaughterhouses: *E. coli*, including the virulent strain 0157, are found in the gut of cattle that show no sign of disease. Therefore strict hygiene is necessary at the point of slaughter to prevent contamination of carcasses with faeces from hides or from intestinal leakage, and in cutting and cold stores to prevent cross-contamination. Responsibility for hygiene practices

³⁷ The Pennington Group *Interim Report and Priority Recommendations* December 1996

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in slaughterhouses is the responsibility of the Meat Hygiene Service (MHS). This Agency was set up in 1995 under MAFF, to provide a unified national meat hygiene service for Great Britain with responsibility for meat inspection and monitoring of hygiene practices in slaughterhouses, cutting plants and cold stores. Prior to 1995 these duties were the responsibility of local authorities, and there were many who maintained that enforcement should be left within their remit. In addition to ensuring standards required by law are met (for instance the removal of specified bovine offals), it is responsible for ensuring the welfare of animals at slaughter.

Regulations require slaughterhouses and similar premises to have a current licence issued by the Secretary of State for Agriculture. Such a licence is only issued if the premises comply with prescribed requirements as to structure and hygiene. Pennington recommends rigorous enforcement of hygiene practices, including a scoring system for clean/dirty animals and observance of the HACCP system which should be enshrined in legislation governing slaughterhouses and the transportation of carcasses and meat.

A Hygiene Assessment System (HAS) is operated by the State Veterinary Service in fresh meat plants to give a score that is a measure of hygiene standards. Pennington suggests targeting efforts and resources of the MHS at high risk premises - those abattoirs with a low HAS.

Meat Production Premises and Butchers' Shops: Despite hygiene measures in slaughterhouses, bacteria may be present in some raw meat arriving at meat production premises and butchers' shops. The bacteria are killed by thorough cooking, but even a few bacteria remaining will be sufficient to cause illness. Again, Pennington recommends training in the use of, and implementation and enforcement of the HACCP system. In addition, it should be incorporated into EU and domestic legislation.

The Government should review the application of the *Meat Products (Hygiene) Regulations 1994*, and the guidance issued subsequently, to clarify the position regarding which premises are intended to be covered by the Regulations. These Regulations, made under the *Food Safety Act 1990*, allow for licensing of certain premises upon conditions of approval of facilities and general hygiene conditions requiring separation of raw and cooked products either by time or space. The conditions are rigorous. At present many premises are able to claim exemption under the Codes of Practice, and in effect only wholesale butchers require licensing.

Pending HACCP implementation, selective licensing arrangements are recommended for those premises not covered by the *Meat Products (Hygiene) Regulations 1994*. These premises (which include most butchers shops) at present have to comply only with the less rigorous

Food Safety (General Food Hygiene) Regulations 1995, made under the *Food Safety Act 1990*. (See section 11). They require good food hygiene practices, including protection from cross-contamination, but they require no licensing. Pennington recommends that the licensing should require documentation of hazard analysis, training of staff, and hygiene practices to a level equivalent to those required by the 1994 Regulations.

Raw meat can readily contaminate cooked meat products and ready to eat foods. There should therefore be separation in storage, production, sale and display between raw meat and unwrapped cooked meat/meat products and other ready to eat foods. This should include the use of separate refrigerators and production equipment, utensils and wherever possible, staff. The Interim Report had recommended a requirement for separate staff. This is a contentious issue, as inevitably these rigorous conditions will impose a heavy financial burden on small businesses. The Meat and Livestock Commission put the cost for Scotland alone of full implementation of the physical separation and extra staff at £20 million per annum. The final report therefore allows for "alternative standards" where separation of staff cannot be achieved (eg the provision of hand washing facilities in the serving area). Where neither of these can be achieved, the premises would only be allowed to sell pre-wrapped cooked meat/cooked meat products prepared elsewhere in addition to raw meats.

Point of Consumption: Here is another point where awareness of hazards will contribute to food safety. The report recommends food hygiene training in primary and secondary schools. Those handling food in establishments such as nursing homes should be trained. Local authorities should encourage the adoption of HACCP principles in non-registered premises (Food premises, including butchers shops, have to be registered with the local authority under the *Food Premises (Registration) Regulations 1991*) where there is catering for functions involving more than just tea, coffee and confectionery). This is an important recommendation as these functions (such as luncheon clubs) often cater for elderly people who are very vulnerable to food poisoning organisms.

Enforcement: The report also gives recommendations in the area of enforcement of food safety measures. Responsibility for the management of outbreaks of foodborne disease falls jointly to local authorities (LAs) and health authorities (HAs). Within LAs, Environmental Health Officers (EHOS) deal with food safety and prevention and investigation of foodborne illness. The EHO has powers under the *Food and Safety Act 1990* to seize food and to close premises where there is a risk to human health. Criticism has been levelled at EHOs for "over-zealous" policing of the Act³⁸.

³⁸ Daily Telegraph 20 April 1993 "Spreading fear and confusion"

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The more recent adoption of EU law³⁹ involved considerable deregulation in food hygiene law, and placed the responsibility for ensuring safety and protection of the consumer with the individual food business. The 1995 Regulations require businesses to implement the HACCP system, but a "light touch" approach in enforcement has apparently been expected of EHOs to allow time for this to be achieved. This has resulted in an area of confusion for EHOs, particularly in the light of the failure to gain a conviction in the Lanark Blue Cheese court case⁴⁰. Pennington stated:

It seems to us unacceptable, particularly in current circumstances, that EHOs should be in any doubt about the need for anything other than rigorous enforcement of food safety standards, which should be clear and unambiguous.

He requested a clear policy lead from Government. To this end a review of the Health Risk Condition is already underway. This condition (section 11(2) of the *Food Safety Act 1990*), must be fulfilled before a court is able to make a prohibition order with regard to a particular food premises.

In addition Pennington recommends earmarking local authority funds for training and adequate manning levels of EHOs.

Questions have been raised following the Lanarkshire outbreak as to the timing of Food Hazard Warnings which are operated by the Department of Health to alert the public. A review is underway of guidelines and Codes of Practice, in particular *Code of Practice 16 of the Food and Safety Act 1990* which covers the point at which a LA must notify the Government, and the release of information to the media in relation to public interests.

Surveillance: Professor Pennington made recommendations for improving surveillance. In particular the testing of all faeces specimens of patients with diarrhoea should be tested for *E. coli* 0157. The surveillance network should be electronically linked.

Research: Research has been commissioned to implement the recommendations of the Interim Report following consultation with the ACMSF. Its initial aim is to determine the prevalence of *E. coli* 0157 in cattle both in Scotland and the rest of the UK, to determine the strain and the biology of its carriage and to forecast future prevalence.

³⁹ *Food and Hygiene Directive 93/94*, implemented by *Food Safety (General Food Hygiene) Regulations 1995* under the *Food Safety Act 1990*

⁴⁰ *Clydesdale District Council v Humphrey Errington and Co*

A Central Scotland E. coli 0157 Project Research Group was set up to co-ordinate and present proposals to the Pennington Group and to the Chief Scientist's Office. It has suggested topics in three areas

- Clinical - to elucidate factors predisposing to development and severity of disease, and the value of clinical regimes. Long term follow up, including period of excretion of bacteria, and effect of complications. Exchange of information with other research groups.
- Microbiological - Studies of antibodies in the blood of those affected including asymptomatic excreters. Study of diagnostic tests such as stool cultures, and of toxin levels in stools.
- Epidemiological, environmental, economic and social - to study secondary spread and the relative importance of cross contamination and the asymptomatic food handler in the Central Scotland and similar outbreaks. To study socioeconomic effects of the Central Scotland outbreaks and the costs and benefits of public health intervention and to assess effectiveness of communications with the public and the media.

There will be many areas in which our ability to combat this organism will benefit from further knowledge such as information on carriage rates in man and animals (including asymptomatic excreters), and concerning bacterial load in individuals.

2. Response to the Pennington Report

Differing perspectives inevitably affect reactions to the report. Public health experts backed Professor Pennington's calls for new licensing arrangements for butchers' shops. The Chartered Institute of Environmental Health which represents EHOs said they should be introduced as soon as possible to protect public health. It is still unclear how far licensing arrangements would go and if they would apply to cafes and restaurants. Licensing before shops were opened would allow environmental health officers to ensure safe working practices from the start.

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Chairman of the CIEH⁴¹ food committee, David Statham, said⁴²:

"It could in many cases remove the need for expensive enforcement action or intensive detective work involved in tracking down the causes of major outbreaks of food-borne illness".

The National Federation of Meat and Food Traders, which represents about 3,500 independent retail butchers criticised the report for going too far⁴³:

"Much of the recommendations reflect good practice for butchers which we support. However, we do have concerns on issues of separation. Selective licensing, we feel, goes beyond what is necessary to ensure the safe supply of food to the public. As we have said before, existing legislation properly enforced, sees to that."

It is important to remember that although the Pennington Report necessarily concentrates on the hazards of contamination of meat, other foods besides meats have caused outbreaks and other premises besides butchers shops have been the setting, notably catering premises. Outbreaks have been ascribed to handling soiled potatoes, apple juice, yoghurt and unpasteurised milk. Person to person transmission also occurs. Therefore measures to ensure food safety must have a broad application. RJ Salmon, consultant epidemiologist at the Communicable Disease Surveillance Centre, has said⁴⁴:

"Prevention may rest principally on the judicious application of time honoured principles of public health rather than on research"

It would seem that hazards that have become apparent in the area of food safety - BSE, and the general increase in foodborne disease may necessitate a tightening of regulatory control and an alteration in the balance between the consumer and the food industry.

There have been many who felt the failure to enforce food safety regulations detailed in the Pennington report lend support to the case for an Independent Food Safety Agency. Gavin Strang, the former Shadow Agriculture Minister, said⁴⁵:

⁴¹ Centre for Infection and Environmental Health

⁴² *Press Association* 8 April 1997

⁴³ Roger Kelsey, President National Federation of Meat and Food Traders reported by *Press Association* 8 April 1997

⁴⁴ *British Medical Journal* vol 314 25 January 1997

⁴⁵ 08 Apr 97 *Press Association*

"The report repeatedly uses the words 'light touch'. The Government have put the dogma of deregulation before the safety of consumers"

The Chairman of the British Medical Association Council has also called for an independent body to advise the Government, representing all the major interests and covering food safety, quality and nutrition.⁴⁶

Measures in the food industry to ensure the safety of the consumer will put a financial burden upon the industry, which to some extent will be passed on to the consumer. It may be that informing and educating the public about the measures necessary to ensure proper food hygiene including those in the home, will prepare them for the notion that food prices may rise to achieve a higher level of food safety.

C. Funding

In reply to a Parliamentary Question the following figures for the annual spending on research into *E. coli* 0157 were given by the then Parliamentary Under-Secretary of State for Health, John Horam⁴⁷, in conjunction with the figures for another bacterium responsible for food poisoning, *Campylobacter*:

Campylobacter and E. coli
Department of Health research and surveillance expenditure

<i>Financial year</i>	<i>Campylobacter</i>	<i>E. coli</i>
1993-94	339	185
1994-95	405	397
1995-96	702	549
1996-97*	608	797

**amount committed to spend through contracts*

Disquiet has been voiced over the level of funding for basic research on food safety. Professor Alan Malcolm, of the Institute of Food Research, said that about 25% has been slashed from his centre's budget - a total of £1.8 million⁴⁸.

⁴⁶ *British Medical Journal* vol. 314 19 April 1997

⁴⁷ HC Deb 5 December 1996 c763

⁴⁸ *The Observer* 1 December 1996

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"Some of our studies involve *E. coli*. Other work could lead to the development of simple diet changes that will make it easier to destroy bugs in our stomachs. We have developed tests for detecting peanut derivatives which can kill allergic children, and many other products. all these are threatened - at a time when society needs them most."

In June 1996 Professor Pennington wrote⁴⁹ on the reappearing threat from infection set in context of the massive reduction of research spending in the field of bacteriology.

"Research funding has been hit hard - so reduced that the Medical Research Council cannot fund more than 20% of grant applications". He flagged up the need not only for increased funding for research but prophetically the necessity for concentration on bacteriology "The formation of a formal strategic alliance with all academic and NHS professionals who combat infection , particularly public health specialists and infectious disease physicians should be given paramount importance"

D. Prospects for the future

Research currently being undertaken in many areas will hopefully be of practical use in the next few years:

- New rapid tests designed to detect *E. coli* in water. Water suppliers and companies that use water have traditionally relied upon culturing the bacteria on agar plate, which takes 2-3 days. Several companies are developing more efficient systems of detection, including Celsis International, which launched its "Colicount" test in April 1997.
- The molecular structure of verocytotoxin, the protein produced by *E. coli* 0157 which binds to the kidney to cause damage, has been elucidated by a team at St. Andrews University led by Professor Steve Homans.⁵⁰ It is hoped that this knowledge will lead to the development of a drug that interferes with the action of the toxin. Its subsequent development would be dependent on funding from the pharmaceutical companies. Prof Homans described the difficulties⁵¹:

"All we can do is produce a possible compound which could be developed as a drug and hope the industry picks up the tab, which could be millions"

⁴⁹ *Herald* 11 June 1996 "Danger of the Disease revival: TH Pennington, Professor of Medical Microbiology at Aberdeen University, looks at the new threat from infection"

⁵⁰ *Nature Structure Biology (USA)*, 1997, 4/3 (190-183) Solution structure of the carbohydrate-binding B-subunit homopentamer of verotoxin VT-1 from *E. coli* Richardson JM, Evans PD, Homans SW, Donohue-Rolfe A

⁵¹ *The Scotsman* 16 April 1997

- Scientists have been researching into high pressure treatment as a method of preserving foods whilst retaining flavour and colour and nutrients such as vitamins. The foods are subjected to up to 9,000 times normal atmospheric pressure, destroying bacteria such as *E. coli* and listeria.⁵² At present spore-forming bacteria such as *Clostridium botulinum*, which causes botulism, are proving resistant to high pressures. The process does not involve chemicals, providing an additional advantage. Research in Japan, where a particular brand of treated fruit and dairy products has become much sought after, is attracting industry sponsors elsewhere in the world. The US Department of Defence is developing pressure-treated field rations.⁵³
- Vaccines could long-term protect farm stock. A vaccine that protects against salmonella has successfully been tested on farm animals. Clinical trials on a vaccine to tackle *E. coli* are expected to be carried out in Australia in 1997.⁵⁴ Professor Pennington has said⁵⁵:

"A major difficulty exists in animals and in those animals it causes no problems ... It may turn out that the only way we can get rid of it is with a vaccine. But who is going to immunise healthy animals to protect people? Is the farmer going to pay to immunise animals when it isn't going to have an economic effect on his herd?"

While research is being accelerated to promote understanding of the of the bacterium and the factors favouring its presence in animals and man, control of the organism through public health measures must remain of paramount importance. This will be a challenging task for the Government's proposed Food Safety Standards Agency.

⁵² *New Scientist* 12 April 1997

⁵³ *The Scotsman* 10 April 1997.

⁵⁴ *The Scotsman* 2 December 1996

⁵⁵ *ibid*

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