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Review

Implications of the COVID-19 Pandemic for Cardiovascular Disease and Risk-Factor Management

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ABSTRACT

COVID-19 and our public health responses to the pandemic may have far-reaching implications for cardiovascular (CV) risk, affecting the general population and not only survivors of COVID-19. In this narrative review, we discuss how the pandemic may affect general CV risk for years to come and explore the mitigating potential of telehealth interventions. From a health care perspective, the shift away from in-person office visits may have led many to defer routine risk- factor management and may have had unforeseen effects on continuity of care and adherence. Fear of COVID-19 has led some patients to forego

RÉSUMÉ

La pandémie de COVID-19 et les mesures prises par les autorités de santé publique pourraient avoir de lourdes conséquences sur le risque cardiovasculaire (CV) dans l'ensemble de la population, et non seulement pour les personnes qui auront survécu à la COVID-19. Dans cette revue non systématique, nous analysons les répercussions possibles de la pandémie sur le risque CV général au cours des années à venir et nous explorons le potentiel d'atténuation de ces répercussions grâce à la télémédecine. Du point de vue des soins de santé, le délaissement des consultations en personne pourrait en avoir incité plusieurs à

Since first emerging in the Hubei province of China, the novel severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has spread globally, with 223,297 cases of COVID-19 and 10,023 reported deaths in Canada as of October 28, 2020.[1] Acute cardiovascular (CV) complications of COVID-19 are more common than initially thought and can include myocarditis, pericarditis, myocardial infarction, decompensated heart failure, stroke, and pulmonary embolus.[2] In addition, a number of the antiviral therapies and immune-response modulators currently being investigated for treatment of COVID-19 have CV side effects and potentially interact with CV medications.[3] Nothing is known about the potential long-term CV complications of COVID-19 infection at this early stage of the pandemic. However, the CV implications of COVID-19 will definitely extend beyond direct infection-related CV damage. The public health response to the pandemic, meant to mitigate morbidity and mortality from acute COVID-19, may have the unintended consequence of increasing CV risk in much broader swaths of the general population, including those uninfected with SARS-CoV-2. In this review, we explore potential mechanisms by which COVID-19 and our responses to the pandemic may affect future CV risk. We then discuss some of the factors that might mitigate this risk if successfully harnessed in these challenging circumstances.

Primary Impact of SARS-CoV-2 Infection on CV Risk

SARS-CoV-2 binds to angiotensin converting-enzyme-2 (ACE2) receptors. Physiologically, ACE2 counters renin-angiotensin-aldosterone system activation by degrading angiotensin 2 to angiotensin 1-7. Angiotensin 2 is a potent vasoconstrictor implicated in the pathophysiology of CV disease, whereas angiotensin 1-7 has been shown to have cardioprotective actions, potentially mediated by vasodilatory, antifibrotic, anti-inflammatory, and antithrombotic effects including the inhibition of proinflammatory cytokines and reduced thrombus formation via nitric oxide and prostacyclin pathways. Down-regulation of the ACE2 receptor induced by SARS-CoV-2 binding and endocytosis may lead to an imbalance of angiotensin 2 and angiotensin 1-7, with consequent alterations of normal circulatory homeostasis, particularly in the endothelium of the pulmonary capillaries, where this imbalance may contribute to the immune-thrombotic microvascular coagulopathy associated with respiratory compromise in COVID-19.[4-7] ACE2 and angiotensin 1-7 have been proposed as potential therapies for COVID-19.[8,9] Other mechanisms of CV injury include direct infection of endothelial cells as well as damage mediated by release of inflammatory mediators and by other aspects of the immune response to COVID-19.[7,10,11] Extensive coronary microvascular thrombi may lead to myocardial infarctions,

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care for acute CV events. Curtailment of routine outpatient laboratory testing has likely delayed intensification of risk-factor—modifying medical therapy, and drug shortages and misinformation may have negative impacts on adherence to antihypertensive, glucose-lowering, and lipid-lowering agents. From a societal perspective, the unprecedented curtailment of social and economic activities has led to loss of income, unemployment, social isolation, decreased physical activity, and increased frequency of depression and anxiety, all of which are known to be associated with worse CV risk-factor control and outcomes. We must embrace and evaluate measures to mitigate these potential harms to avoid an epidemic of CV morbidity and mortality in the coming years that could dwarf the initial health effects of COVID-19.

reporter la prise en charge courante des facteurs de risque, ce qui pourrait avoir des effets imprévus sur le maintien des soins et l'observance thérapeutique. La peur de la COVID-19 a en outre incité certains patients ayant subi une manifestation CV aiguë à se passer de soins. La limitation de l'exécution des tests de laboratoire de contrôle pour les patients ambulatoires a vraisemblablement retardé l'intensification des traitements médicaux visant à atténuer les facteurs de risques, et les pénuries de médicaments et la mésinformation pourraient avoir des répercussions défavorables sur l'observance des traitements antihypertenseurs, hypoglycémiants et hypolipidémiants. D'un point de vue sociétal, la restriction sans précédent des activités sociales et économiques a entraîné des pertes de revenus, des pertes d'emploi, de l'isolement social, une diminution de l'activité physique et une augmentation des cas de dépression et d'anxiété, qui sont tous associés à une détérioration du contrôle des facteurs de risques et des résultats sur le plan de la santé CV. Nous devons évaluer la situation et adopter des mesures pour atténuer ces méfaits potentiels afin d'éviter au cours des prochaines années une épidémie de morbidité et de mortalité CV qui pourrait bien éclipser les effets initiaux de la COVID-19 sur la santé.

even in patients with nonobstructive coronary arteries,[12] and up to one-third of patients hospitalized with COVID-19 have elevated troponins.[13] A recently published cohort study revealed that three-quarters of COVID-19 survivors, most of whom had not even required hospitalization for their illness, had evidence of cardiac involvement on cardiac magnetic resonance imaging, and 60% had ongoing myocardial inflammation more than 2 months after resolution of their COVID-19 symptoms.[2] Whether infection with SARS-CoV-2 will lead to long-term CV risk sequelae among COVID-19 survivors is an open question that will require prospective registries of COVID-19 survivors to detect.[10,14] Certainly, it does appear that COVID-19 may cause diabetes caused by direct viral infection via ACE2 receptors, which are abundant on pancreatic β-cells, and cases of COVID-19 manifesting as new-onset diabetes—and even ketoacidosis—have been reported.[15-17]

However, COVID-19 may adversely affect CV risk in many more than only those who were infected and survived, by various mechanisms related to our individual and collective pandemic responses as will be outlined as follows. It is probable that the footprint of these secondary and tertiary impacts on CV health may far outweigh that related to primary SARS-CoV-2 infection and its treatment (Fig. 1 and Table 1).

Secondary Effects Caused by Pandemic-Related Health Care Restrictions and the Infodemic

Shift from in-person outpatient visits to virtual care

Although the frequency of virtual visits has grown exponentially since the pandemic began, it has not fully made up for the marked decline in outpatient visits owing to restrictions imposed after the onset of the pandemic. A recent study from the US Veterans Health Administration documented that total outpatient visit contacts, both virtual and in-person, were still 30% lower after March 2020, compared with the spring in previous years.[18] Less-frequent outpatient visits will undoubtedly translate into less-rigourous risk-factor control, as many patients and clinicians have deferred routine risk-factor management during the pandemic.[19] In fact, a recent study from the United States confirmed that although telemedicine visits increased several-fold in the second quarter of 2020, the total number of primary care encounters still decreased by 21%, and new medication starts decreased by 26%.[20] Even more concerningly, assessments of blood pressure (BP) decreased by 50% and cholesterol levels by 37%. Moreover, it is unclear whether virtual outpatient visits have the same effect as in-person visits for engaging patients in self-management of CV risk.

The importance of continuity of care in the management of CV risk factors, such as BP, glycemia, or lipids, is well documented. Patients with higher-care continuity report greater satisfaction and exhibit better adherence to prescribed therapies and health-promotion behaviours, fewer visits to emergency departments, or hospitalizations, especially for ambulatory-care sensitive conditions, and even decreased mortality rates in some studies.[21-24] However, all those studies measured continuity of care in terms of face-to-face encounters, and we are not aware of any published studies exploring the impact of virtual care visits on continuity for management of chronic disease or risk-factor control. Physical examination still has a role in medical practice even in 2020. Although it is well known that the accuracy of diagnoses are doubled when clinicians examine patients rather than just hear their histories,[25] it is not unreasonable to hypothesize that the therapeutic alliance formed between patient and physician when face to face[26] is much stronger than when those visits are merely virtual. As pointed out by Chwistek, "There is no doubt that the virtual visit is a fundamental alteration to the patient-physician encounter…an imposed order commands the in-person visit, and it travels beyond the verbal: body language, rush of emotions, physical proximity, and touch. If it goes well, there can be a sense of peace for the patient that they are cared for."[27] On the other hand, he also argued that

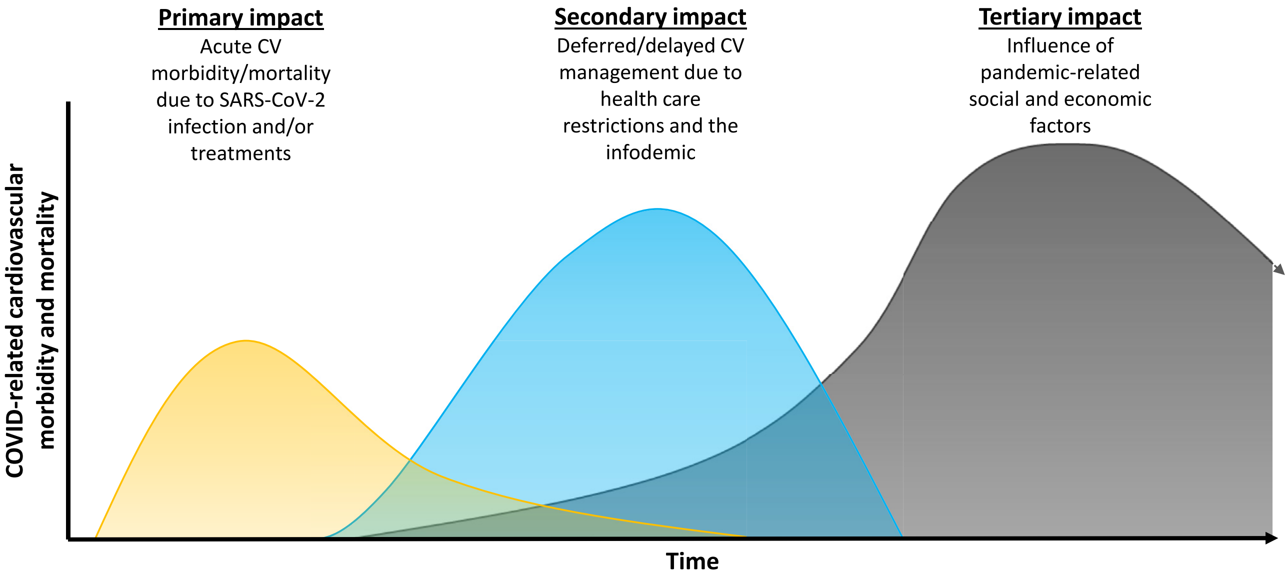

Figure 1. Potential effects of the COVID-19 pandemic on cardiovascular morbidity and mortality. The height and time scale of the 3 waves in this figure are uncertain and not to scale. Waves of cardiovascular mortality and morbidity should be distinguished from "waves" of pandemic COVID-19. We expect each additional "wave" of pandemic COVID-19 to create echoing waves of cardiovascular mortality and morbidity, owing to primary, secondary, and tertiary effects, particularly to the extent that previously relaxed pandemic precautions and curtailments of normal socioeconomic and health care-related activities are reinstated.

"video encounters offer a direct glimpse into the lives of patients, an updated version of the traditional home visit."[27] Thus, determining the impact of virtual visits compared with in-person visits is a clear research priority, as more than half of all visits with physicians in Canada have been virtual since the beginning of the pandemic.[28]

Table 1. Mechanisms for potential effects of COVID-19 pandemic on subsequent cardiovascular mortality and morbidity

Impacts on CV morbidity or mortality	Direct effects of COVID-19	Delayed/foregone health care	Social and economic impacts
Primary impact (days-weeks)	◦ Myocarditis ◦ Acute coronary syndrome ◦ Microvascular thromboses ◦ Arrhythmias ◦ Septic/stress-induced cardiomyopathy ◦ Pericarditis	◦ Out-of-hospital cardiac arrests ◦ Delayed presentation of MI/stroke	
Secondary impact (weeks-months)		◦ Heart failure/structural heart complications caused by missed or late presentations of MI ◦ Shortages of important CV risk-reducing medications ◦ "Infodemic" misinformation ◦ Reduced adherence with CV risk reducing therapy as an unintended consequence of 30-day refill restrictions ◦ Reduced secondary cardiovascular prevention caused by the following: o Foregone outpatient visits o Shift to virtual visits o Curtailment of routine outpatient laboratory monitoring	◦ Income loss and unemployment ◦ Physical inactivity ◦ Social isolation, depression, and anxiety
Tertiary impact (months-years)	◦ Unknown: May include heart failure, myocardial fibrosis, scar-related arrhythmia, etc. ◦ COVID-induced diabetes effect on CV risk	◦ Reduced primary and secondary cardiovascular prevention due to: o Foregone outpatient visits o Shift to virtual visits o Curtailment of routine outpatient laboratory monitoring	◦ Income loss and unemployment ◦ Physical inactivity ◦ Social isolation, depression, and anxiety

CV, cardiovascular; MI, myocardial infarction.

Acute care avoided or delayed because of COVID-19−related fears

Marked declines in ED and hospital-based clinic visits for non-COVID−related conditions have been observed since the pandemic was declared,[29-31] even for acute CV conditions such as myocardial infarction[32,33], decompensated heart failure,[34], and stroke.[35] Correspondingly, there have been reports of up to 3-fold increases in out-of-hospital cardiac arrests during the COVID-19 pandemic, compared with previous years.[36,37] When patients with acute conditions do present, they have been presenting later than usual, and their treatments have also been delayed after arrival, resulting in poorer outcomes.[38,39] One study of patients with ST-elevation myocardial infarction (STEMI) documented increases in times from onset of symptoms to first medical contact (over 4 hours), hospital door to percutaneous coronary intervention (PCI) (approximately 30 minutes), and even catheterization laboratory arrival to PCI time (approximately 15 minutes) compared with the same metrics the year before.[40] Delays in presentation may occur because of patient fears of contracting COVID-19, public health messages to avoid the emergency department for non−COVID-19 related conditions, or limited access to emergency medical services (because of reduced staffing from illness or isolation requirements). The delays in treatment have been attributed to COVID screening, donning of personal protective equipment, and deep cleaning of catheterization laboratories before and after each case.[40] Similar reports have now emerged from Europe, the United Kingdom, and the United States for STEMI[39,41,42] and acute stroke.[43] As delays in presentation and treatment become more common, we are likely to see increases in CV-related morbidity caused by increased rates of heart failure, physical disabilities, and cardiac structural sequelae[44] in survivors of acute events that some authors have labelled an "impending tsunami."[45] It is important to note that after the 2003 SARS-CoV-1 epidemic, inpatient and outpatient visit rates did not recover to pre-epidemic levels until nearly 4 years later, so this may not be as brief a phenomenon as we may think or wish.[46]

Curtailment of routine outpatient laboratory testing

Routine laboratory testing is an important part of CV risk reduction. Medical therapy for diabetes, hypertension, and dyslipidemia involves the routine measurement of laboratory parameters, both for safety and to guide appropriate intensification. In March to May 2020, many outpatient laboratories suspended or limited routine or nonessential bloodwork to protect patients and staff from acquiring COVID-19.[47] Choosing wisely, Canada recommended delaying nonessential care and laboratory testing when possible.[48] Although most outpatient laboratories have since resumed routine bloodwork, albeit at lower volumes—owing to measures put in place for physical distancing and increased personal protective equipment precautions—many patients continue to express anxiety about attending.[49] No studies have been published yet on rates of laboratory testing and therapeutic intensification during the COVID-19 pandemic, but we believe it has undoubtedly led to deferred CV risk-factor management for many patients, particularly those with multiple comorbidities, who are both more likely to need routine laboratory work and also more likely to experience severe COVID-19.[50]

Drug shortages and 30-day prescription refill restrictions

Even before the COVID-19 pandemic, drug shortages were becomingly an increasingly common problem in health care, and the therapeutic turbulence caused by switching among drugs even within the same class has been shown to have a negative impact on patient adherence and outcomes.[51] More than 10% of drug shortages documented by the US FDA are for drugs used in the management of CV disease, and antihypertensive agents have remained firmly in the top 5 drug groups subject to shortages in the past decade. Many of these drugs are manufactured in China and India. Given the disruptions to the global supply chain with the pandemic, it should come as no surprise that the monthly number of new drug shortages listed by Health Canada has doubled since March 2020.[52] Although not a drug shortage per se, the impact of the recall of several generic valsartan preparations in 2018 clearly illustrates what happens when a prescribed medication is suddenly no longer available: There was a negative impact on persistence with antihypertensive medications of several different drug classes,[53,54] an increase in health care encounters,[53,54] and even increased rates of stroke in 1 analysis.[54] Although most Canadian pharmacies have restricted prescription refills to 30-day intervals to preserve stocks during the pandemic, the potentially negative consequences for patient adherence (owing to increased costs, inconvenience, and patient fear of going to a pharmacy multiple times over 3 months rather than once[55]) and clinical outcomes have yet to be revealed. This is a research priority, given that even brief periods of abstinence from antihypertensive or lipid-lowering therapy can be associated with CV events.[56-58]

The Infodemic

"Infodemic" is a word coined by Dr Tedres Adhanom Ghebreyesus, Director-General of the World Health Organization, to refer to inaccurate, decontextualized, misleading, biased, or otherwise "fake" information disseminated on social—and sometimes conventional—media.[59,60] The term may also include legitimate information but accompanied by premature calls to action, as exemplified by the early enthusiasm for hydroxychloroquine, whose benefits were later disproved by higher-quality studies.[61,62] Regarding CV risk, widespread speculation on social media and in the mainstream media that ACE inhibitors and angiotensin receptor blockers could increase susceptibility to COVID-19 and worsen prognoses created sufficient concern in the public that many organizations, including Hypertension Canada and the Canadian Cardiovascular Society, issued specific policy statements in print and social media, encouraging patients treated with these agents not to discontinue therapy.[63] The concerns about these agents were subsequently shown to be unfounded in human studies,[3] but the potential adverse effects of this misinformation on patient adherence with antihypertensive therapy remains a concern.

The infodemic is not only a phenomenon in the lay press. In the scientific literature there has also been a proliferation of COVID-related papers on preprint servers that lack the safeguard of peer review.[64,65] The rush to publication has now been documented in peer-reviewed journals, with articles being published at extraordinary speed in the early phases of the pandemic,[65] and several notable instances of articles being later retracted, withdrawn, or having an expression of concern issued.[66] The situation is unlikely to change in the near future, as a review of ClinicalTrials.gov has identified a concerningly large proportion of studies with expected low levels of evidence.[67] Accordingly, a recent systematic review that examined 42 guidelines related to COVID-19, released in the spring and summer of 2020, found that the quality of all was poor, especially with respect to the rigour of their development.[68] The infodemic in scientific literature may result in a churn of studies that capture attention, but do not—and, arguably, should not—contribute meaningfully to clinical practice.

Tertiary Effects Caused by Pandemic-Related Social and Economic Restrictions

Loss of income and unemployment

The unprecedented economic upheaval generated by COVID-19 and mitigation measures aimed at reducing spread of disease will likely worsen CV risk-factor control and outcomes in the upcoming years. Canadian companies have had to implement substantial reductions in activity and layoffs in the face of diminished demand for services and products because of stay-at-home orders, fear of COVID-19, and travel restrictions. As a result, unemployment in Canada increased to 13.7% in May 2020, and remained 12.3% in June 2020, more than double the rates for the same months the year before.[69] In the United States, 19.6% of respondents in 1 national survey were not working, and one-third described moderate-to-high levels of food insecurity.[70]

The majority of Canadians (59%) have private health insurance for drug benefits,[71] most of which is provided in the form of extended health benefits as part of their employment.[72] More than one-half of these people (53%) would not be eligible for public drug benefits, which are accessible only for those older than 65 years of age, on social assistance, or under unique circumstances (eg, catastrophic costs, cancer therapies).[73] The loss of employment, for many, will lead to loss of insurance benefits and difficulty affording glucose-lowering, antihypertensive, and lipid-lowering medications.[74,75]

A significant body of literature has examined the effect of reduced income, unemployment, and job stress on CV risk factors. Lower income has been consistently associated with higher rates of diabetes in both cross-sectional[76,77] and longitudinal studies.[78] Lower income has been consistently associated with increased rates of hypertension.[79] Unemployment has only sometimes been associated with increased diabetes[80] and hypertension;[81] most studies have instead found that being employed in a job with a high degree of "job strain" (ie, a combination of high job demands and low job control) increased the risk of hypertension.[79] The precise role of unemployment-employment in CV risk-factor control is complicated and may differ by sex and age strata.[81] In terms of CV outcomes, the consensus observation across multiple studies has been more consistent; unemployed persons have higher riskS of major adverse CV events.[82-84]

The best evidence for increased CV risk following COVID-19 job losses may come from another recent economic upheaval. The **M**ulti-**E**thnic **S**tudy of **A**therosclerosis (MESA) followed a panel of patients from 2000 to 2012. The Great Recession of 2008 to 2010 was associated with a worsening of BP and fasting plasma glucose trajectories, particularly among those aged <65 years and on medications, who may be disproportionately affected by unemployment and loss of health benefits. Onset of the Great Recession was also associated with a decline in medication use and treatment intensity.[85] We therefore have good reason to expect the economic fallout from COVID-19 to manifest as worsening CV risk-factor control in years to come.

Physical inactivity caused by stay-at-home orders

A recent study using individual data from 455,404 users of the Argus (Azumio, Palo Alto, CA) smartphone app from 187 countries documented a 27% reduction in step counts worldwide in the month after the WHO declared COVID-19 a pandemic, with a clear link between the degree of local lockdown restrictions and reduced physical activity.[86] For example, step counts decreased by 49% in Italy within days of a rigourously enforced lockdown being initiated on March 9, but by only 7% in Sweden, where social distancing, but no lockdown, was implemented. Fitbit (Fitbit, San Francisco, CA) also reported 7% to 38% reductions in average step counts worldwide within the first week after pandemic restrictions came into force, including a 14% reduction in Canada.[87] Given the importance of regular physical activity in reducing risk of CV events and stroke,[88] there is no question that the pandemic-related lockdown restrictions will have an adverse impact on CV health, particularly as detrimental effects in CV function and increased risk factors can manifest within 1 to 4 weeks of inactivity.[89] Although it will be some time before we have empiric data to quantify this impact, modelling studies have estimated that even a 10% decrease in physical activity levels may result in an extra 535,000 all-cause deaths and 42,000 CV deaths.[89]

Social isolation, depression, and anxiety

The COVID-19 pandemic has been associated with an unprecedented increase in rates of depression and anxiety across the general population. In initial surveys from China during the period of mandatory stay-at-home orders, more than one-half of patients reported a moderate-to-severe psychological impact of the outbreak, with 16.5% reporting moderate-to-severe depressive symptoms, and 28.8% reporting moderate-to-severe anxiety symptoms.[90] By the end of May 2020, more than 60 studies had been published, using validated instruments to measure the psychological impact of COVID-19. Pooling the results of these studies, anxiety and depression were identified in 32% and 27% of the general public, respectively.[91] Most of these studies took place in China, but recent publications in other countries show similar findings,[92,93], including 1 large nation-wide US survey showing severe depression symptoms (Center for Epidemiologic Studies Depression Scale [CES-D] score > = 25) in 28% of respondents.[70] Reasons for this include social isolation owing to fear of contagion and stay-at-home orders;[94] intrinsic fear of COVID-19;[95] food insecurity and other economic deprivation owing to job loss;[70] and false or misleading information: that is, the "infodemic"[60] that has accompanied COVID-19 on media and social media platforms. In addition, even before COVID-19, social isolation and loneliness were recognized risk factors for mortality, with odds ratios of 1.29 and 1.32, consistent with many more traditional "medical" mortality risk factors.[96]

Many, although not all,[97] longitudinal studies have shown a temporal association among depression, anxiety, and diabetes mellitus. Pooling among them, depression appears to increase the risk of diabetes 1.3-fold;[98] anxiety appears to increase the risk of diabetes 1.5-fold.[99,100] Patients with depression may exhibit reduced healthy behaviours,[101] worse glycemic control,[102] and increased insulin resistance.[103,104] Depression, prevalent in over one-fifth of adults with hypertension,[105] has similarly been associated with a 1.4-fold increased risk of hypertension.[106] Anxiety has also been associated with unhealthy behaviours that increase the risk of hypertension,[107] and CV disease such as tobacco use, physical inactivity, and unhealthy food choices.[107,108] Both anxiety and depression have been associated with lower rates of medication adherence.[109-112] Other potential pathways linking depression and anxiety to CV risk have been proposed, including systemic chronic inflammation, hypothalamic-pituitary-adrenal (HPA) axis dysfunction, and autonomic dysregulation as causal mechanisms.[113]

Moving Forward: Strategies to Mitigate Risk in the Era of COVID-19

We have so far sketched a variety of pathways by which the COVID-19 pandemic and our individual and collective responses to it may unintentionally worsen CV risk in the general population. For health care providers, efforts to continue routine CV risk reduction via virtual means in this challenging landscape will be critical.[19,114] Virtual visits may create new challenges, yet telehealth technologies offer key means of communicating with and engaging patients during the pandemic. Here, we briefly review some of the evidence for telemonitoring and telecare in CV risk-factor management.

Digital health interventions for the management of CV risk factors

Digital health interventions (DHIs) span a spectrum from generic web-based strategies, to text messaging or e-mail interactions between patients and health care providers, to the use of mobile phone health-related applications, and to telemonitoring with the use of wearable biometric sensors by patients. All have the goal of "watching over the 5000 hours per year when patients are not in direct contact with health care providers … and are deciding whether to take prescribed medications or follow other medical advice, deciding what to eat and drink and whether to smoke, and making other choices about activities that can profoundly affect their health."[115] Numerous systematic reviews have confirmed that DHIs can successfully improve specific CV risk factors such as smoking cessation,[116] physical activity,[117] and weight loss.[118] Importantly, a systematic review of 9 trials in 2263 patients (2 primary prevention trials, 2 in heart failure, and 5 secondary prevention studies) reported a 40% relative reduction in CV disease outcomes (CV events, hospitalizations, and all-cause mortality) from DHI in secondary prevention patients both via risk-factor reduction but also by increasing adherence to evidence-based preventive therapies such as aspirin or statins. The pooled absolute risk reduction of 7.5% implied a number-needed-to-treat of 16 patients.[119] Although there was no statistically significant difference in CV outcomes with DHI in the primary prevention studies, there were statistically significant benefits on weight, systolic BP, total and low-density lipoprotein (LDL) cholesterol, and Framingham risk scores.[119] However, a Cochrane review of 93 DHI studies highlighted that much of the published evidence is of poor quality, there is evidence of publication bias, and the results are inconsistent across studies with effectiveness influenced by numerous factors, including the type of patients studied, the type and frequency of interactions between patients and health care providers, and the health care system in which the intervention is embedded.[120] Further research is clearly needed to determine the most effective DHI modalities in specific populations and to better understand the patient, provider, health system, and program factors that influence effectiveness. Until then, we can expect to see both positive[121] and negative[122,123] trials published in the literature.[124]

Telehealth for management of BP

Although a number of trials have demonstrated that patient self-monitoring has a small but statistically significant effect on improving control of BP,[125,126] a Canadian study reported that only 16% of patients complied with all recommended procedures when measuring their BP at home, and less than one-third reported at least 80% of their home measurements to their physicians.[127] On the other hand, the addition of telemonitoring, whereby clinicians review BP readings submitted by patients over the internet or via short message service (SMS) and titrate therapy as required, is associated with much larger reductions in BP, in the order of 5 mm Hg for systolic BP,[128-130] and has been shown to be cost effective.[129,131] However, telemonitoring trials have generally recruited small samples of often highly selected individuals, followed for relatively short periods. There are numerous potential barriers to scaling such interventions up to accommodate large numbers of patients,[132] and thus such efforts should be accompanied by robust evaluation plans.

Telehealth for diabetes care

Telehealth interventions in diabetes care have usually involved self-monitoring of blood glucose and communication back to the clinician via a variety of means (text message, web portal, smartphone apps, and telephone), with feedback offered to the patient ranging from none; to generic messages generated by automated processes; to nurse, pharmacist, or physician feedback with or without concrete medication changes; with or without diet and lifestyle coaching, communicated either synchronously or asynchronously.[133,134] Critical appraisal of the field is complicated by the high degree of heterogeneity of interventions, but a recent systematic review of 111 randomized trials identified a pooled mean hemoglobin (Hb) A1c reduction of 0.57% (95% confidence interval [CI], 0.40%-0.74%),[135] consistent with other reviews.[136-138] Other reported benefits of telehealth in diabetes include increased patient satisfaction, knowledge, and self-efficacy outcomes.[139] However, 1 broad theme appears consistently: Interventions involving personal feedback from a health care provider—whether a specialist nurse, pharmacist, or physician does not appear to matter—with the ability to make medication changes appear to be critical to achieving reductions in HbA1c.[135,139] In recognition of this, the current Diabetes Canada guidelines have assigned telehealth a grade A recommendation, as a technology that may help facilitate many of the quality improvement strategies derived from the Chronic Care Model.[140]

Thus, although the evidence for DHI and telehealth is heterogeneous in CV risk-factor management, a key determinant of success appears to be clinician review of patient-generated data linked to actual changes in medical management and the involvement of a broader health care team than merely a single physician.[114] The very best examples of telehealth in the literature improved patient satisfaction, knowledge, and self-efficacy in addition to CV risk factors such as BP levels and HbA1c. Many barriers remain: for example, devising means of transmitting clinical data accessible to patients of varying ages and skill; appropriate remuneration for telemedicine activities; availability of technical support; and navigating new workflows. These barriers are not insurmountable.[141] Although there is no question that implementing and scaling up these new models of care is challenging, the COVID-19 pandemic offers an opportunity to rethink how we deliver care and to embrace new technologies for reaching out to our patients—and allowing our patients to reach out to us—to remodel how we optimize reduction of CV risk in Canada and improve the accessibility and efficiency of health care.

Conclusions

The COVID-19 pandemic is likely to have a wide and long-lasting impact on CV risk-factor control and outcomes for the general population and not only for survivors of COVID-19. The threat of an "impending tsunami"[45] of CV morbidity and mortality in the coming years is real. Many of the challenges to CV risk management caused by the pandemic will require forward-looking social and economic policies to address. New messaging from public health authorities, who have until now been focused on preventing acute COVID-19 infections, will be needed: messaging that considers the overall health needs of the population, including primary and secondary prevention of CV disease, as the pandemic stretches out over time.[19,114] As clinicians, we also need to rise to this challenge by finding ways of remodelling care delivery and improving the effectiveness and efficiency of CV risk management during the COVID-19 pandemic. In doing so, we are likely to find ourselves innovating during the most unlikely of times.

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