

## REVIEW

# The overall impact of COVID-19 on healthcare during the pandemic: A multidisciplinary point of view

Nastaran Sabetkish<sup>1,2</sup>  | Alireza Rahmani<sup>3</sup>

<sup>1</sup>Pediatric Urology and Regenerative Medicine Research Center, Section of Tissue Engineering and Stem Cells Therapy, Children's Hospital Medical Center, Tehran University of Medical Sciences, Tehran, Iran

<sup>2</sup>Immunology, Asthma and Allergy Research Institute, Tehran University of Medical Sciences, Tehran, Iran

<sup>3</sup>Research Center for Prevention of Cardiovascular Disease, Institute of Endocrinology & Metabolism, Iran University of Medical Sciences, Tehran, Iran

**Correspondence**

Nastaran Sabetkish, Pediatric Urology and Regenerative Medicine Research Center, Section of Tissue Engineering and Stem Cells Therapy, Children's Hospital Medical Center, Tehran University of Medical Sciences, No. 62, Dr. Gharib's Street, Keshavarz Boulevard, Tehran 1419433151, Iran.  
Email: n-sabetkish@farabi.tums.ac.ir

**Abstract**

**Background and Aims:** The Coronavirus disease 2019 (COVID-19) pandemic globally changed the priorities of medical and surgical procedures. It has caused many healthcare systems to stop performing their routine screenings. Altering medical clinics to COVID-19 referral centers, lockdowns, and the public fear to refer to medical centers caused a significant reduction in the referral rate; especially in the elderly. This short review article highlights the transform in clinical practice during the post-COVID era and the need for future medical revolutions.

**Methods:** A comprehensive literature search was separately performed by both authors. The articles published between 2019 and August 2021 were included in this study and selected according to a quality appraisal method.

**Results:** We have summarized the possible corresponding changes in the diagnosis and treatment of all fields of medical care including internal medicine, surgical, and minor subcategories after the COVID-19 pandemic. We have also discussed the potential impacts of the pandemic on all these different categories and subcategories of medicine, including the outpatient setting and clinical work. We do believe that the lack of routine check-ups has led to an increase in the stage of disease in patients with a previously diagnosed problem. On the other hand, the dramatic change in the lifestyle of the population including restricted mobility and increased consumption of unhealthy food has caused metabolic syndrome and other new diseases that have not been diagnosed and properly managed.

**Conclusion:** Our findings revealed the urgent need for public health awareness. It indicated the need to carry out both psychological and screening approaches in the post-COVID era to not miss patients with a chronic disease and new cases who were undiagnosed during the COVID pandemic.

**KEYWORDS**

COVID-19 pandemic, epidemiology, morbidity, SARS-CoV-2

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## 1 | INTRODUCTION

The Coronavirus disease 2019 (COVID-19) pandemic as an unprecedented global crisis immediately affected healthcare services. Patients with COVID-19 infection may initially suffer from flu-like symptoms; however, nearly 50% to 75% of the subjects with positive PCR results may remain asymptomatic.<sup>1</sup> However, the disease could be severe in some cases.<sup>2</sup>

The impact of COVID-19 on the health care system has been dramatic as it had to undergo major changes such as postponement of elective surgeries and non-urgent medical care, and acceptance of telehealth to achieve pandemic preparedness. Patients have had difficulty reaching the hospital through ambulances and those with a chronic disease would rather postpone their follow-ups, outpatients' hospital activities were limited to urgent cases, and all scheduled activities were interrupted. As a result, telephonic consultations and messenger services were applied to not lose communication with patients. Despite all benefits of telemedicine during the COVID-19 pandemic, the telemedical examination does not seem to be able to replace personal consultation fully. In addition, training programs have been affected by the COVID-19 pandemic to the highest degree.<sup>3</sup>

In this review, we aimed to discuss the health system should have in mind the post-pandemic care both in patients with a chronic disease and those healthy individuals who may confront a new undiagnosed disease.

## 2 | METHODS

A systematic narrative review of research published between 2019 and August 2021 was performed. Keywords were selected for each subsection including internal medicine, surgical, and minor subcategories and used to search PubMed, Medline, and google scholar as reliable bibliographic databases. Results of each different subsection were then subject to review; using a quality appraisal method and the most related articles were selected. Accordingly, the titles and abstracts of the retrieved articles were screened and the full text of potentially relevant articles was printed and read by both authors.

### 2.1 | COVID-19 and cardiology

COVID-19 is associated with myocarditis, myocardial ischemia, and abnormal host immune response, leading to arrhythmias.<sup>4-6</sup> COVID-19 can cause heart failure (HF) or even make it worse.<sup>6</sup> Acute HF had a higher incidence among patients who did not survive.<sup>5</sup> Older age may increase the risk of cardiovascular events leading to death.<sup>7</sup> In a retrospective cohort study, cardiovascular-associated death accounted for 5% of the 28 969 deaths and increased by 8%.<sup>8</sup>

Lockdowns and the fear to refer to healthcare centers prevented the identification of new patients as well as appropriate treatment of prior patients. This reduction in patient referrals overshadowed cardiac surgery training.<sup>9</sup> There will be an increase in elective procedures

and delayed elective procedures after the pandemic.<sup>10</sup> Post-MI complications will increase, which will potentially have a considerable effect on the healthcare economy, especially for developing countries.<sup>10,11</sup> (Figure 1).

*Pediatrics:* Children often have cardiovascular involvement including myocardial dysfunction (MI), valvulitis, and coronary artery dilation or aneurysms.<sup>12</sup> Pediatric and congenital heart disease (CHD) may cause an increased risk for severe MI.<sup>13</sup>

### 2.2 | COVID-19 and endocrinology

Physical activity has beneficial effects on blood sugar control. During the COVID-19 period, social distance reduced physical activity and diet control, resulting in changes in glucose control, parallel to anxiety and sleep disturbance.<sup>14</sup> In a retrospective study on gestational diabetes mellitus in France, there was a decrease in blood sugar control.<sup>15</sup> As a result, this could lead to maternal and neonatal morbidity.<sup>15</sup> While patient and society educations were focused on COVID-19, maintaining regular education on other aspects of health, especially symptoms of diabetes, may be helpful to lower the prevalence of diabetic ketoacidosis (DKA).<sup>16</sup>

In terms of hypothyroidism, it has been reported in a recent study that compliance to levothyroxine treatment is decreased during the pandemic.<sup>17</sup>

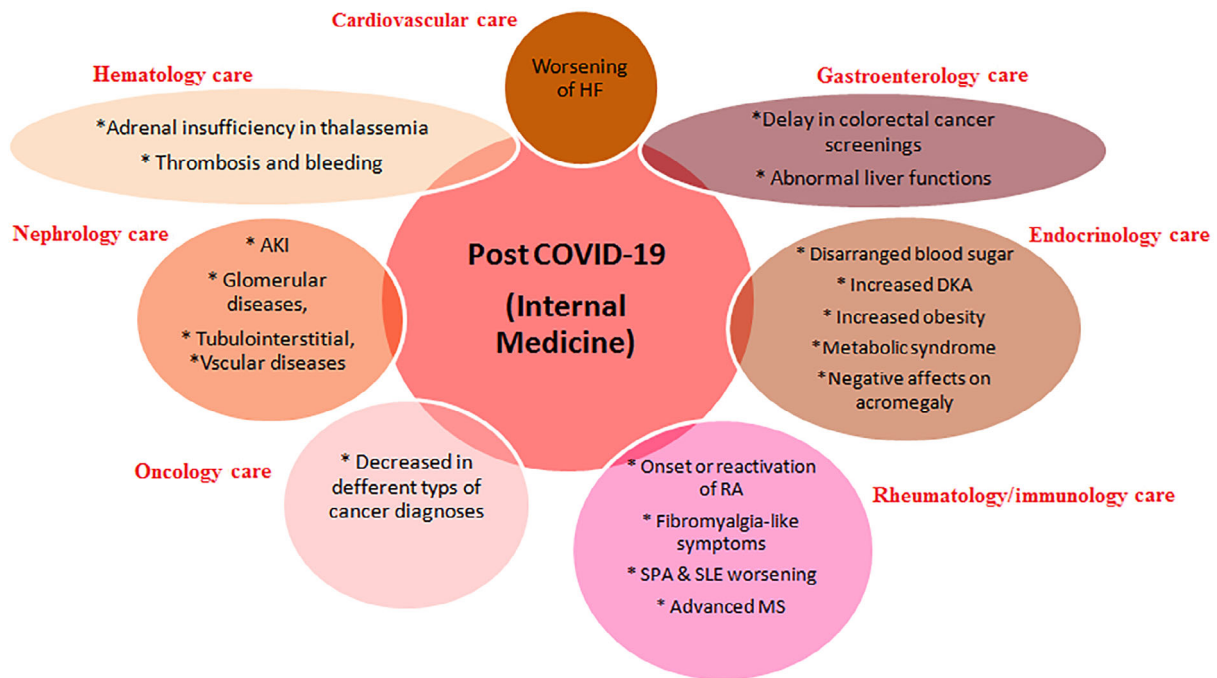
After lockdown in Italy, there was a dramatic increase in obesity prevalence from 37% to 51%, metabolic syndrome from 14% to 27%, and dyslipidemia from 28% to 48%.<sup>18</sup> In a survey among pituitary disease patients, delay or changes in planned care was observed in 64% of individuals.<sup>19</sup>

COVID-19 negatively affected acromegaly care based on endocrinologists' respond.<sup>20</sup> Moreover, there was an increase in delayed surgical procedures for acromegaly patients due to a lack of personal protective equipment and COVID-19 testing provision.<sup>20</sup> Additional effects of these delayed and impaired treatments are unknown, and researchers should focus on these impacts and implications. (Figure 1).

*Pediatrics:* COVID-19 outbreak has been thought to modify type 1 diabetes management by the use of telemedicine; however, psychological aspects deserve attention in future researches.<sup>21</sup> Interestingly, a cross-sectional study revealed that the DKA rate has raised to 12% in children with more severe cases which may be attributed to changes in social limitations.<sup>16</sup> Regelman et al have confirmed the need for research assessing the impact of telemedicine on pediatric care outcomes.<sup>22</sup>

### 2.3 | COVID-19 and gastroenterology

COVID-19 has caused several countries to suspend their colorectal cancer screenings.<sup>23</sup> A study based on the UK national endoscopy database, including over 2.5 million records, showed an 88% decrease in endoscopy activities.<sup>24</sup> Moreover, weekly cancer detection reduced



**FIGURE 1** The consequences of COVID-19 on internal medicine care after the pandemic

to 58% compared to the pre-COVID period; ranging from 19% (pancreaticobiliary cancers) to 72% (colorectal cancers).<sup>24</sup> In another study in the Netherlands, gastroscopy activities declined by 57% and colonoscopies by 45%, with no change in the endoscopic retrograde cholangiopancreatography (ERCP) rate.<sup>25</sup> In a survey among gastroenterologists in India, endoscopic training has decreased to 10% of its capacity.<sup>26</sup> In addition, 98% of endoscopists in France had to cancel procedures, with a 91% decrease in procedures during this pandemic.<sup>27</sup>

COVID-19 can be associated with abnormal liver functions due to viral infection in liver cells, drug toxicity, and systemic inflammation.<sup>28,29</sup> (Figure 1).

**Pediatrics:** Particular populations of children and adolescents may be at greater risk of COVID-19 including those suffering from chronic liver disease.<sup>30</sup> Children presented with gastrointestinal symptoms are found to be at higher risk of the need for pediatric intensive care unit (PICU) admission.<sup>31</sup> Pediatrics are confronted with delays in the presentation of gastrointestinal problems and reduction in endoscopic studies have caused reduced opportunities for clinical and research training.<sup>32</sup>

## 2.4 | COVID-19 and hematology

A variety of hemogram parameters including the mean platelet volume, red cell distribution width (RDW), and neutrophil/lymphocyte ratio have been suggested to be increased in COVID-19 patients.<sup>33</sup> Patients with preexisting chronic morbidities such as those with hemoglobin disorders (sickle cell disease [SCD] or thalassemia) are expected to be more severely affected by COVID-19.<sup>34-36</sup>

COVID-19 infection may result in ICU admissions in older age and cases with lymphopenia, so that, these immunosuppressed patients may likely experience more significant morbidity and mortality and may require long-term follow-up.<sup>37</sup> Inherited or acquired benign hematological disorders may increase the risk of developing severe complications from COVID-19, so that changes to the usual treatment may be required in these patients.<sup>38</sup> (Figure 1).

On the other hand, thrombosis and bleeding may occur as a consequence of COVID-19, even in patients with no underlying disease. However, its severity is affected by age, coagulation profile, immobility state, and comorbidities.<sup>39</sup> (Figure 1).

**Pediatrics:** Children with SCD are at an increased risk of Vaso-occlusive crisis (VOC) and ACS with an increased need in blood requirement and intensive care unit admission.<sup>40</sup>

## 2.5 | COVID-19 and nephrology

In a study in the United States, 36% of COVID-19 patients developed acute kidney injury (AKI), and 14.3% needed kidney replacement therapy.<sup>41</sup> AKI incidence among hospitalized patients was higher in patients with COVID-19 (56% vs 37.2%) and these patients needed kidney replacement therapy more than in other cases (4.6% vs 1.6%).<sup>42-44</sup> Similar results were obtained in the study of Pei et al., showing a high frequency of renal abnormalities in COVID-19 patients (75.4%), with 65.8% of them having proteinuria and 41.7% presenting hematuria.<sup>45</sup>

The direct influence of the SARS-Cov2 in the renal damage or the innate and adaptive immune response activating cytokine and procoagulant cascades have been found to trigger glomerular

diseases, principally collapsing focal segmental glomerulosclerosis, tubulointerstitial, and vascular diseases.<sup>46,47</sup> (Figure 1).

*Pediatrics:* Key areas of glomerular disease care in children that may be affected by the COVID-19 pandemic include limitations in the clinic visit scheduling and provision of multidisciplinary care as well as restrictions in renal biopsy and patient education and support.<sup>48</sup> AKI; caused by inflammatory storm and complement-mediated injury, is prevalent in critically ill children with COVID-19; especially in those with gastrointestinal symptoms.<sup>49</sup> Rhabdomyolysis and AKI with no fever or respiratory symptoms were reported as the presenting symptoms of an adolescent affected with COVID-19.<sup>50</sup>

## 2.6 | COVID-19 and oncology

According to the study of Bertuzzi et al, oncologic patients with COVID-19 were older, had a higher neutrophil-to-lymphocyte ratio, fatality rate (1.92× risk of death), and were more commonly affected with diabetes, hypertension, coronary artery disease, and dyslipidemia.<sup>51</sup>

A notable decrease in cancer diagnoses was observed in the Netherlands after the chaos wreaked by the COVID-19 outbreak.<sup>52</sup> Similarly, a very steep decline was observed in breast cancer diagnoses among women aged 50 to 74 years. It remained lower than the expected number of diagnoses in the study of Dinmohamed et al.<sup>53</sup> The results of another study on colorectal cancer screening programs in Australia, Canada, and the Netherlands revealed that short-term disruption to colorectal cancer screening would have a noticeable impact on colorectal cancer incidence and deaths between 2020 and 2050.<sup>47</sup> (Figure 1).

*Pediatrics:* Two-thirds of the pediatric patients with cancer experienced treatment delays to the postponement of the planned treatment that was not caused by the complications of COVID-19 infection.<sup>54</sup> Ferrari et al suggest that no major adjustments are required in anticancer treatments of pediatric patients with no need to postpone it during the COVID-19 pandemic.<sup>55</sup>

## 2.7 | COVID-19 and rheumatology/immunology

Rheumatic patients may fight back with the consequences of lengthened immobilization, lack of physiotherapy, consultations, and treatment adaptation as well as depression caused by social isolation.<sup>56-59</sup> A recent survey performed on spondyloarthritis (SPA) patients, confirmed worsening of the disease and reduction or postponement of medication intake due to the home confinement linked to the COVID-19 pandemic.<sup>60</sup> The COVID-19 outbreak had a significant effect on the psychological state of patients with systemic lupus erythematosus (SLE) with increased levels of stress, anxiety, and depression.<sup>61</sup>

Coronavirus may induce autoimmune diseases caused by a considerable increase in proinflammatory cytokines and chemokines in the infected person's serum.<sup>62</sup> Accordingly, a virus-triggered immunopathology may advance demyelinating disorders, such as multiple sclerosis (MS).<sup>63</sup> Similar results were obtained in animal models

confirming the role of coronaviruses in demyelination and intracranial axonal degeneration.<sup>64</sup> (Figure 1).

*Pediatrics:* No sufficient evidence exists that pediatric patients with the rheumatic disease have higher risks of developing COVID-19.<sup>65</sup> Because the uncontrolled disease is a crucial risk factor for COVID-19 infection, patients should not withdraw their medications, unless there is a contradiction.<sup>66,67</sup> COVID-19 may result in multi-system inflammatory syndrome in children (MIS-C) which is a very rare complication in pediatrics and is characterized by high fever, organ dysfunction, and strongly elevated markers of inflammation.<sup>68</sup>

## 2.8 | COVID-19 and dermatology

Skin changes related to the application of protective equipment and disinfection including de novo contact reactions and exacerbation of preexisting dermatologic conditions have been revealed in recent studies.<sup>69,70</sup>

Although respiratory symptoms are the most common presentation of COVID-19, skin manifestations including maculopapular rash, urticaria, vesicular rash, petechia, purpura, chilblains, livedo racemosa, and distal ischemia have been reported.<sup>71,72</sup> (Figure 2).

Increased release of pro-inflammatory cytokines such as interleukin-6 and tumor necrosis factor- $\alpha$  are promoted by hypertrophied adipocytes and can lead to skin inflammation.<sup>73,74</sup> Besides the hyper inflammation state, drugs including hydroxychloroquine have been suggested to be triggering or exacerbating factors for psoriasis.<sup>75</sup> Forced quarantine has negative impacts on psoriasis due to the psychological consequences affecting the quality of life as well as preventive discontinuation of effective treatment.<sup>76</sup>

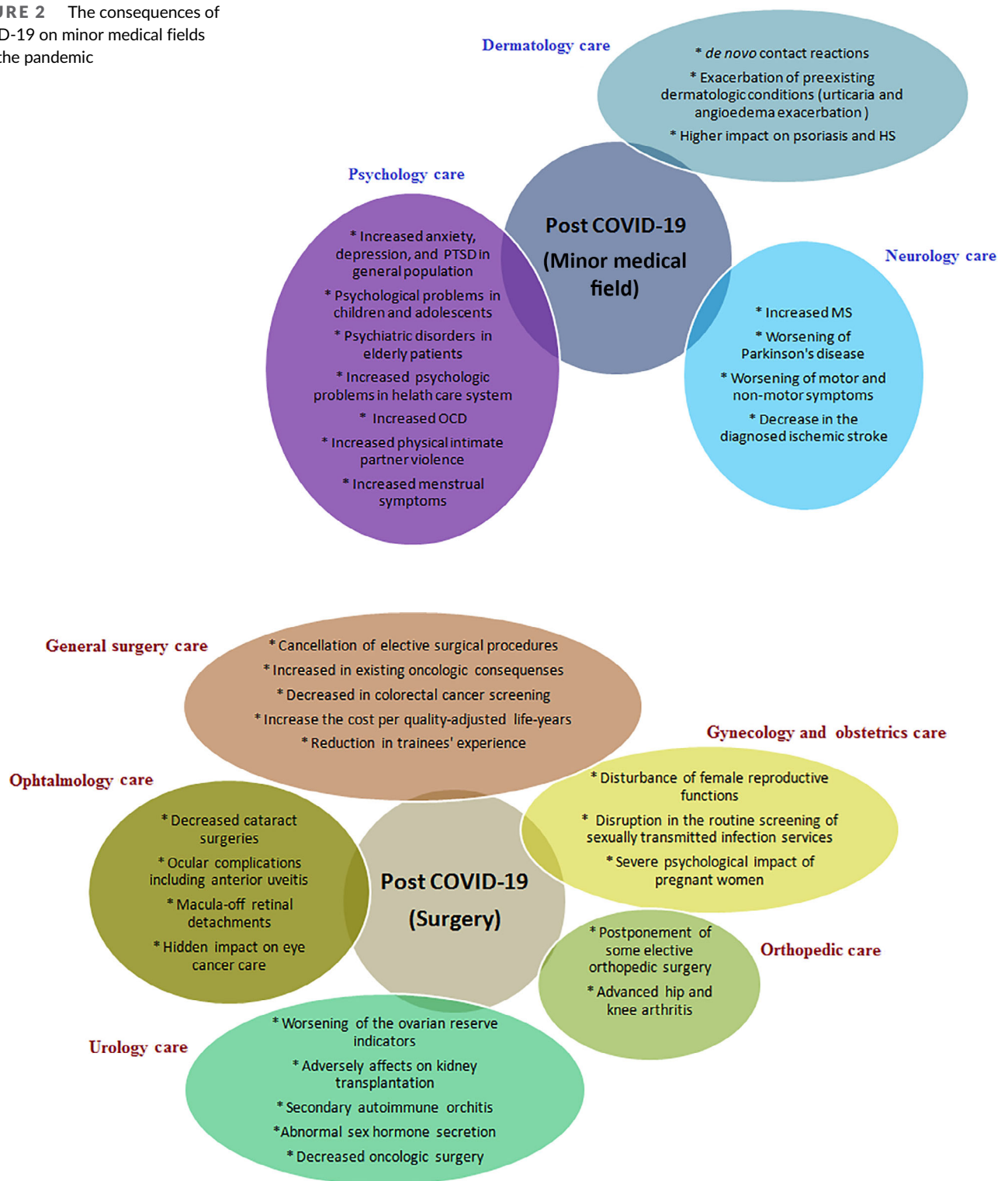
*Pediatrics:* Chilblain-like lesions located on acral regions distributed on hands and feet may be associated with COVID-19 infection in the pediatric population; resulting in possible dermatological complications.<sup>77</sup> The robust immune system in children may cause protection against respiratory symptoms of COVID-19 but also may result in MIS-C with macular, papular, morbilliform, vesicular, urticarial, and vascular morphologies.<sup>78</sup>

## 2.9 | COVID-19 and general surgery

COVID-19 has the potentials to complicate the perioperative period with diagnostic challenges and a potential high fatality rate.<sup>79</sup> Several studies reported considerable adverse effects on trainees.<sup>80-83</sup>

In another survey, among 535 vascular surgeons, 91% noted the cancellation of elective surgical procedures.<sup>84</sup> In a study in Auckland city's hospital, the admission decreased by 26%.<sup>85</sup> Accordingly, patients presenting with trauma decreased by 57%. In addition, there was a 44% reduction in performed operations. Although there was a decrease in patients admissions, no statistical difference was found in discharge diagnosis.<sup>85</sup> This effect is seen even in referrals with acute abdominal complaints. There was a 46% decrease in acute appendicitis admissions.<sup>86</sup> Acute appendicitis and cholecystectomy

**FIGURE 2** The consequences of COVID-19 on minor medical fields after the pandemic



**FIGURE 3** The consequences of COVID-19 on surgery care after the pandemic

decreased by 32% and 30%,<sup>87</sup> while bariatric surgeries and hiatal hernia repairs dropped by 98% and 96%, respectively.<sup>88</sup> In another survey among breast cancer patients awaiting surgery, more than half of them claimed that COVID-19 pandemics increased their existing oncologic fears.<sup>89</sup> According to a study in the UK, 3 to 6 months delay in cancer surgeries could have terrible effects on life-years gained

(LYG's) from cancer surgery which would cause the attributable death of 4755 out of 10 760 cases.<sup>90,91</sup> (Figure 3).

**Pediatrics:** Pediatric tumors require intensive treatment with no postponing or modification in the therapies to not reduce their efficacy and patient cure rates.<sup>92,93</sup> Considering the time-sensitive nature of many pediatric craniofacial interventions these types of surgeries

must be balanced according to the risks of postponing a surgical procedure with the risk of the COVID-19 outbreak for the child.<sup>92</sup>

## 2.10 | COVID-19 and gynecology

ACE2 is widely expressed in the female reproductive system including the ovary, uterus, vagina, and placenta so that follicle development and ovulation, luteal angiogenesis and degeneration as well as regular changes in endometrial tissue and embryo development may be influenced by COVID-19.<sup>94</sup> Considering the disturbance of female reproductive functions,<sup>95</sup> following-up and evaluation of fertility are recommended in patients with a menstrual disorder or those with a delay in pregnancy. Menstrual data analysis of women of childbearing age diagnosed with COVID-19 revealed that a menstrual volume decrease or cycle prolongation in one-fifth of patients as a consequence of transient sex hormone changes.<sup>96</sup> Moreover, the COVID-19 pandemic has disrupted the routine screening of sexually transmitted infection services.<sup>97</sup> As a result, an increase in syndromic sexually transmitted infection testing along with a raised number of missed asymptomatic cases is expected in the post-COVID era. So, regular periodic following-up strategies will be needed to recompense the long-term gap of missed screening opportunities.

Saccone et al found that more than half of the pregnant women; especially those in the first trimester of pregnancy, suffered from the severe psychological impact of the COVID-19 outbreak which was caused by high anxiety regarding the vertical transmission of the disease.<sup>98</sup> So it seems that psychological interventions along with routine clinical screening should be formulated to improve both the mental and physical health after the COVID-19 epidemic. (Figure 3).

## 2.11 | COVID-19 and neurology

A total of 64% of patients with multiple sclerosis (MS) canceled their medical visits, 11% canceled their MRI, and 10% changed their DMT due to COVID-19.<sup>99,100</sup>

In another study in the US, among 1342 patients with Parkinson's disease, the symptoms have been worsened in half of the patients.<sup>101</sup> In a similar study, anxiety and depression had a higher prevalence in advanced Parkinson's disease patients.<sup>102</sup> In a survey in Turkey, 31% of Parkinson's disease patients reported worsening of motor and non-motor symptoms during the lockdown which is related to physical inactivity.<sup>103</sup> Physical inactivity and increased stress may worsen motor symptoms and non-motor symptoms in Parkinson's disease patients.<sup>104</sup>

There was a decrease in the mean weekly volume of newly diagnosed ischemic stroke.<sup>105,106</sup> In another similar study in Germany, there was a significant decrease in transient ischemic strokes (85%, 46%, and 42%) in three different hospitals.<sup>107</sup> As patients with chronic neurological diseases suffer from a disability and restricted mobility, undiagnosed strokes, untreated strokes, delays in patients' treatment, and psychological effects could have serious consequences on the

lifestyle of patients along with costs for the healthcare system.<sup>108,109</sup> (Figure 2).

*Pediatrics:* It has been indicated that neurological diseases of pediatrics such as Guillain-Barre syndrome, multiple sclerosis, infantile spasms, acute disseminated encephalomyelitis, and febrile seizures are associated with COVID-19.<sup>110,111</sup> Recent reports described emerging pediatric cases diagnosed with MIS-C with an unexpectedly high incidence (34%) of neurological involvement.<sup>112</sup>

## 2.12 | COVID-19 and ophthalmology

According to a study performed in New York City, the majority of patients had increased anxiety regarding the suspended ophthalmic care.<sup>113</sup> The COVID-19 pandemic has been shown to reduce the institution's surgical rate to approximately 10%, affecting the type of procedures.<sup>114</sup> COVID-19 may be associated with ocular complications, including anterior uveitis, which is usually leading to intraocular pressure.<sup>115</sup> Orbital myositis in the absence of typical systemic COVID-19 manifestations was reported in a 10-year-old boy; alarming the possible association of this event with coronavirus.<sup>116</sup> According to an investigation performed in 104 confirmed COVID-19 who required mechanical ventilation, 21.9% had eye lesions with a similar rate of intraocular lesions in patients in both the ward or intensive care unit.<sup>117</sup> A higher proportion of macula-off retinal detachments has been reported the delayed presentation of which may cause additional pressures on emergency eye department services due to complications and associated morbidity.<sup>118</sup> Prioritizing intravitreal injections for neovascular age-related macular degeneration and retinal vein occlusions have been announced during the COVID-19 pandemic; as these eyes may experience the greatest loss of vision with treatment delay.<sup>119</sup> COVID-19 pandemic has a hidden impact on eye cancer care as fewer uveal melanoma cases with more advanced diseases were diagnosed during the national lockdowns.<sup>120</sup> (Figure 3).

*Pediatrics:* Ocular involvement in children presented with episcleritis, retinal vasculitis, and neuro-ophthalmological manifestations including optic neuritis or cranial nerve paresis may be associated with COVID-19.<sup>121</sup> In addition, fever, gastrointestinal, and dermatological symptoms may be signs of MIS-C in pediatrics COVID-19 involvement.<sup>122</sup>

## 2.13 | COVID-19 and orthopedy

Restarting elective orthopedic services during the COVID-19 pandemic is still a major challenge as only 56% of patients were prepared to continue their planned surgical care.<sup>123</sup> Opposite results were obtained in the study of Dittman et al suggesting the willingness of patients to undergo elective total hip and knee replacement.<sup>124</sup> Whatever the desire of patients is, postponement of some elective orthopedic surgery may cause an irrecoverable worsening situation.

Even though patients with COVID-19 who undergo urgent and emergent surgery are at increased risk for perioperative morbidity and

mortality,<sup>125</sup> a fine balance should be kept by considering the pros and cons of urgent vs postponed surgery to keep the patients safe and treat the disability associated with advanced hip and knee arthritis.<sup>126</sup>

The withdraws of different modalities are the longer time it takes and the impossibility of functional testing for ligament injuries.<sup>127</sup> Despite the hope that mass vaccination will bring the previous routine healthcare system back, the orthopedic community must readjust its strategies to assemble the challenge of massive backlogs in elective caseloads.<sup>128</sup> (Figure 3).

*Pediatrics:* COVID-19 pandemic has led to a decrease in the number of acute pediatric trauma referrals with a decline in operations that may result in malformations of traumatic fractures by missing the golden weeks.<sup>129</sup> However, in the study of Iliadis et al patients across different orthopedic subspecialties underwent the surgery without respiratory complications in the early postoperative period.<sup>130</sup>

## 2.14 | COVID-19 and psychology

Quarantine and social isolation have increased fear-related disorders and widespread mental health problems.<sup>131</sup> Unfavorable long-term effects both on patients with previous psychiatric disorders and the general population are inevitable during the COVID-19 pandemic.<sup>132,133</sup> Similar results were found in Brazil, as the country with the second-highest number of COVID-19 cases in the world; confirming the negative impact of the COVID-19 pandemic on the mental health of the general population.<sup>134</sup> In elderly patients with psychiatric disorders and suggested the consideration of patients' needs to ensure their well-being throughout the current and future pandemics.<sup>135</sup> Kovner et al have found the same results in frontline nurses during the first wave of the COVID-19 pandemic in New York City.<sup>136</sup> Psychological fatigue during a pandemic scenario is more prevalent in mothers of asthmatic children.<sup>137</sup> The increase and persistence of obsessive-compulsive symptoms have shown the importance of close monitoring of the public's mental health.<sup>138</sup> The incidence and severity of physical intimate partner violence have also been increased during the COVID-19 pandemic, and the victims were not referred to health care services until the late stages.<sup>139</sup>

According to the study of Demir et al, an increase in anxiety scores and women's menstrual symptoms were detected; while the length of periods was decreased.<sup>140</sup> Impaired physiologic and emotional states during the forced quarantine may worsen several psychological or psoriasis conditions.<sup>141</sup> (Figure 2).

*Pediatrics:* According to a study performed on quality of life and psychological state of children and adolescents in Germany, low socioeconomic status, migration background, and restricted living space were the main triggers of psychological problems.<sup>142</sup>

## 2.15 | COVID-19 and urology

Due to the COVID-19 pandemic, low priority surgeries such as fertility procedures have been delayed, resulting in worsening of the

ovarian reserve indicators caused by the increase in the average age of women as well as progressive testicular damage.<sup>143</sup>

The SCQ-score has been suggested as a new quantitative system for prioritizing elective stone surgeries, which may probably remain of interest in the post-COVID-19 era.<sup>144</sup> The kidney transplantation curriculum has been also adversely affected by the COVID-19 pandemic with a drop in the operations of 72% of living and 84% of deceased donor programs.<sup>145</sup>

The male gonadal function may be impaired after COVID-19 infection caused by even secondary autoimmune orchitis triggered by SARS-CoV-2 infection or segmental vasculitis caused by abnormal blood clotting.<sup>146,147</sup> Other studies have also confirmed the presence of leukocyte infiltration that could affect the function of Leydig cells, harm the blood-testis barrier, and devastate the seminiferous epithelium.<sup>148-150</sup> A dramatic decrease was found in the testosterone-to-luteinizing hormone ratio in patients with COVID-19 compared to age-matched healthy controls.<sup>151</sup> An abnormal sex hormone secretion has also been confirmed; suggesting special attention to the reproductive function evaluation in the post-COVID-19 follow-ups.<sup>152</sup>

Prostate cancer (PCa) needs to be managed by surgery as the gold-standard treatment compared to radiation therapy alone; while oncologic surgery has been reduced.<sup>153</sup> (Figure 2).

*Pediatrics:* The COVID-19 pandemic has caused an extreme change in pediatric urology care. According to the study of Charnaya et al COVID-19 pandemic had primarily reduced kidney transplantation among pediatrics with no sustained effect.<sup>154</sup>

## 2.16 | Pulmonary involvement

Interestingly, patients with severe asthma did not show higher rates of exacerbations during the pandemic outbreak that may be contributed to the self-administration of biological drugs.<sup>155</sup> A significant reduction in asthma exacerbation was detected during COVID-19 compared with previous years despite they were more expected to avoid or delay medical visits due to fear of referring to medical facilities.<sup>156-158</sup>

Similar results were found in the case of chronic obstructive pulmonary disease (COPD) with the most substantial reductions ever seen across Scotland and Wales which is hypothesized to have resulted from the decreased transmission of respiratory infection and exposure to outdoor pollution as well as possible enhanced COPD self-management.<sup>159</sup>

*Pediatrics:* Studies are needed that go beyond to identify whether childhood asthma or any other kind of pediatric respiratory disease such as allergic manifestations constitute risk factors for COVID-19 severity.<sup>160</sup>

## 3 | CONCLUSION

Lockdown strategies during the COVID-19 pandemic era may have negative effects on diagnostic and screening programs. To date, little

is known about the possible incidence of new cases with a chronic disease in whom the diagnosis has been delayed because of the fear to refer to healthcare centers during the COVID-19 pandemic. Similarly, it is unclear how those with an underlying disease have suffered from the condition due to the loss of patient-clinician interaction, discontinuity of treatment, and lack of previously scheduled follow-ups.

The major point of this review is that the bias of telehealth was not evaluated. Future directions in telehealth use and quality measures have still to be explored considering the changes in health care practice which is unlikely to resemble the prior era in the post-COVID-19 world. In addition, adherence to medication and the risk of flares are not yet assessed. As a result, further cooperative efforts are required to unfold this information. Direct engagement of multidisciplinary stakeholders should be considered to meet known and new patients' needs. This study highlighted the importance of being prepared to support families with special needs and mitigate the burden caused by COVID-19. Containment policies and behavioral preventive modalities are suggested to limit the impact of COVID-19 in patients with chronic underlying diseases. Furthermore, both the health systems and individual clinicians must be arranged to propose specific interventions to identify and treat psychiatric issues.

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## CONFLICT OF INTEREST

The author does not have any conflict of interest and will sign the Disclosing Form. The [lead author: Nastaran Sabetkish] affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

## AUTHOR CONTRIBUTIONS

Conceptualization: Nastaran Sabetkish.

Literature review: Nastaran Sabetkish, Alireza Rahmani.

Writing-Original Draft Preparation: Nastaran Sabetkish, Alireza Rahmani.

Writing-Review and Editing: Nastaran Sabetkish, Alireza Rahmani.

All authors have read and approved the final version of the manuscript.

Nastaran Sabetkish had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

## ORCID

Nastaran Sabetkish  <https://orcid.org/0000-0003-1994-8064>

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