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Cancer Screening in the United States and Europe

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Cancer Screening in the United States and Europe

There are more than 100 types of cancers and, according to the World Health Organization (WHO), cancer is the leading cause of death worldwide. It was estimated that 7.6 million people died from cancer in 2008 (WHO, 2011). Screening has reduced the mortality rates for breast, colorectal, cervical, and even prostate cancer (Berry, Cronin, Plevritis, Fryback, Clarke, Zelen, et al., 2005; Etzioni, Gulati, Falcon, Penson, 2008; Peto, Gilham, Fletcher, Matthews, 2004; Rabeneck, Soucek, El-Serag, 2003; Vogelaar, van Ballegooijen, Schrag, Boer, Winawer, Habbema, et al, 2006). A third of cancers could be cured if detected early and treated adequately. Research supports the use of screening for breast, cervical, and colorectal cancers; the evidence for prostate and lung screening are not clear (Miller et al...).

A screening test can detect premalignant changes that can be treated to prevent cancer from developing or detect cancerous growth early, so that morbidity and mortality rates can be reduced. If cancer is detected, screening enables early diagnosis and treatment. Therefore, effective screening can reduce the burden of cancer on both the individual and society (Miller, Bowen, Croyle, & Rowland, 2008).

Epidemiology of Cancer in North America and Europe

In both the United States (US) and European Union (EU-27), lung, breast, colorectal, and prostate cancers account for more than half of all cancer incidents and deaths (WHO, 2011). Lung, colorectal, and breast cancers produce the highest mortality rates. Tables 1 and 2 show the incidence and mortality rates for these five cancers in the US and EU-27. However, the most recent available data compares North America (The US and Canada) with four areas of Europe: the western, eastern, northern, and southern regions (Jemal et al., 2011). Therefore, we will refer to these areas in comparing the epidemiology of these cancers.

Breast Cancer

Breast cancer is the most common cancer for women throughout the world. As shown in Table 3, the highest incidence rates are in Western Europe and the lowest in Central and Eastern Europe. It should be noted that the lower rates in Central and Eastern Europe may be attributed, at least in part, to the lower use of postmenopausal hormone therapy and to less mammography screening rather than an actual difference in incidence (Jemal et al., 2011). Though incidence rates are higher in North America than in most of Europe, North America's mortality rates for breast cancer are lower than Europe's (Jemal et al., 2011). Within Europe in 2008, Belgium, Denmark, France, and the Netherlands had the highest incidence rates of breast cancer and Bosnia Herzegovena, Republic of Moldova, and Ukraine had the lowest incidence (IARC, 2010). The mortality rates are highest in Ireland, Serbia, Belgium, and Denmark (IARC, 2010). Overall, the mortality rates are much lower than the incidence rates, and this discrepancy can be attributed to screening and early treatment.

Over the last decade, North America's cancer incidence rates have declined, whereas the incidence rates for all four European regions have increased (see Table 3). Mortality rates for all regions of Europe, as well as for North America, decreased between 2002 and 2011 (Parkin, Pisani, & Ferlay, 1999; Parkin, Bray, Ferlay, & Pisani, 2002; Jemal et al., 2011).

Cervical Cancer

In Europe, the highest incidence and mortality rates for cervical cancer are found in Central and Eastern Europe. This is consistent with data suggesting that the incidence and mortality rates are higher in developing countries than in developed countries. The higher rates in developing countries are attributed to the lack of screening and treatment available at the early stages of cancer (Jemal et al., 2011; Parkin, Pisani, & Ferlay, 1999; Parkin, Bray, Ferlay, & Pisani, 2002). As shown in Table 4, the highest incidence and mortality rates are in Central and Eastern Europe. Specifically, in 2008, Romania,

Macedonia, Bulgaria, and Lithuania had the highest incidence rates of cervical cancer and Romania, Macedonia, Serbia, and Lithuania had the highest mortality rates (IARC, 2010). Countries like Switzerland and Finland report cervical cancer incidence and mortality rates approximately 500% lower than these countries (IARC, 2010). In North America, rates have largely decreased from 2002 to 2011 (Jemal et al., 2011).

Colorectal Cancer

Colorectal cancer (CRC) is the third most commonly diagnosed cancer in males and the second most common among females. . In 2011, the highest incidence rate of CRC was found in Western Europe for both genders, with rates for women lower than men in all areas. In 2008, Hungary, Czech Republic, and Slovakia had the highest incidence and mortality rates for CRC for males and females combined (IARC, 2010). However, the countries of Western Europe, such as the Netherlands, Norway, Italy, Belgium, Ireland, and Germany all follow close behind (IARC, 2010). The lowest incidence rates in 2011 are in Central and Eastern Europe.

In examining incidence rates over time for men in the five regions, only North America had a decrease. For women, rates of CRC decreased between 1999 and 2011 in North America, Western and Northern Europe, but increased in both Central and Eastern as well as in Southern Europe (Parkin, Pisani, & Ferlay, 1999; Parkin, Bray, Ferlay, & Pisani, 2002; Jemal et al., 2011).

Prostate Cancer

Prostate cancer is the most prevalent cancer among males in developed countries (Jemal et al., 2011). The incidence rates in the four regions of Europe have increased dramatically. As shown in Table 6, the Western region of Europe has the highest incidence rates among all regions, followed by the U.S.. Ireland, France, Iceland, and Norway had the highest incidence rates for prostate cancer in Europe in 2008, and Estonia, Latvia, Sweden, and Denmark had the highest mortality rates (IARC, 2010). The

mortality rates are considerably lower across North America and Europe, having decreased in all regions except for Eastern Europe.

Lung Cancer

Lung cancer is the leading cause of cancer-related death for men, accounting for 17% of new cases of cancer and 23% of deaths worldwide. Within the five regions compared (see Table 7), males have the highest rates of lung cancer in Central and Eastern Europe, followed by North America at all three times (Parkin, et al., 1999; Parkin, Bray, Ferlay, & Pisani, 2002; Jemal et al., 2011). For women, North America had the highest incidence rates at all three times presented (see Table 7), followed by Northern Europe .

In all regions, rates among men have decreased over time. However, except Central and Eastern Europe, women's rates increased slightly, attributed to the increased smoking rates among women (Cancer Facts & Figures, 2010;) (see Table 7). The differences in rates among women between the US and Northern Europe and the rest of the regions are noteworthy.

With regards to mortality rates, trends closely follow incidence rates; men in Central and Eastern Europe have the highest rates, followed by Southern Europe, Western Europe, and North America. For women, mortality rates are the highest in North America, followed by Northern Europe and Western Europe. Thus, lung cancer is a leading cause of cancer-related deaths for both males and females.

Types of Screening Tests and Recommendations

The types of screening tests that are available in North America and Europe are the same, but the recommendations vary for which test to use for detection of specific cancers (e.g., colorectal cancer), when the test should be used, and on which age groups. In addition, in the US, the recommendations may vary, depending upon the source of the recommendation. Specifically, the main sources for recommendation are the US Preventive Services Task Force (USPSTF), National Cancer Institute (NCI),

and the American Cancer Society (ACS). There are also other groups, such as the American College of Obstetricians and Gynecologists, the American College of Chest Physicians, the American Society of Colon and Rectal Surgeons, and the American Urology Association, that also make recommendations for screening. In Europe, the European Commission, Directorate-General for Health and Consumers, Executive Agency for Health and Consumers, and WHO collaboratively made screening recommendations for Europeans.

Breast Cancer Tests.

Three screening tests for breast cancer are mammography, clinical breast exam, and magnetic resonance imaging (MRI). The MRI is usually performed for high-risk patients (e.g., BRCA1 or BRCA2 gene mutation, first-degree relative with BRCA1 or BRCA2 mutation). The screening recommendations for these tests are different for the US and the EU.

In the US, until recently, the recommendation was for women to start receiving an annual mammogram at the age of 40 and to continue for as long as they are in good health. However, a group of health experts, convened by the US Health and Human Services, recently changed the recommendation. They suggested that women with no known history of breast cancer begin screening at the age of 50, rather than 40, and that the screening be conducted every two years until the age of 74. They also suggested that, based on published studies, breast self-exams were not very effective in detecting breast cancer. Despite these controversial recommendations, the ACS still recommends that women start annual mammography screening at the age of 40, with no upper age limit. In Europe, the recommendation for breast cancer screening is for women aged 50 to 69 to have mammograms every 2 years (European Council Recommendation of 2 December, 2003, on Cancer Screening; IARC Working Group on the Evaluation of Cancer Preventive Strategies, 2002).

Cervical Cancer Tests.

The Papanicolaou (Pap) Test is the standard screening test for cervical cancer. In the US, it is recommended that women begin screening approximately 3 years after they start having vaginal intercourse, but not later than 21 years of age. After that time, screening should be done every one or two years until the age of 29. At the age of 30, women who have had three consecutive normal Pap test results should be screened every 2 to 3 years. It is also stated that women who are older than 30 should be screened every 3 years and should receive the human papilloma virus (HPV) test. Women 70 and older who have had three or more normal Pap tests in a row without any abnormal Pap test in the past 10 years may stop being screened. Women who have had a total hysterectomy may also stop being screened.

In Europe, the recommendation for cervical cancer screening varies across countries, with some implementing organized population-based screenings (e.g., Denmark, England, Finland, Hungary, Iceland) and others not (e.g., France, Germany, Luxembourg). The recommendation for the age at which screening for cervical cancer should start varies from 18 to 30 (Antilla et al., 2009). The age at which to stop screening also varies from 59 to no age limit (Antilla et al., 2009).

Colorectal cancer tests.

Four types of screening tests for colorectal cancer are the: *fecal occult blood test* (FOBT; a chemical test used to detect blood in the stool); *flexible sigmoidoscopy* (FS; using a hollow, lighted tube to visually inspect the walls of the rectum and sigmoid colon); *colonoscopy* (using a hollow lighted tube to visually inspect the walls of the rectum and the entire colon); and *double contrast barium enema* (DCBE; an x-ray technique for examining the colon) (Centers for Disease Control and Prevention, 2011;).

In the US, it is advised that an FOBT be conducted annually, an FS or double contrast barium enema every 5 years, or a colonoscopy every 10 years. The virtual colonoscopy is a newer test. It

requires a series of x-rays, called computed tomography (CT), to make a series of pictures of the colon. A computer puts the pictures together to create detailed images that may show polyps and anomalies on the inside surface of the colon. This test is also called colonography or CT colonography. The ACS recommends that this test be conducted every 5 years. Clinical trials are being conducted to compare virtual colonoscopy with the other colorectal cancer screening tests. Clinical trials also are underway to test whether drinking a contrast material that coats the stool, instead of using laxatives to clear the colon, will show polyps clearly. In Europe, the fecal occult blood test (FOBT) is recommended for men and women aged 50 to 74 years. Although other endoscopic exams are available, the FOBT is the only recommended cancer-screening test for colorectal cancer in Europe (Segnan, Patnick, & von Karsa, 2010).

Prostate Cancer Tests.

The Prostate-specific Antigen (PSA) test and the Digital Rectal Exam (DRE) are the tests used for prostate screening. The PSA test is a blood test that measures the levels of a protein produced by cells of the prostate gland (NCI, 2011). The DRE is an exam that a health provider conducts manually by inserting a finger into the rectum to detect abnormalities in the prostate.

In the US, the ACS revised its guidelines in 2010 for prostate screening. The new guidelines state that men who have at least a 10-year life expectancy should make an informed decision with their health care provider about whether to be screened for prostate cancer, after receiving information about the risks, benefits, and uncertainties associated with the screening. Men who are at an average risk should start receiving information at the age of 50. Men with higher risks (e.g., familial history of prostate cancer) should receive the information at either age 40 or 45, depending on the risk level. Further, it is suggested that, in the case of men who cannot make a decision, the health care provider should make a decision based on the guidelines. When a man decides to be screened, it is recommended

that the PSA test be performed and, for those with hypogonadism, a DRE should also be performed. If the PSA test result shows less than 2.5 ng/ml, future screening should occur every 2 years. For those with a PSA level of 2.5 ng/ml or higher, annual screening should occur. Those with a PSA level of 4.0 ng/ml or higher should receive referrals for further evaluation.

In Europe, the recommendation for prostate screening is that mass screening should not be introduced unless there is sufficient, supportive evidence demonstrating its efficacy in reducing mortality (WHO, 2004). At the present time, there is not enough evidence to justify mass screening (Ilic, O'Connor, Green, & Wilt, 2007); although evidence in this area is both being amassed and shifting rapidly (Heidenreich et al., 2011). According to a WHO report (2004), although there are no formal population-based screening programs in Europe or North America, there are a number of programs through which prostate cancer screening is available. These programs exist in several countries and include research studies and screening provided by individual physicians or health care providers.

In summary, there is debate, both in the US and Europe, about the merits of prostate screening. Individuals and professional organizations argue that people have the right to screen and to know their risks, so that, if risks are found, action can be taken to save the patients' lives (cite). However, most government agencies indicate that the available research evidence regarding its effectiveness is not sufficient to support the decision to conduct mass screening.

Lung Cancer Tests.

The two most common tests for lung cancer are the chest radiograph test and the Spiral/Helical Computed Tomography (CT) test. Although these screening tests are available, they are not being recommended for use in detecting lung cancer. According to van Klaveren et al. (2001), screening by chest radiography is not recommended because there is not enough evidence to show that it decreases

mortality from lung cancer. Clinical trials are being conducted in both the US and Europe to determine the efficacy of screening for lung cancer.

Summary of Screening Tests.

In summary, there are screening tests for each of the five cancers discussed. There are data that indicate the merits of screening for breast, cervical, and colorectal cancers. The data do not yet indicate that screening for prostate and lung cancer should be conducted on a large scale.

In this paper, we discuss breast, cervical, colorectal, prostate, and lung cancers. For each cancer we outline their incidence and prevalence, screening rates, discuss health care systems and access to resources more broadly, and interventions tested in the US and the EU.

Screening Rates in the US and EU

As discussed previously, the US and EU cancer screening guidelines differ as is apparent in Table 8. For the US the data are from 2005 and 2006 (Smith, Cokkinides, & Brawley, 2009; NCI, 2010). For the EU 27, the screening statistics are based on data from *The European Commission's First Report on Cancer Screening* (von Karsa et al., 2008) and data from Eurostat.

Of note, how data are presented within the EU differs from how they are presented in the US. Within the EU, people are targeted based on the screening recommendations and invited to be screened for a particular cancer. The data on the screening rates for the EU are based on the percentage of those targeted within the EU guidelines who were invited to be screened divided by the number of individuals within the EU guidelines who were screened. The US data are based on a sample from the National Health Interview Survey (NHIS) that include approximately 10,000 interviews to calculate the percentage of screening for the US. For the EU, the data are based on how many organized screenings were reported by member states with added approximations of the number of screenings not reported that occurred in either organized or

opportunistic programs (von Karsa et al., 2008). Thus, von Karsa et al. (2008) noted that the rates represent “conservative estimates” of screening within the EU.

The US screening rates were higher for breast, cervical, and colorectal even though they did not reach recommended rates. Only the data for the US are presented for prostate screening because in the EU prostate cancer screening is not recommended. For lung cancer neither the US nor the EU recommend screening at the present time.

Type of Coverage, Access to Health Care, and Cancer Screening in the US and EU

The US: Health Care and Cancer Screening

The US has a diverse health care delivery system that offers different levels and different kinds of health insurance coverage. The most common forms include employer insurance, Medicare, Medicaid, and private insurance. The type of coverage one receives impacts his or her ability to access secondary cancer care services, such as cancer screening. Research suggests that insurance type and status are two of the most important predictors of cancer screening (Hsia et al., 2000; Robinson & Shaver, 2008).

Among Americans under the age of 65, more than half receive insurance coverage through their employers (Ward et al., 2008). This form of coverage typically requires the payment of a premium and can be extended to cover family members of the employee. Depending on the insurance plan chosen, secondary cancer prevention services, such as cancer screening, may be partially or fully covered. Unfortunately, not all companies offer insurance coverage for employees, and for those that do, there are a portion of employees who opt out because of inability to pay premiums (Ward et al., 2008). With costs of health insurance increasing at a faster rate than wages, this may lead to a larger number of employees becoming uninsured.

After reaching 65 years of age, individuals (or their spouses) who contributed to Social Security for a minimum of ten years are eligible to receive Medicare health insurance. These individuals are

provided with the Medicare A package, which is a type of hospital insurance; however, to receive additional cancer screening services (e.g., pap tests, colorectal, mammograms), they must pay a monthly premium for Medicare B coverage (Ward et al., 2008). Access to these services may be limited to individuals who are able to afford the out-of-pocket costs for extended coverage.

Medicaid is a program for the low-income people. It is typically funded by a combination of state and federal funds but in some states it also partially funded by the local government. It is offered to low-income families and children, elderly, and disabled individuals. This service covers basic medical care; however, initiatives have been passed to increase access to breast and cervical cancer screening. Unfortunately, funding limitations and inconsistent service delivery practices across states have produced barriers to accessing these preventative/screening services (Ward et al., 2008).

Some US citizens have insurance coverage from private insurance companies. Similar to employer insurance, depending on the insurance package selected, cancer screening may or may not be covered. The premiums for private insurance are higher than most forms of insurance; thus, fewer people exercise this option (Ward et al., 2008).

In the US, there are also people who do not have any insurance. Robinson and Shaver (2008) found that being uninsured was related to lower rates of pap testing, mammograms, PSA testing, and colorectal endoscopy; but not to Fecal Occult Blood Test (FOBT). Consistent with these findings, uninsured individuals are more likely to be diagnosed at later disease stages (Hadley et al., 2003; Ward et al., 2008), have higher mortality rates (Ward et al., 2008), and are less likely to receive aggressive treatment after diagnosis (Bradley, Given, & Roberts, 2002; Coburn, Fulton, Pearlman, Law, DiPaolo, & Cady, 2008). Insurance rates are highly related to sociodemographic variables. Risk factors for being uninsured include being male, an ethnic minority (African American, Hispanic, Asian American/Pacific Islander, Native American/Alaska Native), between the ages of 18 and 24, and impoverished (Ward et

al., 2008). . One can examine health insurance status at a broader level by breaking down the population into three definable groups, those who are *adequately insured*, *underinsured*, and *uninsured*. An individual can be considered underinsured if he or she spends at least 10% of family income on health care costs (Ward et al., 2008). It is estimated that approximately 12% of individuals receiving insurance in the US are classified appropriately as underinsured, and these individuals are two to four times less likely to receive needed health care treatments than those with adequate insurance coverage (Schoen, Doty, & Collins, 2005). Combined, approximately one third of Americans under the age of 65 are considered to be underinsured or uninsured (Schoen, Doty, Collins, & Holmgren, 2005). Evidence is mounting to suggest that those who are uninsured, underinsured, and reliant on government-assisted programs (e.g., Medicaid) are less likely to receive preventative health care services, including cancer screening (Meissner, Smith, et al., 2004; Meissner, Vernon, et al., 2004; Ward et al., 2008). For instance, underinsured women are significantly less likely to receive mammograms between the ages of 40 and 64, and underinsured males are less likely to obtain PSA testing when over the age of 65 (Ward et al., 2008). Zapka et al. (2002) reported that the type of insurance does not significantly predict CRC screening rates; however, they also found that the population in general was under-screened. Other research suggests that rates of cancer screening are consistently correlated with insurance coverage (Meissner, Smith, et al., 2004; Meissner, Vernon, et al., 2004).

In summary, the US has a diverse and multi-tiered health care system. Overall, research suggests that access to cancer screening services and resulting cancer-related outcomes are highly related to insurance status and type of coverage. With disproportionate rates of access, there are segments of the population that are left underserved. For an in-depth review of the relationship between health insurance and cancer screening in the US, we direct readers to Ward et al. (2008). Is all this still the case with the health care reform?

The EU: Health Care and Cancer Screening

Within the EU, the socialized health care model is the most common vehicle of health care delivery (Normand & Busse, 2002; Thomson & Mossialos, 2006). Broadly stated, this entails universal health care coverage, in addition to compulsory contribution and participation from citizens (Mossialos & Thomson, 2002). To accomplish this, many EU member states fund health care through taxation, and/or employee and employer financial contributions (Mossialos & Thomson, 2002). For those who are unemployed, contributions may be obtained from pension, unemployment or sickness funds, and/or population-wide taxation (Mossialos & Dixon, 2002).

Moreover, nationwide health care coverage has been extended to allow for the creation of a network of health care coverage across member states. Specifically, the EU has introduced the European Health Insurance Card (EHIC) that allows members to access health care services in other EU member states while visiting these countries (Manea & Manea, 2009). The cost of health care is fully or partially covered, depending on the individual's local insurance coverage (Manea & Manea, 2009). This is applied to anyone who is under a national health insurance plan in his or her EU member state (Manea & Manea, 2009). It should be noted that although there are a number of member states that have the EHIC for their citizens, the percentage of individuals who have cards varies across countries (Manea & Manea, 2009).

Although contribution to and use of nationwide health care are generally mandatory within countries, some member states (e.g., Germany, Finland, Netherlands, Spain) provide access to private insurance, referred to as *voluntary health insurance* (Gallina, et al., 2007). Voluntary health insurance can be classified as being a substitute, complement, or supplement to public health insurance (Thomson & Mossialos, 2006). Depending on the national health insurance policies of a specific country, one of more of these options may be available to the population or a subset of the population. Voluntary

insurance as a *complement* to public health care refers to use of private insurance to cover health care costs that are not covered by the nationwide public health care plan. *Supplementary* private health insurance refers to the use of private health insurance to increase choice of health care services and access to greater quality of care. These types of access create a multi-tiered health care system, producing disparities in service received based on financial ability (Micheli, et al., 2003; Mossialos & Dixon, 2002). Another voluntary health care option is *substitution*, which refers to the replacement of nationwide public health care coverage with selected private insurance coverage (Thomson & Mossialos, 2006). For instance, Germany, the Netherlands, and Spain allow individuals to substitute mandatory coverage for private insurance if a person has a high income, is self-employed, or is a civil servant (Mossialos & Thomson, 2002).

It is suggested that cancer survival and mortality are related to macroeconomic variables that are related to health care, including the gross domestic product (GDP), national expenditures on health care, and total public expenditures on health care (Micheli, et al., 2003). That is, the more wealth associated with a country (i.e., GDP), the higher the population's rate of cancer survival (e.g., GDP). In addition, the more financial investment placed into health care (i.e., national and public expenditure), the greater rate of cancer survival. In fact, total public expenditure on health care on its own is correlated strongly with cancer survival in both men and women (Micheli et al., 2003).

To address the growing rates of cancer incidence and inconsistency in screening practices across member states, financial resources have been dedicated (Micheli, et al., 2003) and initiatives have been instituted to provide screening guidelines, improve quality assurance, and control the volume of examinations (EU report, 2008; Nicula et al., 2009). In 2003, the European Union Council introduced guidelines of best practice for cancer screening and quality assurance for its member states (EU report, 2008; Nicula et al., 2009). In line with the nationwide health care model that has been adopted by many

EU member states, the EU council recommendations called for member states to adopt population-based, organized cancer screening and to adhere to quality assurance guidelines (EU report, 2008). Nationwide, population-based screening initiatives are designed to reach as much of the population as possible in a cost-effective way (EU report, 2008).

As of 2007, nationwide screening programs for breast, cervical, or colorectal cancer were active throughout much of the EU (EU report, 2008). However, across EU countries, cancer-screening implementation appears to differ. For instance, countries have different age eligibility limits for breast cancer screening (EU report, 2008). In addition, not all EU countries offer screening services for all types of cancer; there are a number of countries that offer opportunistic and non-population-based programs (EU Report, 2008; Micheli, et al., 2003). With regards to cervical cancer, most member states have adopted national, population-based screening programs, although several have non-population-based initiatives in place (EU report, 2008). Estimates indicated that in 2007, population-based programs targeted 51% of age-eligible women whereas non-population based targeted 47% (EU report, 2008). With regards to colorectal cancer, more member states implement population-based screening than non-population-based programs. Whereas the nationwide programs targeted 43% of age-eligible individuals, the non-nationwide programs targeted 34% of individuals. In addition to variability in screening practices, there are still member states that do not offer screening for one or more of the cancer types (EU report, 2008). Overall, little is known about the community-level implementation and quality of services provided across member states (EU report, 2008).

In Europe, there is a paucity of research that examines the relationship between health care delivery and cancer screening. Results from one European study suggest that those with access to private insurance demonstrate more favorable clinical and pathological characteristics associated with localized prostate cancer than those with public health care (Gallina, et al., 2007). Conversely, other research

suggests that the implementation of population-based practices and quality assurance policies, such as in Finland and Netherlands, produce the best outcomes for cancer patients (Nicula et al., 2009). Overall, there appears to be movement toward implementation of a unified system of cancer care delivery across the EU that is organized and adheres to specific quality assurance standards.

Efforts to Optimize Screening

The differences between the health care, economic, and sociopolitical systems under which cancer screening is conducted within the EU and US reveal the different perspectives on cancer screening that exist in these countries. Given these differences, one can conceive of cancer screening initiatives within these countries as efforts to *optimize* screening, rather than simply to *increase* screening. In general, the US uses an opportunistic screening approach while the EU is moving toward nationwide, population-based, organized screening programs being instituted in all of its member states (Miles, Cockburn, Smith, & Wardle, 2004; von Karsa et al., 2008).

It is desirable to keep optimization in mind as a long-term goal. Ideal screening rates differ for different cancers. For example, the ideal screening rates for prostate or lung cancers, for which the value of screening is controversial (Smith, Cokkinides, & Brawley, 2009), are much lower than the ideal screening rates for cervical, breast, or colorectal cancers. Thus, screening for different cancers have different cost-benefit or risk-benefit ratios regardless of geographic location, though the EU and US have distinctive perspectives on how these differences inform practice (Howard, 2009; Miles et al., 2004).

Moreover, some cancer intervention researchers, particularly in the US, but also within EU member states such as the United Kingdom (UK), have begun to envisage a new benchmark for intervention efficacy. Specifically, it has been purported that informed decision-making

might be a more appropriate outcome than increasing screening rates in general (Forbes, Jepsen, & Martin-Hirsch, 2009; Keen, 2010; Meissner, Vernon, et al., 2004; Rimer, Briss, Zeller, Chan, & Woolf, 2004). Thus, the goal of screening interventions would not be to *maximize* screening rates per se, but to ensure that each eligible patient 1) is sufficiently informed about the condition for which screening is being considered, the nature of the screening procedure (e.g., benefits, risks, limitations, established utility, etc.) and the alternatives to it (e.g., watchful waiting, informed refusal, etc.); 2) considers this information within the context of his or her personal values, beliefs, and preferences; 3) concludes that he or she has participated in the decision-making process; and 4) reaches a decision based upon the aforementioned processes (Holt et al., 2009; Rimer et al., 2004).

This refocusing may be particularly appropriate within the US, especially in light of the fact that several authoritative, professional organizations (e.g., UPSTF, National Cancer Institute [NCI], ACS, applicable American Colleges of Medicine) have recommended different standards and recommendations for screening. Informed decision making leads some patients to *choose* not to undergo screening. This could pose new problems when physician liability is taken into consideration (Meissner, Vernon, et al., 2004; Rimer et al., 2004). Informed decision-making, especially in the context of cancer screening, is a relatively new conception that is evolving still (Rimer et al., 2004). Nevertheless, these hypothesized reconfigurations may, in fact, be harbingers of things to come, not simply thought-experiments. All of these facts are supportive of the notion that screening interventions should be considered as *optimization*, not *maximization* efforts.

Conceptualizing Interventions

Once interventions are acknowledged as efforts to optimize screening, it becomes necessary to classify these interventions into assessable and comprehensible parts. There are many ways that this can be achieved. For example, interventions could be classified by considering the screening-related factors that they aim to manipulate. This type of taxonomy might label interventions as behavioral, cognitive, and sociological (e.g., Mandelblatt & Yabroff, 1999; Yabroff & Mandelblatt, 1999). Alternatively, it is possible to group interventions based upon the mechanism of change that they employ. For example, interventions might use reminders, education, financial incentives, regulatory or policy institution or modification, organizational restructuring, or media campaigns to affect cancer-screening rates (e.g., Stone et al., 2002). For the purpose of examining efforts to optimize screening within both the EU and US, a conceptual model that categorizes interventions based upon their target within a socio-ecological framework seems most useful (e.g., Baron et al., 2008; Breslow et al., 2008; Sabatino et al., 2008). In such a paradigm, interventions may be identified as being patient-directed, provider-directed, community-directed, or system-directed (see, e.g., Pasick, Hiatt, & Paskett, 2004). It should be noted that, in this classification, systems are the infrastructures and organizations (e.g., professional firms, governmental agencies, etc.) that establish the laws, ordinances, regulations, and policies that govern these patients, providers, and communities. Barriers to screening have been recognized at the patient, provider, community, and system levels; thus, each of these entities is a prospective target of screening interventions.

Patient-directed interventions

Many barriers to screening have been identified at the individual or patient level. These include practical (e.g., pecuniary, insurance, or access issues), psychological (e.g., beliefs regarding screening, one's susceptibility to cancer and resultant need for screening), and

informational (e.g., knowledge of screening's existence, purpose, availability, etc.) barriers. Patient-directed interventions aim to surmount one or more of these obstacles to promote screening. In the US, where screening occurs almost invariably in an opportunistic fashion and is dependent primarily upon an individual's knowledge of and interaction with the health care system (see Miles et al., 2004), patient-directed interventions are most prevalent and arguably most commonsensical and direct.

This conceptualization is applicable within the EU as well because opportunistic screening continues to typify, at least at present, the delivery modality that is used within many of its member states (Anttila, Ronco, & Working Group on the Registration and Monitoring of Cervical Cancer Screening Programmes in the European Union, 2009). Even within organized screening systems, patient-directed interventions predominate because organized programs typically send out *screening invitations* from centralized population registries to individuals in need of screening, and reduce patients' out-of-pocket costs (Miles et al., 2004; Nicula et al., 2009; von Karsa et al., 2008). These archetypical features of organized screening (Miles et al., 2004) are characterized most aptly as patient-directed interventions (e.g., Baron et al., 2008), though they do succeed and are encompassed within system-level change.

Research findings indicate that patient-directed interventions are generally effective (Baron et al., 2008; Breslow et al., 2008;). Patient-directed interventions have been both numerous and varied; they include mail and telephone invitations and reminders (e.g. Cosp, Castillejo, Vila, Marti, & Empananza, 2009;), various financial incentives (Meissner, Smith, et al., 2004), scheduling assistance or scheduling with notification of appointment (Baron et al., 2008; Breslow et al., 2008), direct mailing of at-home screening kits (e.g., FOBT kits; see Hoffman et al., 2011), informing patients of the gender of the examiner (Margolis, Lurie,

McGovern, Tyrrell, & Slater, 1998), various forms of individual and group education (Blumenthal, Smith, Majett, & Alema-Mensah, 2010;), face-to-face or telephone counseling (Sequist et al., 2009), presenting risk-factor assessments and decision aids (Lewis et al., 2010), and orchestrating transportation to screening facilities (Meissner, Smith, et al., 2004).

Factors that have been shown to improve outcomes within patient-directed interventions include targeting (i.e., focusing on individuals who are in the greatest need of screening; Pasick et al., 2004; Zapka & Lemon, 2004), cultural tailoring (Ka'opua, Park, Ward, & Braun, 2011;), individual tailoring (Manne et al., 2009;), and use of a theoretical foundation (Lewis et al., 2010;). These considerations appear to be important in both the EU and US, because language, ethnicity, education, and socioeconomic status are known barriers within both systems (Casamitjana et al., 2009;).

Although the majority of these interventions have been employed in attempts to influence colorectal, breast, and cervical cancer screening, the body of research suggests that the effectiveness of these interventions is related to the specific type of cancer targeted (e.g., Baron et al., 2008). In their review, Forbes et al. (2009) concluded that invitation letters and educational interventions are effective in promoting cervical cancer screening by Papanicolaou (Pap) smear. Yabroff and Mandelblatt (1999) noted that, for breast cancer screening by mammography, reminders (both printed and telephone), education, use of community peers or lay health advisors (LHAs), media messages, and financial incentives all led to increased breast cancer screening rates. Cosp et al. (2009) reviewed breast cancer screening interventions and also concluded that mailed invitations, printed educational materials, telephone contact, and educational training activities plus direct reminders are efficacious. Fisher et al. (2007) surveyed women in the UK and found that they preferred to be educated via one-on-one discussions with

physicians, educational leaflets, or, for some of the more youthful participants, computer. However, analyses of the efficacy of such interventions on optimizing screening were not conducted. Sequist et al. (2009) found that, for CRC, mailing educational pamphlets, FOBT kits, and instructions for direct scheduling of flexible sigmoidoscopy or colonoscopy to patients in need of screening was effective in increasing screening rates.

In their review for the Center of Disease Control (CDC), Baron et al. (2008) recommended 1) reminders, one-on-one educational interventions, and reduction of structural barriers and out-of-pocket costs for breast cancer screening by mammography, 2) reminders and one-on-one educational interventions for cervical cancer screening by cervical cytology of Pap smear, and 3) reminders and reducing structural barriers for CRC screening by FOBT. It should be noted that the interventions' utility for other CRC screening modalities [e.g., endoscopy] were not established based on the available evidence. Baron et al. (2008) stated that it was not possible to reach any conclusions regarding the effects of 1) client incentives or group education on breast cancer screening; 2) client incentives, group education, reduction of structural barriers or out-of-pocket costs on cervical cancer screening; or 3) client incentives, one-on-one or group education, or reduction of out-of-pocket costs on CRC screening because of insufficient evidence. Conversely, Stone et al. (2002) reported that patient financial incentives were the most successful patient-directed intervention for increasing breast, cervical, and colorectal cancer screening. Additionally, in a three-part study conducted by Baron et al.'s review, Blumenthal et al. (2010) found that group education was the only intervention that yielded significantly higher CRC screening rates among an African American sample. Clearly, it is necessary to understand that, for the most part, Baron et al.'s assessments do not indicate an intervention's relative

inefficacy, but do reflect a need for further research in these areas. This paragraph was too wordy, maybe go straight to the message from the review?

Provider-directed interventions

Provider-directed interventions are not as diverse as patient-directed interventions. Strategies for promoting the recommendation and completion of screening by providers have included audits and feedback (Hillman et al., 1998; Mandelblatt & Yabroff, 1999; Sabatino et al., 2004; Snell & Buck, 1996), financial incentives (Hillman et al., 1998; Sabatino et al., 2004), education and training (Friedman & Borum, 2007; Grimshaw et al., 2001; Mandelblatt & Yabroff, 1999; Nguyen, McPhee, Stewart, & Doan, 2010; Snell & Buck, 1996; Zapka & Lemon, 2004), and printed or electronic reminder and recall systems that prompt the physician either during or between patient visits (Grimshaw et al., 2001; Mandelblatt & Yabroff, 1999; Sabatino et al., 2004; Snell & Buck, 1996; Zapka & Lemon, 2004). In general, these interventions are effective in some context and not in others (Grimshaw et al., 2001). In Italy, a pilot version of the Lazio program for CRC screening included financial incentives for providers who chose to participate in the organized screening program, but its usefulness in recruiting physicians was not assessed (Federici et al., 2008). Research suggests that a combination of two or three concurrent provider-directed interventions has a synergistic effect; however, diminishing returns are observed when more than three interventions are concurrently implemented (Grimshaw et al., 2001; Snell & Buck, 1996). Finally, it is not clear whether simultaneously targeting providers and patients is superior to targeting either in isolation (e.g., Snell & Buck [1996] reported no benefit; Zapka & Lemon [2004] hypothesized synergism through multi-directed interventions).

Community-directed interventions

Media messages are the typical community-directed intervention (Stone et al., 2002). Any other interventions that could be conceived of as community-directed are better suited for reclassification as patient-, provider-, or system-directed interventions within our conceptual framework. In general, mass media appears to be effective at encouraging health care use (Grilli, Ramsay, & Minozzi, 2009). Unfortunately, because analyzing and quantifying the efficacy of media interventions is a challenging undertaking for researchers, questions about the true effect of mass media remain unanswered (Randolph & Viswanath, 2004; Steinwachs et al., 2010; see also, Baron et al., 2008; Stone et al., 2002). One reason for this difficulty is that media messages rarely exist in isolation (Baron et al., 2008; Pasick et al., 2004). Baron et al. (2008) noted that small media messages are recommended for breast, cervical, and colorectal cancer screening intervention, and trials that have incorporated them have been successful (e.g., Nguyen, McPhee, et al., 2010). However, the difficulty of quantifying the effects of mass media messages has resulted in a paucity of relevant research and an inability to determine their usefulness.

Pasick et al. (2004) noted that mass media messages, where they have been assessable, have shown utility in promoting breast and cervical cancer screening. This research is consistent and theoretically supported (see, e.g., Bandura, 2001) with the notion that mass media messages are effective promulgators of information and useful forums for inducing cognitive, affective, and behavioral change (Grilli et al., 2009). Clearly, despite the paucity of quantitative research, mass media is commonsensical, qualitative useful, and easy to dissemination (Glasgow, Marcus, Bull, & Wilson, 2004). Because of this, mass media campaigns have become a staple of health promotion efforts (Randolph & Viswanath, 2004).

System-directed interventions

System-directed interventions are common for several reasons. First, these interventions can be targeted at several *levels* (e.g., hospital administration, governmental agencies, etc.). Primarily, these interventions seek to enhance access to services by restructuring the systems within which screening occurs. This is accomplished by making it easier for patients, providers, and communities to conform to recommended screening behaviors. Stone et al. (2002) conceptualized this form of intervention as “regulatory and legislative action” and “organizational change” (p. 642). Although Stone et al. were unable to determine the efficacy of regulatory and legislative actions, they found that organizational change had the most consistent and potent effect for enhancing screening uptake and was the most complex intervention type, comprising actions such as: 1) the establishment of clinics devoted solely to screening, 2) use of planned care visits, 3) use of quality improvement techniques (e.g., benchmarking), and 4) division of responsibility (e.g., employing non-physician staff to fulfill screening roles). Clearly, if system-directed interventions were the most varied intervention type when they were separated from governmental actions, they will be even more expansive within our framework. It seems that interventions that target governmental and organizational policy and structure and enhance access are one of the most effective strategies for optimizing screening (Christie et al., 2008; Legler et al., 2002; Pasick et al., 2004; Stone et al., 2002; Zapka & Lemon, 2004).

A notable difference in system-directed interventions between the US and EU is that the EU has established a much broader system-directed intervention (i.e., the goal for uniform implementation of nationwide, organized screening programs for member states, Hakama et al., 2008; von Karsa, 2008). In the US, system-directed interventions have taken the form of state laws regarding screening (Zapka & Lemon, 2004), expanded insurance coverage (Cosp et al., 2009; Stone et al., 2002; Zapka & Lemon, 2004), organizational policies (Christie et al., 2008;

Hoffman et al., 2011; Meissner, Smith, et al., 2004; Stone et al., 2002; Zapka & Lemon, 2004), medical organizations' benchmarks (Zapka & Lemon, 2004), the use of nonclinical settings for screening or intervention (Baron et al., 2008; Cosp et al., 2009; Drake, Shelton, Gilligan, & Allen, 2010; Fernández et al., 2009; Forbes et al., 2009; Hiatt et al., 2008; Ka'opua et al., 2011; Meissner, Smith, et al., 2004; Pasick et al., 2004; Schoenberg et al., 2009; Ward et al., 2008; Yeary et al., 2011), and redefining or redistributing the roles and responsibilities of particular professionals as they relate to screening (e.g., using nurse-practitioners to conduct screening; Forbes et al., 2009;) or even using non-professionals, such as peers or lay health advisors (Baron et al., 2008;).

The EU is undertaking exhaustive and encompassing efforts not seen in the U.S. Examples of these efforts in the EU include the European Parliament's charge to EU member states in June 2003 and October 2006 to make cancer a health priority and to develop and implement effective strategies for screening, diagnosis, and treatment throughout Europe (Perry et al., 2008). There has been a call for implementation of organized, population-based screening programs throughout all member states (Arbyn et al., 2010, p. 448). Although these efforts are impressive, the comparative efficacy of large, organized screening programs to opportunistic screening has not been examined methodically or collectively (Madlensky, Goal, Polzer, & Ashbury, 2003). the EU's organized programs are characterized by fewer false-positives, greater access, and longer intervals between screenings than is the opportunistic system of the US (Miller). Similarly, Eisinger, Cals, et al. (2008) reported that the implementation of population-based, nationwide, organized screening in France decreased screening inequities and improved the overall quality of screening for CRC. Conversely, implementation of organized, population-based CRC screening in England and breast cancer screening in the Netherlands did not appear

to diminish the socioeconomic inequalities that were present before their execution and, contrarily, may have exacerbated some of these disparities (Louwman et al., 2007; von Wagner et al., 2009). Thus, it is difficult to determine the true utility of such an extensive system-directed approach. In fact, studies that have been conducted within the EU suggest that member states using opportunistic paradigms have incidence and mortality trends comparable to those employing organized programs (Vutuc, Waldhoer, & Haidinger, 2006). Unfortunately, although system-directed interventions exhibit noteworthy efficacy, they are challenging to implement and scrutinize, irrespective of whether one is attempting to examine the localized efforts in the US or the national strides of the EU (Federici et al., 2008; Nicula et al., 2009; Zapka & Lemon, 2004). This paragraph was very hard to get through. It seems to contain a number of ideas, and I am not sure the data support the underlying statements. What is its purpose? What is the key message that this paragraph has?

A Note on Interventions for Cancers with Equivocal Responsiveness to Screening

It is important to address screening and screening interventions for lung and prostate cancer because screening by helical CT and PSA testing, are engulfed in uncertainty and debate (Rosser, 2008). As it stands, no professional organization, in either the US or EU recommends regular screening for either of these cancers (Hakama, Coleman, Alexe, & Auvinen, 2008; Smith et al., 2009). This is not surprising considering that large research trials of the efficacy of PSA and helical CT (i.e., the US Prostate, Lung, Colorectal, and Ovarian [PLCO] Cancer Screening Trial; the European Randomized Study of Screening for Prostate Cancer [ERSPC]) have been completed just recently and resulted in data that are *mixed* (see, e.g., Andriole et al., 2009; Sandblom, Varenhorst, Rosell, Löfman, & Carlsson, 2011; Roobol et al., 2009; Schröder et al., 2009; see also, Barry, 2009).

Because of the uncertainty of the screening modalities, researchers in the US and EU are searching persistently for superior methods of early risk identification, such as calculating risk for prostate cancer based upon family history and genetic markers (Xu et al., 2009). Though these issues are more salient for prostate cancer, ambiguous outcomes also have been reported for lung cancer screening by helical CT (see, e.g., Field & Duffy, 2008;). So here you suggest it is the quality of the test that causes doubts about screening. Isn't it the quality of treatment if the test is positive instead? My understanding is that there is this ethical problem with certain screenings because all you are doing is telling someone they have a cancer that will kill them, but you don't have any good tx to offer.

I would cut short the intervention section, which was too long anyways and less relevant, and add a section on the ethics of screening.

As a result, there is a paucity of research available regarding screening optimization for these cancers, and professionals are undecided on the issue. In the US, informed decision-making remains the standard for practice and is the focus of intervention research, investigating tools such as decision aids (Drake et al., 2010; Frosch et al., 2008; Holt et al., 2009; Smith et al., 2009). Interventions for these cancers demonstrate that not all screening interventions are designed or intended to *increase* screening. In fact, many researchers believe that screening for these cancers, especially prostate cancer, has been too sudden and extensive (Frosch et al., 2008; see also, Eisinger, Blay, et al., 2008; Gigerenzer, Mata, & Frank, 2009). These researchers have noted that informed decision-making, chronic disease trajectory models, and decisional balance aids can result in *decreased* screening and a preference for watchful waiting (Frosch et al., 2008), which seems to be a favorable response in light of the arguable incongruity between current evidence and practice in prostate cancer screening.

In the EU, researchers also have noted an overestimation of the utility of PSA and an underestimation of its risks among the public and noted the need for informed decision-making to equilibrate these common misperceptions (Gigerenzer et al., 2009). Furthermore, though screening for prostate and lung cancer in the EU is encouraged only within the context of clinical trials (Ciatto, Zappa, Bonardi, & Gervasi, 2000;), researchers have noted that the public's perception of prostate screening's usefulness appears to be resistant to research-based, as well as information related by a physician regarding PSA's factual risk-benefit profile (Gigerenzer et al., 2009). I don't understand this last sentence.

There may be another factor underlying this apparent resistance. Drummond, Carsin, Sharp, and Comber (2009) found that *general practitioners* (GPs) in Ireland had overly optimistic views of PSA as well, as indicated by personal willingness both to undergo PSA and to test asymptomatic patients. Drummond et al. and his colleagues (2009) noted a need for greater GP education and reported that 91% of surveyed GPs supported establishing national PSA testing guidelines to help inform their practices. Similarly, in France, Eisinger, Blay, et al. (2008) found that both patients' and, to a certain degree, providers' beliefs and attitudes about prostate cancer were incompatible with the evidence. For example, a stronger focus was placed on prostate cancer screening than on CRC screening, a cancer for which screening is supported by a *much stronger* corpus of empirical research. Clearly, within both the EU and US, more research is needed in the areas of provider and patient education, and informed decision-making both in general and specifically for cancers for which the utility of screening is not verified. Again, shorten and focus. What's the purpose of this section?

Summary

In summary, the US and the EU approach screening from different perspectives that result in different approaches. In general, the US tends to take a more opportunistic screening approach whereas the EU tends to take an organized screening approach. In the US, more money is invested in screening because the guidelines recommend more frequent screening for more cancers and rarely include upper age limits for screening. As a result, there are higher screening rates, but more false positives, which create greater psychological burden and higher additional expenditures. In the EU, the focus tends to be more on cost-effectiveness that has been relatively successful in countries where nationwide, population-based screening programs have been implemented. However, in developing member states within the EU, the screening rates have been lower than in the US resulting in higher mortality rates. These lower screening rates could be artificially lowering the EU's estimated total screening rates or do you mean total incidence rates?.

Differences in screening rates could be attributed to cultural differences in the attitudes toward screening (Howard, 2009). Some researchers have suggested that US residents are more likely than EU residents to endorse preventive medicine (Howard, 2009). However, the general populations' attitudes in the EU and US regarding adopting new developments in preventive medicine (e.g., new screening tests) may not differ as much as the reported disparities in screening rates imply (see, e.g., Gigerenzer et al., 2009; Drummond et al., 2009; Eisinger, Blay, et al., 2008). Rather, the systemic differences in screening programs (i.e., the top-down governmental regulation exerted in the EU and the bottom-up, consumer- and lobbyist-driven impetus of the US) likely are responsible for discernible differences that exist between the EU and US. The question of how to optimize screening modalities, guidelines, and interventions is a priority in both the US and EU. The focus for both regions needs to be on constructing healthy

vigilance regarding cancer risks and screening, and, to generate screening initiatives that are marked by advantageous cost-benefit and risk-reward ratios. Toward this end, collaborative efforts between the US and EU could be used to identify the best, evidence-based practices in cancer screening.

Within both the EU and US, there are still marked disparities between those screened and not screening. Disparities have been found to be a function of immigration status, language, ethnicity, socioeconomic status, education, and rural residency. Inequalities in screening persist even though efforts have been made to minimize them. In addition, in some cases, interventions have been found to accentuate disparities. For example, educational interventions have the greatest effect within educated samples (Stone et al., 2002; Zapka & Lemon, 2004). It is important to note that when screening is assessed and interventions are tested within health care settings with participants who have access to the care, we fail to reach underserved groups or develop interventions that will be well suited for use among these groups. If screening is promoted before access to services is ensured, those in the greatest need of intervention may be the least likely to benefit from it. Great paragraph!

Researchers have suggested that an important issue to address is how much effort should be expended in reaching those who are the hardest to reach and what should be done for those who elect not to screen (e.g., Meissner, Vernon, et al., 2004). Although much effort has been focused on improving screening methods and increasing screening rates, more efforts are needed to improve access and use of services. In the US, the National Institutes of Health (NIH) has established an Office of Health Disparities to fund research aimed at decreasing disparities including access inequalities. In the EU, the roll out of organized screening programs is expected to lessen these disparities.

At the same time, we need to examine how we are assessing success in cancer screening interventions. Outcomes in cancer screening interventions are generally examined as discrete and singular events. An inordinate amount of research has been conducted on one-time screening and the impact of interventions on regular use of screening has been largely neglected. Regular use of screening may be a particularly salient issue in decreasing disparities in cancer screening. For example, if an intervention benefits underserved samples in a research setting, but access has not been ensured, these benefits probably will be isolated events, not lasting effects, because these populations may be unable to access services in real-world settings. Though the complexities and impracticalities of longitudinal research are appreciated, it would be advantageous for researchers to begin to examine the utility of cancer screening interventions in both achieving and *maintaining* health-promoting behavioral changes.

Once successful interventions have been identified, they need to be disseminated to appropriate settings (e.g., community and health care systems). Although randomized-controlled trials are the gold standard for establishing efficacy of cancer screening interventions, interventions need to be designed so that they are translatable into clinical settings (Glasgow et al., 2004; Lewis et al., 2010) and the fidelity of the intervention should be assessed. The cost-effectiveness of these interventions should be assessed so that health care systems have information about the resources necessary to implement the effective interventions. In addition, low cost, effective interventions are needed for use among low-income and underserved people and with health care systems that serve these individuals.

Within the US, there have been few organizations willing to shoulder the responsibility for the dissemination (e.g., mass production, manualization, etc.) of efficacious screening interventions (Glasgow et al., 2004). Within the EU this responsibility is being borne

predominately by the national governments. In the US, the NIH has included translational research as part of its road map in order to foster the goal of disseminating effective research into practice settings.

Research that optimizes cancer screening can improve the health and well being of members of the US and the EU, as well as individuals across the entire globe. Increasing the collaborations of researchers in both regions has the potential for benefiting millions of lives and becoming an example to the world for effective, cooperative research. In addition, collaborations between systems with different perspectives, like those of the EU and US, have the potential for creating synergistic relationships that could exponentially increase the progress toward reducing the burden of cancer worldwide.

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Table 1

Cancer Incidence and Mortality Rates in EU-27

Cancer	Incidence		Mortality	
	Number	ASR (W)	Number	ASR (W)
Colorectum	334092	31.7	149159	12.6
Lung	289406	30.2	254031	25.2
Breast	332670	77.1	89801	16.6
Cervix uteri	31038	9	13430	3
Prostate	323790	69.5	71027	12.1

Table 2

Cancer Incidence and Mortality Rates in US

Cancer	Incidence		Mortality	
	Number	ASR (W)	Number	ASR (W)
Colorectum	153881	29.2	50640	8.8
Lung	215021	42.1	161841	30.4
Breast	182460	76	40481	14.7
Cervix uteri	11069	5.7	3869	1.7
Prostate	186320	83.8	28660	9.7

Table 3

Breast Cancer Incidence and Mortality Rates

Region		1999	2002	2011
North America	Incidence	86.3	99.4	76.7
	Mortality		19.2	14.8
Western Europe	Incidence	67.35	84.6	89.9
	Mortality		22.3	17.5
Central and Eastern Europe	Incidence	35.95	42.6	45.3

	Mortality		17.9	16.9
Northern Europe	Incidence	68.31	82.5	84
	Mortality		22.5	17.8
Southern Europe	Incidence	49.51	62.4	68.9
	Mortality		18.1	15.3

Note. Rates are per 100,000 (Parkin, Pisani, & Ferlay, 1999; Parkin, Bray, Ferlay, & Pisani, 2002; Jemal et al., 2011)

Table 4

Cervical Cancer Incidence and Mortality Rates

Region		1999	2002	2011
North America	Incidence		9.07	7.7
	Mortality			2.3
Western Europe	Incidence	10.94	10.0	6.9
	Mortality			3.4
Central and Eastern Europe	Incidence	13.72	14.5	14.5
	Mortality			7.1
Northern Europe	Incidence	12.47	9.0	8.3
	Mortality			3.6
Southern Europe	Incidence	10.41	10.7	8
	Mortality			3.3

Note. Rates are per 100,000. (Jemal et al., 2011; Parkin, Bray, Ferlay, & Pisani, 2002; Parkin, Pisani, & Ferlay, 1999)

Table 5

Colorectal Incidence Rates over Time

Region	Gender	1999	2002	2011
North America	Male	44.33	44.4	35.3
	Female	32.80	32.8	25.7
Western Europe	Males	39.84	42.9	41.2
	Female	29.01	29.8	26.3
Central and Eastern Europe	Male	25.29	30.1	32.9
	Female	18.47	20.1	21.0
Northern Europe	Male	34.35	37.5	36.0
	Female	26.11	26.4	24.6
Southern Europe	Male	28.76	35.9	39.3

Female	20.21	23.5	24.5
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Note. Rates are per 100,000 (Parkin, Pisani, & Ferlay, 1999; Parkin, Bray, Ferlay, & Pisani, 2002; Jemal et al., 2011)

Table 6

Prostate Cancer Incidence and Mortality Rates

Region		1999	2002	2011
North America	Incidence	92.39	119.9	85.6
	Mortality		15.8	9.9
Western Europe	Incidence	39.55	61.6	94.1
	Mortality		17.5	12.4
Central and Eastern Europe	Incidence	14.06	17.3	28.5
	Mortality		9.70	10.9
Northern Europe	Incidence	34.70	57.4	75.2
	Mortality		19.7	15.7
Southern Europe	Incidence	16.91	35.5	50.2
	Mortality		13.2	1.5

Note. Rates are per 100,000 (Parkin, Pisani, & Ferlay, 1999; Parkin, Bray, Ferlay, & Pisani, 2002; Jemal et al., 2011)

Table 7

Lung Cancer Incidence Rates over Time

Region	Gender	1999	2002	2011
North America	Male	69.62	61.2	48.5
	Female	32.91	35.6	35.8
Western Europe	Males	54.1	50.9	44.7
	Female	8.16	12	16.7
Eastern Europe	Male	75.85	65.7	57
	Female	10.3	8.7	9.6
Northern Europe	Male	59.12	44.3	39.3
	Female	20.21	21.3	21.8
Southern Europe	Male	58.81	56.9	49
	Female	7.26	9.2	10.4

Note. Rates are per 100,000 (Jemal, et al., 2011)

Table 8

US & EU Screening Statistics

<u>Cancer Type</u>	<u>Screening Test</u>	<u>Screening % US</u>	<u>Screening % EU</u>
	Mammography	67	49
Breast	Plus Clinical Breast Exam	53	NR
Cervical	Pap	78	59.3
	PSA	55.4	NR
Prostate	DRE	51.1	NR
	Endoscopic	50	NR
Colorectal	FOBT	25	UR
	Any CRC Test	59	20.7
Lung	Spiral CT	NR	NR

Note: NR = Not recommended; UR = Unreported