CANCER AND CANCER CARE

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2 CANCER RISK AND SCREENING

CHRISTINE CAMPBELL

Chapter outline

- Cancer risk and lifetime risk of most common cancers
- Main risk factors for developing cancer, including genetic risk and lifestyle factors
- Primary and secondary prevention strategies to modify cancer risk
- Effective communication of cancer risk
- Purpose and principles of screening and selected screening terminology
- Current screening programmes in the UK
- Barriers to participation in screening and the importance of informed choice

INTRODUCTION

The aim of this chapter is to introduce the reader to concepts relating to the risk of developing cancer and to issues in cancer screening. Cancer screening has an important role in any national strategy to reduce cancer-related mortality. The majority of cancers present symptomatically and, therefore, evidence-based and adequately resourced pathways to diagnosis are essential within the health service. Additionally, effective cancer screening programmes can raise awareness of a particular cancer and associated symptoms, drive improvements in treatment options, and contribute to detection and treatment of early stage disease.

CANCER RISK

What is risk, and how is it quantified?

Within healthcare, risk is the probability of the occurrence of a future adverse event such as death, disease, or a complication of disease. In terms of cancer, the term risk is employed to describe the likelihood of developing or dying from cancer. **Lifetime risk** is a commonly used term, and refers to the likelihood of a person developing cancer in their lifetime (either from birth or during a specified age span): estimates of lifetime risk are usually expressed as the odds of developing cancer ('1 in x') or as a percentage (Cancer Research UK, 2014r; Sasieni et al., 2011).

Risk of developing cancer

The risk of an individual developing cancer is affected by many factors including **genetic** and **lifestyle**, some of which are outlined later. It is estimated that over 1 in 3 people in the UK will be diagnosed with at least one type of cancer during their life. The highest lifetime risks for men are prostate cancer (1 in 8), lung cancer and bowel cancer (both 1 in 14), while for women breast cancer (1 in 8), lung cancer (1 in 18) and bowel cancer (1 in 19) are the most common (Cancer Research UK, 2014r). Fifty-four percent of cancer incidence in the UK is due to cancers at only four sites: breast, lung, bowel and prostate.

CANCER RISK FACTORS

Age

Cancer is largely (though clearly not exclusively) a disease of older age. Although approximately 1 in 3 of the population will develop cancer at some point in their lifetime, over a third are in those aged over 75 years (Cancer Research UK, 2014r). With life expectancy continuing to increase in the UK, cancer in the elderly will become more common. However, cancer is also frequently diagnosed in those aged over 50 years, with 53% of cancers occurring in those aged 50–74 years, and prostate, lung and bowel cancer being most common in men, and breast, lung and bowel cancers being the most frequent in women (Cancer Research UK, 2014s). Screening for breast cancer in women and more recently for bowel cancer in both men and women contributes in part to the high incidence of these cancers in this age group. In adults aged between 25–49 years, breast cancer is by far the most common cancer (Cancer Research UK, 2014s). Cancer is relatively rare in teenagers and young adults (15–24 years), and among children (0–14 years), with less than 1% of total cancers in the UK diagnosed in each of these groups. Leukaemia is the most common childhood cancer (Stiller, 2007; Murphy et al., 2013).

Genetic

Although the majority of cancers are sporadic, a proportion of all common cancers have a familial component, for example between 5–10% of individuals with breast, colorectal or ovarian cancer will have a **family history** of first or second degree relatives with the same cancer, suggestive of an inherited predisposition (American Cancer Society, 2013). Approximately 1% of all cancers are associated with a **high-risk mutation** in one of a number of genes (Garber and Offit, 2005): some of these are associated with very rare familial cancer syndromes, others with common cancers, and many are associated with early onset of the cancer (often below the age of 40). An inherited predisposition to one cancer may also increase the risk of developing other cancers. **Mutations** in **BRCA1** (associated with breast ovarian, bowel and prostate cancers) and **BRCA2** (associated with breast, ovarian, prostate and pancreatic cancers) are found in 1 in 850 and 1 in 500 individuals, respectively, although mutations in both are found in 1 in 100 of Ashkenazi Jews, and are also more common in those of African–American and Afro-Caribbean descent (Levy-Lahad and Friedman, 2007; Nelson et al., 2013). **Familial Adenomatis Polyposis** (FAP) accounts for just under 1% of new

colorectal cancers, and is caused by mutations in the adenomatosis polyposis coli gene: this mutation has 100% penetrance (Galiatsatos and Foulkes, 2006). **Hereditary non-polyposis colorectal cancer** (HNPCC or Lynch syndrome) is associated with up to 5% of new colorectal cancer cases (Lynch et al., 2009). Specialist cancer genetics clinics provide support to individuals and families: assessing an individual's risk of developing cancer is complex, and has the potential to cause significant distress, including anxiety, depression, and poorer quality of life. Counselling recommendations emphasize the need to carry out a detailed psychosocial assessment, and contextualizing risk communication to the individual's life situation (Trepanier et al., 2004). Key areas relating to psychosocial and behavioural aspects of **genetic counselling** and testing for BRCA1/2 mutations, and for FAP, have been reviewed (Vadaparampil et al., 2006–2007; Douma et al., 2008).

Smoking

Over a quarter (28%) of all cancer deaths in the UK are linked with smoking and, as such, smoking is the single most avoidable risk factor for cancer (Sasco et al., 2004). Smoking is linked with 87% of male lung cancer deaths and 83% of female lung cancer deaths: 10% of these are from exposure to environmental tobacco smoke ('passive smoking') (Parkin et al., 2011; Jamrozik et al., 2005). The link with lung cancer is well established (Doll and Hill, 1950), but epidemiological evidence also demonstrates a link between tobacco consumption and a long list of other cancers, including those of the oral cavity (mouth, tongue and lips), nose and sinuses, the larynx and pharynx, oesophagus, stomach, pancreas, cervix, kidney, bladder and colorectal cancers, as well as some leukaemias (Parkin et al., 2011). Although cigarette smoking rates in the UK have fallen in both men and women in recent decades (Wald and Nicolaides-Bouman, 1991; Office for National Statistics, 2012), smoking prevalence is currently 21% in males and 20% in females, with a strong gradient by socio-demographic group, and by age group (less than 15% of those aged over 60 are current smokers). Globally, cigarette smoking is projected to contribute to cancer in up to 1000 million in the twenty-first century (World Health Organization (WHO), 2011).

Alcohol

Alcohol is one of the most well established causes of cancer, to the extent that it has been rated a 'Class 1' (i.e. the highest category) carcinogen since 1988 (International Agency for Research on Cancer, 1988). Alcohol is associated with 4% overall of cancers in the UK (Parkin et al., 2011). Upper aero-digestive tract cancers (the oral cavity, pharynx, larynx and oesophagus) have the highest alcohol-attributable levels (up to 30%), but even moderate drinking is associated with increased risk of breast and bowel cancer (Corrao et al., 2004; Key et al., 2006; Stickel et al., 2002). Liver cancer is linked to long-term alcohol use (Stickel et al., 2002).

Occupational exposures

It is estimated that over 13,500 cancers are caused in the UK each year due to occupational exposure to **carcinogens** (Parkin, 2011; Baan et al., 2009): this equates to 8% of male cancer

deaths and 2% of cancer deaths in women. Occupational exposure to asbestos is attributed to between 80–97% of mesothelioma cases or deaths in men (Rushton et al., 2012) and is particularly common among those who worked in shipbuilding, construction or as carpenters. Lung cancer has also been linked to asbestos exposure, as well as to mineral oils, silica and radon amongst other carcinogens. Other cancers with an occupational link include bladder (e.g. exposure to paint, diesel fumes), larynx (exposure to asbestos), and liver (exposure to vinyl chloride) cancers (Boffetta et al., 2003; Parkin et al., 2011). Shift work has been linked to breast cancer (Megdal et al., 2005).

Infections

Globally, infections by **viruses** are estimated to contribute to 2 million new cancer cases each year (Boyle et al., 2003). The majority of these are in less developed regions of the world (de Martel et al., 2012): in the UK, 3% of new cancer cases per annum are linked to infections (Parkin et al., 2011). Persistent infection with the human papilloma virus (HPV) is a necessary step in the development of cervical cancer (Schiffman et al., 2007). Epstein–Barr virus (EBV) is related to around 45% of Hodgkin lymphomas in the UK; it is estimated that *Helicobactor pylori* infection is linked to just over 30% of stomach cancers in the UK, while approximately 16% of liver cancers were linked to infection with either hepatitis B virus (HBV) or hepatitis C virus (HCV) infection (compared to 85% of all liver cancer cases worldwide) (Parkin et al., 2011; Parkin, 2006). Kaposi's sarcoma is associated with HIV/AIDS (Antman and Chang, 2000).

Diet and body weight

Recent evidence suggests that over 17,000 cancers per year in the UK are linked to being **overweight** (body mass index (BMI) of 25–30) or **obese** (BMI ≥ 30) (Parkin and Boyd, 2011). These include postmenopausal breast cancer (up to 30% increased risk), and colon (particularly in men), endometrial, kidney, oesophagus, gallbladder and pancreas, with weaker evidence for a number of other cancers. Over 65% of men and over 55% of women in the UK are either overweight or obese; however, the links between body weight and cancer are complex and mechanisms of action are not yet fully understood. Body fat becomes an additional source of oestrogen, which increases the risk of selected cancers (Huang et al., 1997). The role of diet and nutrition in cancer causation is similarly complex – although up to 5% of cancers in the UK are estimated to be linked to low intake of fresh fruit and vegetables containing **antioxidants**, their protective effects are likely due to the interactive effect of many different chemicals. The World Cancer Research Fund estimates that about a third (38%) of 12 of the most common cancers in the UK could be prevented through improved diet, physical activity and body weight (World Cancer Research Fund, 2007).

Hormones

Both **endogenous** and **exogenous hormones** have been linked with increased cancer risk. In men, no link has been found between endogenous sex hormones and overall prostate cancer risk, but in women the risk of developing breast, ovarian and endometrial cancers is increased

with early menarche and later menopause, and reduced with full-term pregnancy. The risk of breast cancer is reduced with breastfeeding. The risks of endometrial and ovarian cancers appear to be reduced with the use of oral contraceptives containing oestrogen and progesterone, whereas the risks of breast, cervical, and liver cancer appear to be increased (Burkman et al., 2004). Levels of these hormones differ by specific type and formulation of contraceptive, as does the associated risk. Oestrogen-only hormone replacement therapy is associated with a doubling of risk of uterine cancer after five years of use. For ovarian cancer the risk is increased by approximately 25%, which can be associated with use of the combined oestrogen and progesterone HRT (Pike et al., 2004; Lacey et al., 2002; Pearce et al., 2009).

Physical activity

Approximately 1% of cancers in the UK have been linked with physical inactivity, with consistent evidence now emerging that individuals with lower levels of physical activity have an increased risk of cancers independent of body weight. Physical activity seems to have a protective association with colon cancer in both men and women (Wolin et al., 2009), and with both breast and endometrial cancer in women (Moore et al., 2010; Wu et al., 2013).

Sunlight

The incidence rates of **malignant melanoma** have risen dramatically since the early 1970s and this increase is expected to continue for another two decades. Over 85% of new cases are linked to excess exposure to ultraviolet (UV) radiation, either through sunlight or use of sunbeds. Intermittent sun exposure to high-intensity sunlight resulting in sunburn episodes over a lifetime, and use of sunbeds at any age are both linked to increased melanoma risk (Cancer Research UK, 2014t; Cogliano et al., 2011; Parkin, Boyd and Walker, 2010).

MODIFICATION OF CANCER RISK: PRIMARY PREVENTION

Lifestyle measures

Prevention offers the most cost-effective long-term strategy for the control of cancer. **Prevention measures** are required and can be effective at both the individual and the population level (World Cancer Research Fund, 2007). There is good evidence that smoking cessation reduces an individual's risk of lung and other cancers, whilst at a national and global level the tobacco control measures in the World Health Organization Framework Convention on Tobacco Control seek to reduce the prevalence of tobacco use and exposure to tobacco smoke (WHO, 2003). Guidelines have been developed regarding optimal levels of fruits, vegetables and other foods from plant sources, such as whole grains and beans, use of fewer high-fat foods and recommendations on alcohol consumption (World Cancer Research Fund, 2007). Similarly, the UK's Chief Medical Officers provide guidelines regarding physical activity

(DH, DHSSPS, The Scottish Government and Welsh Government (2011)) – although research is ongoing into optimal levels for cancer prevention, at least 30 minutes of physical activity per day is currently recommended. Healthcare professionals are increasingly involved in delivery of these and similar messages, with the aim not just of reducing the risk and rates of cancer but also other non-communicable diseases. *The European Code Against Cancer* (Association of European Cancer Leagues, 2010–2014) promotes the following key **health promotion** messages:

1. Do not smoke. If you smoke, stop doing so. If you fail to stop, do not smoke in the presence of non-smokers.
2. Avoid obesity.
3. Undertake some brisk, physical activity every day.
4. Increase your daily intake and variety of vegetables and fruits: eat at least five servings daily. Limit your intake of foods containing fats from animal sources.
5. If you drink alcohol, whether beer, wine or spirits, moderate your consumption to two drinks per day if you are a man or one drink per day if you are a woman.
6. Care must be taken to avoid excessive sun exposure. It is specifically important to protect children and adolescents. For individuals who have a tendency to burn in the sun, active protective measures must be taken throughout life.
7. Apply strictly regulations aimed at preventing any exposure to known cancer-causing substances. Follow all health and safety instructions on substances that may cause cancer. Follow advice of national radiation protection offices.
8. Women from 25 years of age should participate in cervical screening. This should be within programmes with quality control procedures in compliance with 'European Guidelines for Quality Assurance in Cervical Screening'.
9. Women from 50 years of age should participate in breast screening. This should be within programmes with quality control procedures in compliance with 'European Guidelines for Quality Assurance in Mammography Screening'.
10. Men and women from 50 years of age should participate in colorectal screening. This should be within programmes with built-in quality assurance procedures.
11. Participate in vaccination programmes against hepatitis B virus infection.

Reflective activity

Healthcare professionals are being encouraged to think of all healthcare encounters as potential opportunities to promote healthy lifestyle messages. Reflect on patients you have cared for recently where you recognized that unhealthy lifestyles (e.g. smoking, obesity, etc.) were likely to be contributing to poorer health outcomes. Consider conversational approaches that might have allowed you to sensitively explore patients' own awareness of these risk factors, and their willingness to change.

Consider what might be the sensitivities of these type of conversations and how best to avoid patient distress, embarrassment, or subsequent reluctance to engage with healthcare.

Vaccination

A number of vaccines have been developed or are currently being developed against cancer-causing viruses (Dochez et al., 2014). Prophylactic HPV vaccines have been developed against HPV types 16 and 18 that are based on virus-like particles, induce high titres of neutralizing antibodies and have been shown to be effective in preventing type 16 and 18 cervical intraneoplasia. The optimal age to vaccinate is pre-adolescence. The UK has a school-based programme of HPV vaccination (Russell et al., 2013).

MODIFICATION OF CANCER RISK: SECONDARY PREVENTION (SCREENING)

The purpose of screening is to identify early disease, or precursors of disease, before it becomes a cancer (i.e. to identify people with an earlier stage of cancer than if they presented with symptoms). The term screening is often used loosely and can refer either to when screening is offered opportunistically to an individual, or in a more systematic approach to a group of people or an individual. Mass screening refers to screening of eligible age groups in the population, and selective screening refers to screening high-risk groups (e.g. those with familial cancer syndromes).

Programmatic **cancer screening programmes** (as carried out in the UK and in many other countries (Benson et al., 2008; Dowling et al., 2010) seek to provide a quality assured and evidence-based service at a population level. The formal definition from the UK National Cancer Screening Committee is given in below.

UK National Cancer Screening Committee

Screening is a process of identifying apparently healthy people who may be at increased risk of a disease or condition. They can then be offered information, further tests and appropriate treatment to reduce their risk and/or any complications arising from the disease or condition (UK National Screening Committee, 2014).

Principles of cancer screening

In the 1960s, WHO commissioned a report on screening that led to the development of screening criteria. These were based, among other factors, on the capacity to detect the condition at an early stage and the availability of an acceptable treatment, and have become the standard screening criteria to guide decision-making in establishing cancer screening programmes (Wilson and Jungner, 1968).

More recently, these criteria have been updated to reflect the now widespread screening for genetic conditions, as well as newer issues that have emerged over the last four decades that have shaped both Western medicine and society more generally, including trends such as increased

consumerism, the emphasis on informed choice and on evidence-based healthcare, and the rise of healthcare systems where cost-effectiveness, quality assurance, and accountability of decision makers are recognized (Andermann et al., 2008). The use of potential biomarkers for cancer screening will also become more commonplace in the next decade. The new criteria are:

- The screening programme should respond to a recognized need.
- The objectives of screening should be defined at the outset.
- There should be a defined target population.
- There should be scientific evidence of screening programme effectiveness.
- The programme should integrate education, testing, clinical services and programme management.
- There should be quality assurance, with mechanisms to minimize potential risks of screening.
- The programme should ensure informed choice, confidentiality and respect for autonomy.
- The programme should promote equity and access to screening for the entire target population.
- Programme evaluation should be planned from the outset.
- The overall benefits of screening should outweigh the harm.

Screening should never be considered as merely the provision of a test, rather as a system where improved cancer outcomes are achieved through earlier detection by means of the test, coupled with the provision of effective and available treatment options ('sieving and sorting').

Terms used in cancer screening

A number of terms are commonly used when describing the evaluation of screening services and the effectiveness of specific screening modalities (see Raffle and Gray, 2007: 86–96 and Bhopal, 2008: 178–90 for detailed descriptions).

Selection bias – people that choose to take part in screening differ from those that don't. Individuals who participate in screening – the 'healthy screenee' tend to be healthier than those who do not, for many reasons (see 'Barriers to screening participation' below).

Lead time bias – apparent improvement in survival due to earlier date of diagnosis by screening compared with the usual time of diagnosis by symptomatic presentation.

Length time bias – screening more likely to pick up slower growing tumours with better prognosis (screen-detected cancer cannot be assumed to be directly comparable to those that present symptomatically).

Overdiagnosis bias – detection of pre-invasive disease that would not have progressed to invasive disease (e.g. *ductal carcinoma in situ*), although in reality it is not possible to distinguish for any one individual whether this applies.

Sensitivity – the ability of a test to detect the condition that the test is measuring for when the condition is actually present (i.e. the proportion of people who have the disease that have a positive test).

Specificity – the ability of the test to detect that the condition being measured for by the test is not present when it is, in fact, not present (i.e. the proportion of people who do not have the disease that have a negative test).

True positive – the individual has the condition, and the test result is positive.

True negative – the individual does not have the condition, and the test result is negative.

False positive – the individual does *not* have the condition, and the test result is positive.

False negative – the individual *has* the condition, and the test result is negative.

Positive predictive value – the proportion of people with a positive test that have the disease.

Negative predictive value – the proportion of people with a negative test that don't have the disease.

A variety of study designs are used to evaluate screening (see Raffle and Gray, 2007 and Bhopal, 2008). Cohort studies can compare survival in screen-detected and non-screen-detected (i.e. symptomatic) cases. Time-trend studies compare trends in incidence and death before and after the introduction of screening, but this method is prone to bias from changes in diagnosis or treatment. Case-control studies to compare screening history are useful particularly to examine the impact of different policies and protocols, but they cannot reliably measure the differences between screened and not-screened population. Well-conducted and adequately powered randomized control trials (RCTs) are the only rigorous way of evaluating the effectiveness (and if designed well, the cost-effectiveness) of a new screening modality.

Current screening modalities within the UK

Cervical screening

The UK had a longstanding cervical cytology programme, which underwent a major upgrade around twenty years ago. The programme is estimated to save around 4500 lives per year, and the number of cervical cancer cases has decreased by about 7% each year since the 1980s (Sasieni et al., 2003). In England, all women aged between 25 and 64 are invited for cervical screening. Women aged between 25 and 49 are invited for testing every three years, and women aged between 50 and 64 are invited every five years. Currently, cervical screening is based on **liquid-based cytology** (National Office of the NHS Screening Programme, 2014a). More recently, in England, HPV triage has been introduced into the cervical screening programme based on evidence of effectiveness in sentinel sites (Kelly et al., 2011). If a conventional smear is found to have borderline changes or low-grade dyskaryosis, the sample is tested for human papilloma virus (HPV). If this is HPV positive, the woman is invited to attend a colposcopy; if negative she returns to a regular screening invitation every 3–5 years (dependent on age). There are some differences across the UK: in Scotland and Wales, cervical screening is offered to eligible women aged 20–60 every three years, but this will change to 25–64 years from 2015 (Cancer Research UK, 2014u). In England, cervical screening coverage (the proportion of women who have been screened within the past five years)

is approximately 80%, with variation by socio-economic status and ethnicity, and markedly lower coverage in younger women from more deprived areas (National Office of the NHS Screening Programme, 2014b). Trials are ongoing to examine whether self-sampling will be effective in increasing coverage (Szarewski et al., 2011).

Breast screening

Two-view mammography is used in all national breast-screening programmes across the UK. **Digital mammography** is currently being introduced nationally (National Office of the NHS Screening Programme, 2014c). Across the UK, women aged 50–70 are invited for breast screening with mammography every three years. Women over 70 are eligible for breast screening but are not automatically invited, although a trial is underway examining the potential benefits of extending breast-screening age to women aged 47–49 and 71–73 (Moser et al., 2011). Of the 2.3 million women aged 50–70 years invited for a mammogram in 2010–2011, the average attendance was 73.4%, with variation by geographical region, ethnicity and by socio-economic status (National Office of the NHS Screening Programme, 2014d).

Bowel screening

Following large-scale pilots of the feasibility and acceptability of screening with the guaiac-based **faecal occult blood test** (FOBT) (Moss et al., 2011), roll-out of routine FOBT for men and women aged 60–69 years began in England from 2006 (Cancer Research UK, 2014v). Screening is administered through five screening 'hubs' with around 100 centres where colonoscopy and any required treatment takes place. Participation in bowel screening is lower than for either breast or cervical screening at approximately 55%. In Scotland and England, 50–74-year-olds are invited; in Northern Ireland the age range is between 60 and 71 with extension up to 74 from mid-2014, while in Wales the age range is 60–74 years, with plans to reduce the age to those aged 50 over the next few years (Cancer Research UK, 2014v). There is good research evidence that the use of immunochemical FOBT kits, which have more acceptable modes of stool sampling, has the potential to increase uptake and may be introduced into the programme. Results of the major RCT of **flexible sigmoidoscopy** (FS) together with clinical and cost-effectiveness modelling suggests that a one-off FS could reduce incidence of colorectal cancer by 33% and mortality by 43% in the screened population (Atkin et al., 2010), and the UK National Screening Committee has recommended that FS be introduced. Pilots are underway of a one-off FS at 55 years, followed by a FOBT from 60–69 years (National Office of the NHS Screening Programme, 2014e).

PSA testing

There is currently no screening programme in the UK for prostate cancer. Although one European study has shown deaths from prostate cancer could be reduced by 20% if there was a screening programme using the **prostate specific antigen** (PSA) test, only one additional life would be saved for every 48 men treated, and a North American study demonstrated no reductions in prostate-specific mortality (Andriole et al., 2009; Schröder et al., 2009). However, rather than a national screening programme, there is an informed choice approach called

'prostate cancer risk management' where the benefits and harms of PSA testing are presented (National Office of the NHS Screening Programme, 2014f).

Barriers to screening participation

Uptake is the most important factor in determining the success of any screening programme. As described earlier, uptake in the three screening programmes in the UK varies considerably. This is particularly true for bowel screening. The reasons are complex, and are often underpinned by a range of health beliefs and cultural attitudes. Generic factors across all cancer sites include a perceived lack of clinical support (for some, this is especially so if no primary care provider is involved in the screening process), fear of a cancer diagnosis or of treatment and side effects, a lack of understanding of the nature of screening (e.g. in the absence of symptoms), or embarrassment at the procedure. For many, conflicting priorities, including lack of time to attend a screening appointment, caring responsibilities, and existing poor physical or mental health, are important deterrents to screening participation. For some, cultural concerns, such as taboos around handling and storing faecal matter, fatalistic beliefs, poor understanding of the health system, and concerns around cost and access, may play a role. The importance of poor health literacy is increasingly being acknowledged as a barrier (Weller and Campbell, 2009; Power et al., 2009; Weller et al., 2009).

Considerable research efforts seek to address these barriers to participation, even whilst acknowledging the need to respect the principle of informed choice. Examples include the introduction of more acceptable screening modalities, such as a one-sample immunochemical FOBT and HPV self-sampling tests. Another strategy involves improving access through extended screening facility hours, more convenient locations and reducing or eliminating direct costs. Adapting recruitment materials by development of targeted and tailored materials to meet the information needs of specific communities has been adopted. There is good evidence that use of pre-notification letters and reminders can improve uptake. Primary care can play a role through endorsement of invitations, contacting non-responders and general practice-based promotion of screening (Weller and Campbell, 2009).

Benefits and harms of screening

No screening test or procedure is perfect, and screening therefore has the potential to benefit an individual, but also to harm him/her (Raffle and Gray, 2007). Benefits may include improved prognosis for some cases, less radical treatment, resource savings and the reassurance for negative test results. Disadvantages may include longer morbidity where the prognosis is unaltered, over-treatment of abnormalities that would not have progressed to become malignant, resource costs, false reassurance for false negatives, adverse effects of false positives including psychological distress and unnecessary testing, and exposure to hazards of a test (such as colon perforation with colonoscopy). A review of the psychological sequelae following a false positive mammogram found that studies using disease-specific measures (such as the Psychological Consequences Questionnaire, PCQ) suggested that negative psychological impact can last up to three years, with the degree of distress related to the extent of invasiveness of the investigation (Bond et al., 2013). High distress levels have also been associated with false positive bowel screening results (Denters et al., 2013).

CASE STUDY

Mr Murray, a 62-year-old man, is visiting his general practice nurse for routine diabetes checks. The general practice takes a proactive approach to encouraging patients to consider all relevant screening invitations, and the practice nurse sees in Mr Murray's notes that he has not taken part in bowel cancer screening despite repeat invitations. The practice nurse decides to explore this decision, and it quickly becomes clear that Mr Murray has received and read the invitations but is very concerned that treatment for any cancer detected might be ineffective – he lost a friend to advanced bowel cancer despite chemotherapy. The nurse and Mr Murray then spend some time discussing the purpose of screening to detect early bowel cancer, where survival outcomes are higher. They also discuss the pros and cons of screening, including the potential for distress caused by an abnormal test result, as well as the need to be vigilant for symptoms.

Informed choice in cancer screening

There has been controversy about the balance of harms and benefits for breast screening over recent years, leading to an expert panel Breast Screening Review in the UK in 2011/2012 (Independent UK Panel on Breast Cancer Screening, 2012). The Report estimated that although screening prevents about 1300 breast cancer deaths per year, it can also result in about 4000 women aged 50–70 in the UK having treatment for a problem that would not have troubled them (i.e. overdiagnosis). This has led to a renewed emphasis on informed choice and provision of clear and adequate information to women (National Office of the NHS Screening Programme, 2014g; Forbes and Ramirez, 2014). Informed choice principles involve recognition of the ethical underpinnings to any screening provision (autonomy, non-maleficence, beneficence, justice). It is clear, however, that although most people value information on the limits of screening, provision of information and education alone are not sufficient to facilitate an informed choice, and rather an individual's personal experience, values, and health and social contexts are equally or more important. The potential tension between personal autonomy and public health benefit is also recognized because facilitating informed choice does not necessarily increase uptake. However, autonomous decision-making does not preclude provider input: there is evidence that the UK public would welcome a recommendation from the NHS – not as an alternative to information, but as an *adjunct* to it, consistent with a 'consider an offer' approach (Waller et al., 2012; Entwistle et al., 2008).

Screening for other cancers

Policy documents emphasize strong commitments to cancer screening and prevention. The *Cancer Reform Strategy* (DH, 2007a: 47) stated 'We will extend and widen our existing screening programmes and continue to investigate opportunities for new screening programmes for other cancers', while the 2011 *Improving Outcomes: A Strategy for Cancer* had a strong public health focus particularly in areas such as diet, obesity, smoking and on screening participation across all communities (DH, 2011a).

There is currently no national screening programme for lung cancer in the UK; however, a recent trial in the USA has shown that screening individuals aged 55–74 who have cigarette smoking histories of 30 or more pack years with low-dose helical computed tomography (spiral CT) reduces lung cancer mortality by 20% and all-cause mortality by 6.7%. Screening would lead to false-positive test results in approximately 25% of those screened (Oken et al., 2011). Research is underway in the UK to examine how lung cancer screening may be introduced in the future for selected populations.

Randomized controlled trials are currently underway in the UK to assess the effectiveness of screening in high-risk women and in the general population for ovarian cancer with the tumour marker CA125 and transvaginal ultrasound (Institute for Women's Health, 2014). Results from the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS) will be available after 2015.

COMMUNICATING RISK TO PUBLIC AND PATIENTS

Communicating risk, whether to an individual and/or their family and carers, to other health professionals, or to a wider lay or professional audience, is an important skill. Effective risk communication needs to be transparent, understandable and meaningful to those receiving it and clear enough to allow others to make appropriate decisions based on the information received if necessary.

Cancer risk communication requires a balanced summary of available evidence of the potential benefits, and the potential harms, associated with participating in an activity (e.g. smoking cessation, participating in screening) or undertaking a course of treatment (e.g. chemotherapy). Provision of information should improve the recipient's perception and understanding of their own risk, enable a discussion and, where appropriate, ensure shared decision-making consistent with the patient's values (Ahmed et al., 2012).

There are a number of reasons why effective risk communication can be difficult, not least because many health professionals, as well as patients, have trouble interpreting health statistics (Gigerenzer et al., 2007). Low health literacy is also recognized as a contributing factor to cancer health inequalities because patients with low health literacy are less likely to participate in cancer screening, have less understanding of cancer susceptibility and the importance of early detection of a cancer, and may also lack numeracy skills to inform and guide their decisions (Dewalt et al., 2004; Davis et al., 2002).

A number of strategies have been developed to help address these and similar challenges. These include the use of **Framing manipulation**, where logically equivalent information can be provided in different ways, positively or negatively (e.g. 'screening will improve your chance of survival from cancer' versus 'not participating in cancer screening will reduce your chance of survival from cancer'). Presenting risk reduction (i.e. relative risk reduction, absolute risk reduction or number needed to treat), personalizing risk information (based on the individual's own risk factors), the use of natural frequencies (rather than percentages) and the use of decision aids (interventions designed to aid shared decision-making) have also been advocated (Ahmed et al., 2012). Recommendations have been developed to guide risk communication to patients: some of the most salient for cancer are provided below.

Recommendations to guide risk communication

- Use plain language to make verbal and written materials more understandable
- Present data using absolute risks
- Present information in pictographs if using graphs
- Present data using frequencies
- Use incremental risk to highlight how treatment can change risk from the pre-existing baseline level
- Recognize that the order in which potential benefits and harms are presented can affect risk perception
- Consider providing only the information that is most critical to the patient's decision-making, even at the expense of completeness

Source: Fagerlin et al. (2011).

Although challenging, early studies that explicitly apply these principles in cancer treatment contexts have encouraging initial results (Korfage et al., 2013).

Communicating uncertainty

There are times when the evidence base regarding risk information or treatment options is limited and/or ambiguous, presenting considerable challenges in how to communicate risk or the balance of potential benefits and harms in a meaningful way. Responding to uncertainty is influenced by both the clinician's and the patient's personal characteristics and values (Politi et al., 2007) – clinicians modify their risk communication strategies depending on their own perception of the patient's ambiguity aversion (Portnoy et al., 2013), while communicating uncertainty in shared decision-making can lead to less patient decision satisfaction (Politi et al., 2011).

Other sources of cancer risk information

Increasingly, the general public and patients and their families will make use of the vast array of health websites on the Internet to learn more about cancer risk and to inform their healthcare decisions. Clearly, there are many excellent health websites providing accurate and evidence-based information, but equally there are many that do not and not only provide inaccurate or out-of-date information but also cause unnecessary anxiety and fear. There is a need for health professionals to signpost patients and their families to reliable, high-quality online sites.

Key learning points

- Although there are no proven ways to prevent cancer, individuals can reduce their risk of developing this disease through healthy lifestyle choices.
- Cancer screening has the potential to reduce an individual's risk of developing cancer through detection of pre-neoplastic or early disease.

- Cancer screening is a process and, to be effective and efficient, each step should be underpinned by evidence.
- In the UK, screening programmes have been established for cervical, breast and bowel cancer. Reducing inequalities in participation across socio-economic and minority ethnic groups remains a challenge.
- Effective communication with patients and with the public about cancer risk, and about the potential benefits and harms of cancer screening, is an essential skill for healthcare providers to cultivate.

Recommended further reading

- World Cancer Research Fund/American Institute for Cancer Research. (2007) *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective* (www.dietandcancerreport.org/er)
- Raffle, A. and Gray, M. (2007) *Screening: Evidence and Practice*. Oxford: Oxford University Press.
- Bhopal, R. (2008) *Concepts of Epidemiology: Integrating the Ideas, Theories, Principles and Methods of Epidemiology*. 2nd edn. Oxford: Oxford University Press.
- Chamberlain, J. and Moss, S. (eds) (1996) *Evaluation of Cancer Screening*. London: Springer.
- NHS Cancer Screening Programmes (www.cancerscreening.nhs.uk/)

Examples of online resources

- Cancer Research UK (www.cancerresearchuk.org)
- Macmillan Cancer Support (www.macmillan.org.uk/Home.aspx)
- National Cancer Institute (www.cancer.gov) Although not a UK site and therefore some terminology and healthcare options are US-specific, this is a very helpful and comprehensive resource for both professionals and patients.
- American Cancer Society (www.cancer.org) Again, not a UK site, but a well-designed and informative resource for patients.