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Effects on Cancer Prevention from the COVID-19 Pandemic

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Keywords

COVID-19, pandemic, cancer prevention, cancer screening

Abstract

The COVID-19 pandemic led to disruption of health services around the world, including cancer services. We carried out a narrative review of the effect of the pandemic on cancer prevention services, including screening. Services were severely affected in the early months of the pandemic, and in some areas are still recovering. Large numbers of additional cancers or additional late-stage cancers have been predicted to arise over the coming years as a result of this disruption. To minimize the effects on cancer outcomes, it is necessary to return as quickly as possible to prepandemic levels of screening and prevention activity or indeed to exceed these levels. The recovery of services should address health inequalities.

INTRODUCTION

The global COVID-19 pandemic has made massive changes worldwide to patterns of healthcare and modes of healthcare delivery. During the prevaccination periods of high risk of serious infection, there was a major shift toward remote consultation and disease management, which in many areas of medicine has remained in place (1–2). Formal public health programs, such as cancer screening programs, were suspended in many areas for part of 2020 (3–5). Recovery of services thereafter was a slow process, due to the need to minimize infection risk, ensure air exchange and thorough hygiene between one patient and the next, and so on (6–7). In some healthcare settings, such services have still not fully recovered as of 2023 (8).

There are various routes to prevention of cancer or its sequelae. These include:

1. lifestyle and environment changes, such as smoking cessation, tobacco legislation, and weight control;
2. treatment of or vaccination against a pathogen that predisposes to cancer, such as human papillomavirus (HPV) vaccination and *Helicobacter* eradication therapy;
3. chemoprevention, such as aspirin, selective estrogen receptor modulators, and aromatase inhibitors;
4. removal of precursor lesions, such as cervical intraepithelial neoplasia or adenomas in the colon;
5. surgical removal of the organ at risk;
6. screening of asymptomatic individuals for early disease or precursor lesions.

We briefly review the changes in delivery of the activities above in various healthcare environments due to the COVID-19 pandemic. In addition, we review the effect of the pandemic on secondary prevention via cancer screening services. We consider the potential long-term implications of these changes for cancer incidence and mortality.

METHODS

This is not a systematic review, but a selective narrative review, conducted partly for historical purposes and partly to identify likely priorities for cancer prevention and screening in the future. We carried out broad literature searches using the terms detailed in **Supplemental Appendix 1**. For timeliness and conciseness, we prioritized reviews, focusing on individual primary studies where necessary to clarify individual issues. We then identified key references reporting on changes to cancer prevention and screening services as a result of the pandemic. We then classified these and reported them in the following categories:

1. lifestyle and environment changes to reduce cancer risk;
2. medical prevention (including vaccination, chemoprevention, etc.);
3. surgical prevention either by removal of healthy but high-risk organs or by removal of precursor lesions;
4. breast cancer screening;
5. colorectal cancer screening;
6. cervical cancer screening.

We also considered the recovery of services and whether changes have been maintained after the emergency period. Finally, we considered the likely implications for future rates of cancer incidence and mortality and therefore the important future issues in primary and secondary prevention of cancer.

Supplemental Material >

A substantial body of modeling work has taken place, and is ongoing, under the aegis of the International Partnership for Resilience in Cancer Systems (I-PARCS), formerly the COVID-19 and Cancer Global Modelling Consortium, to estimate likely effects of the pandemic on future cancer outcomes (9). The group has been particularly active in modeling effects of the pandemic on breast and colorectal cancer screening and the likely implications for future outcomes. In addition, there has been considerable work on estimation of the likely effects of reductions in diagnosis and treatment activity in the early pandemic period (10–12). Below, we consider effects on individual categories of cancer prevention.

LIFESTYLE AND ENVIRONMENT CHANGES TO REDUCE CANCER RISK

A significant issue for cancer prevention is the effect of the pandemic on tobacco smoking. A systematic review of reported survey data indicated that smoking increased during the lockdown periods (13). This is consistent with higher than expected cigarette sales in the United States, as Asare et al. reported that the prepandemic trend of decline in cigarette sales slowed down in 2020 (14). Similar observations have been made in East Asia (15). In the United Kingdom, the long-term trend of decreasing household expenditure on tobacco was reversed to an increase in 2020 and 2021 (16). However, this was not the universal experience. For example, in Denmark, there was a considerable reduction in tobacco sales in the lockdown periods (17). Services and support for smoking cessation shifted to noncontact formats, such as telemedicine and online support, including social media (18, 19). In all, there is a mixed picture of the effect of the pandemic on smoking. There is evidence of an increase in tobacco use or a slowing of trends of lesser tobacco use in some countries, but also some evidence of a reversal of this in 2022, as can be seen from the reduction in tobacco expenditure in the United Kingdom from 2022 to 2023 (16).

The effect of the pandemic on alcohol use was similarly varied. In their review of population studies estimating changes in alcohol consumption or patterns of drinking behavior, Sohi et al. found increases in alcohol use reported in 21 of 48 studies in North America, Europe, Australasia and Asia; decreases in 19; and no change in the remaining 8 studies (20). For the United States and United Kingdom in particular, increases in the frequency of alcohol drinking were reported. In a number of countries, an initial increase in sales of alcohol in early 2020 was observed, but worldwide and over the whole year of 2020, both individual consumption and revenue from alcohol sales declined (21). While it is clear that patterns of drinking changed, including increases in some high-risk behaviors (20), there is no evidence to suggest we should expect an increase in alcohol-related cancers in future years.

There is an anecdotal convention that with restrictions on movement and a shift to working from home, the pandemic led to a widespread gain in body weight. Published evidence, however, is more nuanced. An early review found no clear trend in body mass index between prepandemic and pandemic periods, although it did find evidence that those who were already overweight gained further weight during the pandemic (22). Self-reports from individual surveys in North America, Europe, the Middle East, and Asia suggest that overall, there was a tendency to weight gain (23–27), although in most surveys, there was a minority population who lost weight. Worryingly, increases in weight tended to be more consistently reported among those already overweight (23, 28).

Overall, it is difficult to quantify the likely effect of the pandemic on future cancer incidence due to changes in smoking, alcohol use, and body habitus. The evidence is more consistent for an increase in body weight during the lockdown period, and it is reasonable to expect that this will lead to higher incidence of weight-related cancers, notably upper and lower gastrointestinal cancers, breast cancer, and endometrial cancer.

MEDICAL PREVENTION INCLUDING VACCINATION

The HPV vaccine is one of the most effective forms of medical prevention against several types of cancer. Despite this, its coverage was variable even before the pandemic (29, 30). In their review of cervical cancer control and the pandemic, Ferrara et al. identified six reports on vaccination coverage before and during the pandemic period in the United States, Italy, and Spain (31). All reported a decrease in coverage in the pandemic period (31). A reduction was also observed in the United Kingdom (30). Reductions in vaccination activity have also been reported in Asia (32) and in South and Central America (33). Since vaccination is frequently offered within the school environment, the closure of schools during lockdowns was clearly a factor in the reduction in vaccination coverage (32). Bénard et al. carried out a modeling study to assess the likely effect of different vaccination strategies on future incidence of cervical cancer (34). The reductions of ~10% in rates observed in high- and middle-income countries would lead to a modest increase in future rates of cervical cancer (according to the models used), but the reduction of 17% in low-income countries would have more substantial implications for future cervical cancer rates. In particular, the authors emphasized the importance of catch-up and recovery campaigns in all countries (34).

In terms of chemoprevention of cancer, an interesting example is hormonal chemoprevention of breast cancer. This tends to be administered in the context of genetic services. There was already considerable use of telephone and other remote genetic counseling prior to the pandemic, and this activity increased in the pandemic period (35, 36). There is little quantitative evidence on the effect of the pandemic on the volume of preventive activity using selective estrogen receptor modulators or aromatase inhibitors, but two observations can be made. First, there has been a clear, international acceleration of the trend toward telemedicine and remote consultation in the likely target population for such prevention (35–38). Second, these shifts toward remote consultation are likely to be permanent in many healthcare environments (39).

SURGICAL PREVENTION BY REMOVAL OF THE ORGAN OR OF PRECURSOR LESIONS

We consider two particular cases of risk reduction by surgery: mastectomy for prevention of breast cancer in high-risk women, and salpingo-oophorectomy in women at increased risk of ovarian cancer. It is clear that in many countries, breast surgery rates, both therapeutic and prophylactic, declined from 2019 to 2020 but that the deficit was temporary (40, 41). There are no quantitative data on the volume of surgery specifically for primary prevention of breast cancer; however, given the hiatus in surgical activity in 2020, it is likely that substantial numbers of preventive mastectomies were canceled or delayed. As noted above, however, the genetics services that often provide a pathway to such surgery shifted dramatically toward remote consultation with the pandemic.

As was observed above for persons at high genetic risk of breast cancer, there was a major shift to telemedicine for consultations in women at high risk of ovarian cancer (often the same population of women with a high risk of a *BRCA1* mutation) (42). The COVIDSurg Collaborative reported that worldwide, more than 300,000 gynecological cancer operations and more than 2 million benign gynecological operations were delayed or canceled during the first wave of the pandemic (43). A proportion of these will have been prophylactic surgery cases. Again, quantitative data on specifically risk-reducing operations canceled or delayed are not available, but it is clear from the totals above that the number must be substantial. Manchanda et al. (44) and Oxley et al. (45) emphasize the need to plan for recovery, dealing with backlogs of surgical cases, support for staff under considerable pressure, and further research on the effect of the pandemic on long-term outcomes in gynecological cancers.

BREAST CANCER SCREENING

In many countries, mammography screening programs were halted, at least for a few months, during the intense pandemic period of 2020 (46). Even if programs were not officially halted, there is evidence that numbers actually screened fell dramatically during this period (47). This clearly had implications in terms of delayed diagnoses, giving the opportunity for tumors to grow and disseminate (3).

Quantitative estimates of the screening activity delayed or canceled are sporadic, but a useful review is provided by Ng & Hamilton (48). This review reports the deficit in numbers of screening episodes in the pandemic period (January 2020 to October 2021) compared to the prepandemic period. Results include deficits of 500,000 in Italy, 800,000 in parts of Brazil, and 100,000 in parts of Japan. Much higher figures result from national recording or estimation of national figures from survey data. For example, from recorded screening activity, Duffy et al. reported more than 1 million screens missed or delayed in England in 2020–2021 (3), and Dennis et al. reported an estimated deficit of 1.1 million mammography screens in the United States between April and December 2020 (49).

The implications of these data for breast cancer outcomes are substantial. Duffy et al. (3) estimated that the 2020 hiatus in breast screening in England could lead to up to 687 more breast cancer deaths in England over the next 10 years, as a result of cancers progressing to symptomatic status, more advanced stage at presentation within the screen-detected cancers, and cases of ductal carcinoma in situ progressing to invasive disease. This would be a result of ~1.3 million delayed screening invitations and ~900,000 delayed or missed screens. Alagoz et al. estimated that 950 additional breast cancer deaths would occur in the United States by 2030 as a result of disruption of screening services in the first 6 months of 2020 (50). However, the assumption that the only affected period was the first 6 months of 2020 might underestimate the impact. Considering the millions of screening episodes delayed or canceled worldwide, thousands and perhaps tens of thousands of additional breast cancer deaths might be expected in the next decade.

There is, however, a qualification to this. Noting that these projected deaths have not yet occurred, there remains scope to prevent a large proportion of them, if the screening services recover adequately. Sprague et al. report that in 62 radiology services in the United States, mammography activity had reached 89.7% of prepandemic levels by July 2020 (51). In the United Kingdom, invitation and screening activity has increased in the year 2021–2022 to beyond prepandemic levels (Table 1), so some of the early detection lost during 2020–2021 will have been retrieved (52–55). If other national and regional programs are taking similar remedial measures, the adverse consequences of the pandemic for breast cancer outcomes will be mitigated.

It is worth remarking that in both the United Kingdom and the United States, there is some evidence that the effect of the pandemic on screening services may have been disproportionately large in populations already underserved (56, 57).

Table 1 Breast screening invitations, screens attended, and cancers diagnosed by year in the National Health Service Breast Screening Program, United Kingdom

Metric	Screening year ^a			
	2018–2019	2019–2020	2020–2021	2021–2022
Invitations (millions)	2.54	2.56	1.75	3.17
Screens (millions)	1.82	1.79	1.08	1.97
Cancers diagnosed	15,289	14,679	9,902	17,949

^aScreening years run from April to March, so 2018–2019 means April 2018 to March 2019 and so on.

COLORECTAL CANCER SCREENING

Internationally, colorectal cancer screening programs were disrupted or follow-up services were restricted for some months during the first COVID-19 wave (47, 58–61). For example, it was estimated that there was a deficit of 3.8 million colorectal cancer screening episodes in the United States in the first months of the pandemic (60). In most healthcare settings, the initial screening test is one for blood in feces, usually a fecal immunochemical test, for which the sampling can be done at home. However, those testing positive would generally be referred for colonoscopy. Endoscopy activities were significantly constrained in the early period of the pandemic for a number of reasons (58, 59), including (a) longer time intervals between colonoscopy patients due to the need for infection control measures, (b) transfer of personnel and resources to COVID-19-related activities, and (c) reluctance of members of the public to attend hospital appointments for fear of COVID-19 infection.

There is some evidence from North America, Europe, and Australasia that services recovered relatively rapidly and screening participation rates returned to approximately prepandemic levels (58, 60, 61). Willingness to participate in follow-up procedures after a positive primary screen test has been reported to be lower compared to prepandemic rates (62). Lower participation might be attributable to distrust in healthcare services or perceived risk of seeking diagnostic care.

Modeling of likely long-term outcomes suggests that the effects on colorectal cancer outcomes depend strongly on the duration of the hiatus or deficit period and the rate of remedial catch-up (61, 63, 64). For example, de Jonge et al. estimated that with a 3-month disruption period in the Netherlands, an additional 324–440 deaths would be expected in the future, whereas with a 12-month period, the expected number of additional deaths would be 1,360–1,762 (61).

As was the case with breast cancer screening, there is some evidence of a worsening of inequalities in screening delivery as a result of the pandemic (65, 66), although this was not universally observed (67).

CERVICAL CANCER SCREENING

Similarly to breast and colorectal cancer screening, cervical screening activity was substantially reduced in the early pandemic period (47, 68, 69). Reductions in numbers of screening episodes of ~90% were reported in the period around April–May 2020 for the United States, Canada, Italy, and the United Kingdom (47, 68, 69), but with fairly rapid recovery of service thereafter in many areas (68, 69).

Modeling of the likely impact of the reduction in screening activity gave results that were strongly dependent on the duration of disruption. In the United States, an additional 5–8 cervical screening cases per million were expected over 2020–2027 for a 3-month disruption period, and 38–45 additional cases per million for a 24-month period (70), a range of relative increases of between 3% and 27%. In the United Kingdom, rather higher rates were predicted, but for a smaller population having delayed or missed screens (69). Modeling exercises indicated that effects would be mitigated by rapid catch-up (as one would expect), and continued provision of colposcopy and precancer treatment services (70). There was also an indication that cytology programs were likely to suffer greater effects on outcomes than HPV testing programs (70, 71).

DISCUSSION

It is absolutely clear that the pandemic, particularly in 2020, led to a dramatic reduction in cancer diagnosis and treatment volumes (10–12). It also is clear from the above that there were similar deficits in screening and primary prevention. These have implied and will continue to imply higher incidence of cancer, including later-stage cancer, in the postpandemic period.

Estimates of the likely effect on future cancer mortality are not available for some activity deficits, for example, primary prevention by chemotherapeutic or surgical means in persons at high risk of cancer. For other cancers, with widespread screening programs, estimates are too numerous and too variable to summarize here. However, both the empirical and predictive modeling research all indicate the importance of recovery and of compensating for the lack of activity in the early lockdown periods. Many of the additional predicted cancer deaths have not occurred yet, and the rapidity with which preventive and screening services recover their previous coverage will determine what proportion of these can yet be avoided.

This message has already been taken on board by healthcare providers. As noted above, colorectal screening programs in several countries were swift to return to prepandemic activity (58, 60, 61). The National Health Service Breast Cancer Screening Program in the United Kingdom is screening 150,000 more women per year than in the prepandemic period (55). However, uptake is still running at ~60%, compared with 70% prepandemic, and this is a target for future improvement.

This review did not cover the entire spectrum of primary and secondary prevention for reasons of space. Interventions such as hepatitis B vaccination and neither low-dose computed tomography screening for lung cancer nor prostate cancer screening were covered, although it is likely that these were also affected by the pandemic (5, 30, 60). However, it is hoped that this review gives a picture of the extent of the reduction in prevention activity during the COVID-19 pandemic.

There can be no doubt that the pandemic disrupted cancer prevention and screening services, and that a price will be paid, and is already being paid, in terms of higher incidence of some cancers, as well as later diagnosis and poorer survival for others. The message from this is the obvious one: It is imperative to bring the services back to equal or higher levels of activity than prepandemic as quickly as possible. Furthermore, for some cancer screening services, there is evidence that the pandemic caused a worsening of inequalities in delivery (56, 65, 66). Given that the communities previously potentially underserved by healthcare provision were often the hardest hit by the pandemic (72), providers have a duty to address the inequalities in cancer and other diseases as we recover.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

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