Creating Preventive Spaces: A strategy for designing environmental urban spaces to deter the pandemics

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Abstract

It is well-known that currently, the world is facing the challenge of the "COVID-19" pandemic: the worst pandemic for a few centuries. There is a consensus that crowded spaces spread viral infections. In fact, WHO has found that a relationship exists between crowded cities and "COVID-19" infections? This means that there is a dire need now to create good environments founded on healthy architecture and healthy cities. Undeniably, designers need to develop new design strategies to produce such healthy and safe spaces and environments.

This research investigates how to produce healthy urban environments and spaces in the post-pandemic era. It does so, first by re-reading the transformation of the new urban spaces during the pandemic and post-pandemic times. It reviews studies that have examined the relationships between the pandemics and the concepts of urban spaces. Thereby, it uncovers the strategies that have proven to be effective in addressing the effects of pandemics.

The research employs an inductive approach to examine the phenomenon presented through studies and applications that preceded the current study. The concepts used for transforming urban spaces during the post-pandemic period are unraveled. The research thus constructs a theoretical framework and a model to articulate design and planning for creating the post-pandemic urban spaces. It presents the concept of "preventive space" as a strategy, which can be used to create urban spaces that will deter the spread of the viral epidemics and overcome the adverse effects of them if and when they occur.

Keywords: preventive space, environmental urban space, covid-19, city, post-pandemic urban space

Introduction

During the current pandemic, the world faced a set of unprecedented restrictions; First and foremost, people were asked to stay home based on the recommendations of the World Health Organization (WHO). Social distancing in public places became the norm. Those infected were asked to self-isolate as an essential strategy to reduce the spread of the disease (Lunn, 2020);

(Organization, 2020). These have directly and significantly affected most urban spaces (cities: parks, squares, subways, common places, and designed city streets) (Hall, 2021). Although inter-connection between cities is a major source of social and economic progress, this was found to spread the diseases simultaneously.

Today, urban designers face the challenges and questions related to increasing social relations between users on the one hand (Boyko, 2020), and the need to isolate and separate them from each other on the other hand (Boyko, 2020); (Kimmelman, 2020). Cities have to continue to be agglomerations of people who have to use public urban spaces despite these limitations. In this context, this epidemic has to be looked upon as an available opportunity through which the urban designers can re-create and re-organize the urban spaces of the city (Duhl, 1999). The designers must reconsider the designs of urban spaces in general to suit the circumstances and the people who use them: pedestrians, cyclists: men, women and children. They need to redesign the buildings surrounding these spaces in an environmentally healthy way to contribute to change the city to be better. Needless to say, the relationships between the different elements of the cities such as the buildings, the public spaces such as streets and gardens, in addition to city infrastructure clearly affect the quality of life of the individuals (Berardi, 2013).

The objective of this research is to study the impact of the Covid1-19 Pandemic on the design of urban spaces so that they can be created environmentally healthy and to demonstrate how this may be accomplished. The research offers the concept of ‘preventive space’ as a potential conceptual shift that may enable the conceptualization of strategies to do so.

The history of epidemics and its effects on urban space:

The chronological order of epidemics through the history of the last 200 years shows that the number of epidemics has increased. Cities have always been arenas for the spread of diseases, and there have been many pandemics in the world that have killed millions of people (LePan, 2020). Statistics of the World Health Organization (WHO) show that during the last two centuries, the number of epidemics has increased sharply (Fig. 1). When they do occur, they transform the cities and public places into empty environments, which should not be the case. For example, the crisis of the Black Death had affected the urban places of the European cities leading to a call to open the public squares to connect with Nature to reduce the isolation of the users. The impact of epidemics in Europe had led to some of the modern trends towards openness and suburban housing. In the nineteenth century (1850) urban spaces in London were seriously affected, according to the data of the World Health Organization (White, 2006); (WHO, 2020). One of the main causes of cholera was the mixing of clean drinking water with sewage. Subsequently, the disease played a major role in inventing waste management in the streets. It was soon discovered that supporting natural ventilation, daylight, outdoor mobility and enhancing spaces ensure the creation of spaces users can live healthily in. From 1918 to 1919, the deadliest "Spanish Flu” pandemic killed around 50 million people worldwide, which had affected and slowed the urban public life only to reduce the spread of the disease. It has greatly affected the nature of social life, environmental interaction and urban growth. For example, transportation had shifted to walking on the not-so-crowded streets, and the sidewalks at night were unusually empty (Rinde, 2020); (Wilder, 2020). Most residents preferred to stay at home, and this is similar to what is happening now in the Covid-19 crisis.

The “Tuberculosis” in South Africa in 2006, and the crisis of “Ebola” in West Africa in 2014 posed new challenges for the urban spaces. Indeed, it has now become necessary to transform cities into more livable and healthy urban spaces (Duhl, 1999). Needless to say, it is the duty of urban designers to take responsibility for creating designs for urban public areas that promote health and are resilient to epidemics.

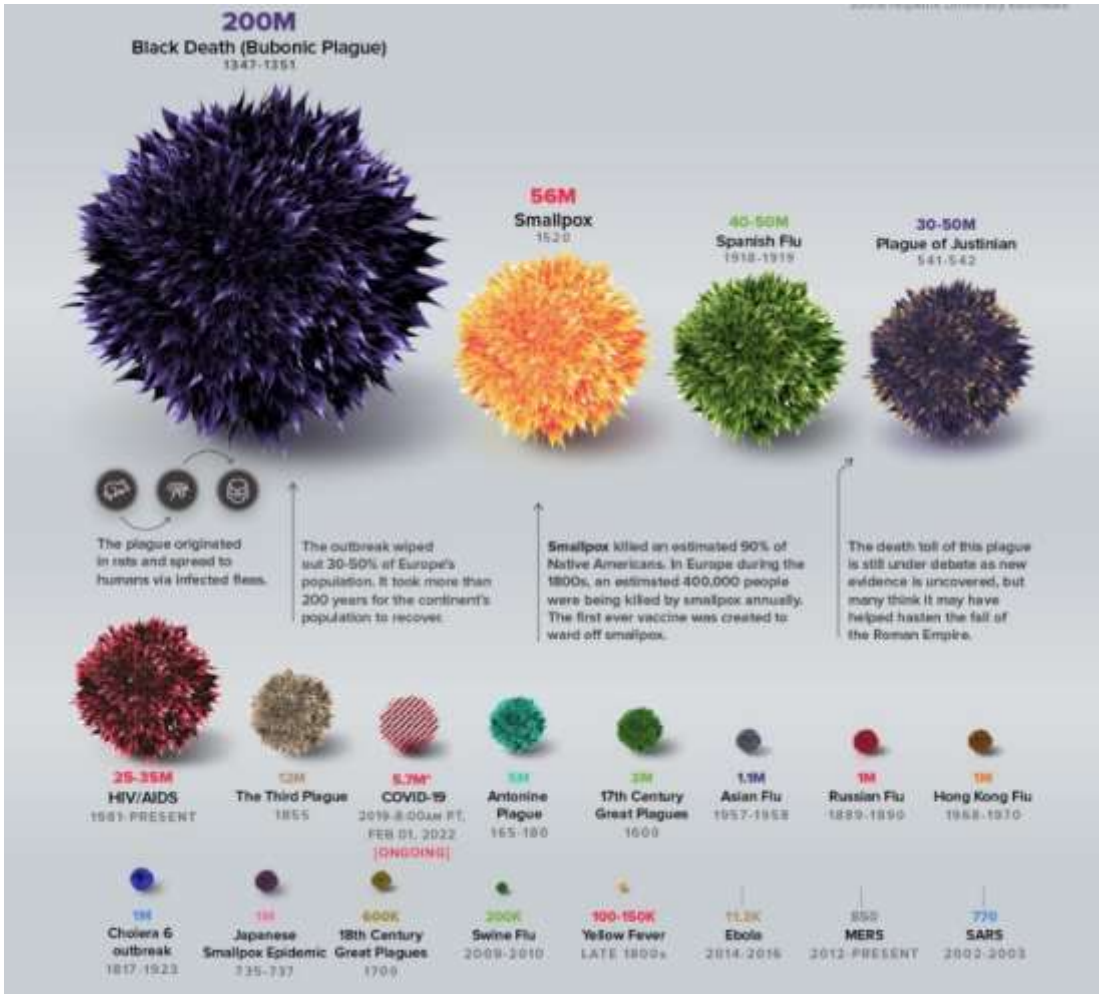

Fig. 1: The deadliest epidemics in history
Source: LePan, 2020

Research Objective:

Throughout history, the various epidemics have affected the urban places and uses of the cities. However, this epidemic has also given the opportunities for urban designers to acquire new skills and create new solutions for the urban places. After the COVID-19 pandemic, the cities must be re-orientated towards providing more effective and healthy urban places. As has been reported, "With increasing numbers of positive cases and deaths related to the size of cities and population density, residents face significant risks" (Blancafort, 2015). Indeed, the COVID-19 crisis is an opportunity for improving the urban places and cities by recognizing and facilitating social behaviors during the pandemic and afterwards to bring in a health perspective in the design of urban spaces. The objective of this paper is to introduce a health perspective to the design of urban social spaces in the cities to confront the global pandemics, if and when they occur. As shown in Fig 2, this will help urban designers to prepare the cities for any emerging crises.

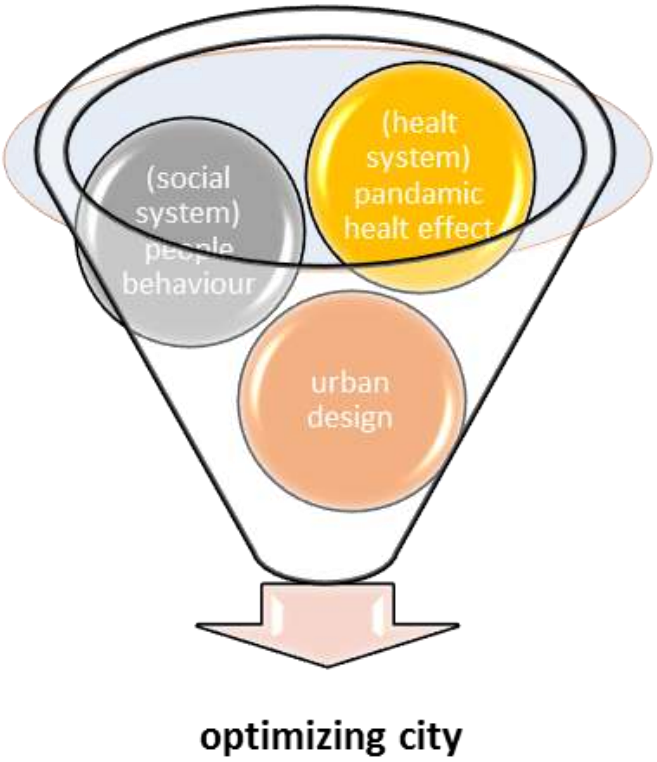

Fig 2: Integration of health and social systems to urban design to produce healthy cities.
Source: Author

Review of Literature:

Since the beginning of the pandemic, many studies have examined the effect of the COVID-19 crisis on the changing forms and functions of urban spaces. Among them, the works of Salama (2021, 2022), and Sharifi and Garmsir (2020) stand out. While Salama proposes how the cities may change, Sharifi and Garmsir provide an overview of COVID-19 research related to cities by reviewing literature published during the first eight months after the first confirmed cases were reported in Wuhan, China. Other studies also exist. For example, Mohammad, Al-Nuaimi, and AlHinkawi (Mohammad, 2021) explore a new understanding for the spaces and the functions of the urban spaces, affected by the pandemic. Others have highlighted the key lessons that can be learned for urban planning and design after COVID-19. Some of the major studies are as follows.

i) **Sharifi, A., & Khavarian-Garmsir (2020)** (sharifi, 2020):
The paper discusses the effects of the COVID-19 pandemic on urban spaces and cities and links this impact mainly to four main themes. They discuss the quality of the environment, the impact of social and economic factors, management and governance and the effect of transportation and urban design. The paper also refers to air quality, the standards of meteorology, prevailing water quality, and air improvements. It highlights the significant environmental impacts of human activities and conclude with a wake-up call to the adoption of eco-friendly and sustainable development paths as a means to deal with the effects of the pandemic. It has been articulated as shown in Fig. 3 below.

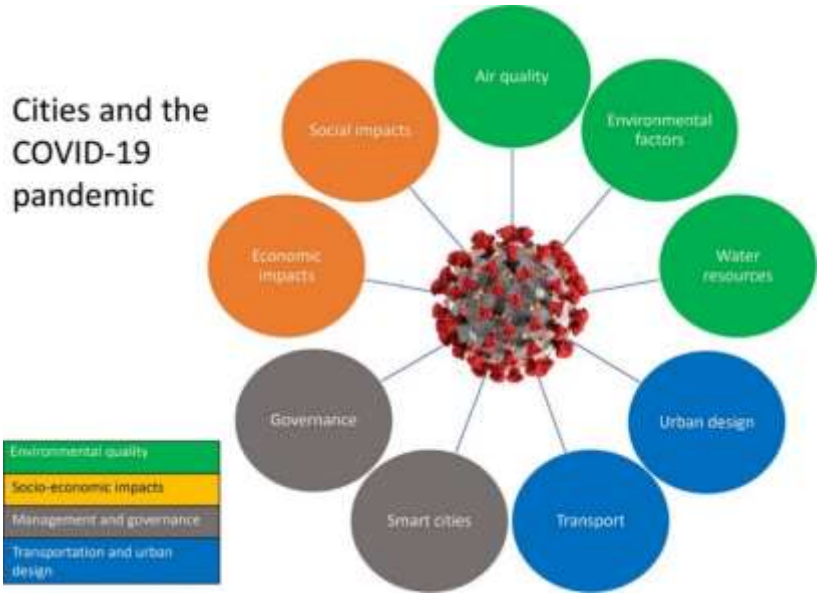

Fig. 3: The effect of the pandemic on the sustanability of the city "environmental, social and economic factors"
Source:Sharifi, & Khavarian-Garmsir, 2020

ii) **Pisano, C. (2020)** (Pisano,2020):
This paper presents a series of factors that must be taken into account in defining and evaluating strategies for post COVID-19 urban places and cities. The study identifies three important factors that can define the features of post-pandemic cities and be prepared to face future epidemiological events. These factors are: 1- Decentralization of services, 2- Hierarchy of the transport system and public services, 3- Repetition in public and semi-public jobs) (Urban, 2020).

iii) **Nia, H. (2021)** (Nia, 2021):
This paper examines the difference between pandemic adversities and other types of disasters. It argues that the pandemics intimidate the people in the way they use general and public urban places. Furthermore, it points out that the disasters caused by the pandemic are usually long-term and have huge economic consequences. The research proposes several plans for long and short-term involvements to promote the expansion of urban fabric in response to the pandemic. It proposes that in "the post-pandemic era", everything related to the sustainable factors (social, economic and environmental aspects) and the measurements of efficiency of the cities and urban spaces must be re-thought and suggest biological considerations. It promotes an approach to smart cities that may protect the city dwellers from the negative effects of pandemics. Ideas such as the use of "touchless technologies, voice control, facial recognition technologies, smart cards, smart devices, elevators or motion sensors for doors, self-cleaning spaces, especially in commercial places" are explored. These they argue, are important ways to eliminate the opportunities for the spread of any virus.

These studies show that the pandemic may directly and strongly affect the lives of residents and their way of living in social spaces. They also show that the concept of social urban spaces has shifted from 'spaces of social interaction' to 'spaces of isolation'. Therefore, it is only through an understanding of the components of urban spaces most affected by the pandemic, that the problem can be addressed. The studies propose dimensions such as urban

density, street design, public places, parks and green spaces, building design, and smart city technologies as potential ways to transmit them to create healthy spaces for the people.

Dimensions and Factors:

Following is a discussion of these six factors and dimensions that were unearthed from the previous studies in order to find tools that can contribute to solving the research problem:

a. Density of cities:

Population density is a basic factor affecting pandemics directly. In other words, the higher the density, higher the risk of infection (Gandy, 1999) is. Therefore, cities must evaluate the designs to reach social fairness in response to the pandemics in a sustainable way. It is worth noting that the initial efforts to review the urban designs came to stop due to the Cholera epidemic in London in 1850, when measures were taken to reduce the epidemic and prevent its spread by reducing population density in some cities. They expanded the parks and streets, establishing sewage systems and isolating them from the clean water systems. The WHO has established guidelines to avoid crowds and has concluded that spaces of gathering must be avoided. For that reason, the coffee shops, restaurants, theaters, shopping centers, open places and schools were closed. While the closure of general places was an operative measure, it had an impact on the urban places and cities that responded initially (Reyes, 2013). It warranted methods to drive the people to live in lower densely populated places instead of overcrowded cities.

There was another planning proposal to address the problem of overcrowding in cities, suggested by the Mayor of Paris (Anne Hidalgo). She accepted in her recent campaign that a policy of decentralization and dismantling of the city could decrease the existing density, and endorsed the idea of walking in each district, which contains households, workspaces, services, stores, etc. (Birch,2006). According to Birch (Hall, 2017) "If neighborhoods are changed to be more accessible on foot providing services and jobs in those communities, cities may be able to alleviate congestion in different systems such as public transportation. Anthropologically speaking, walking is not just the movement of people, but also a culture and social practice that enables it to enhance physical activity and affect the health of the population while increasing the value of urban spaces. (Hall, 2017) Undeniably, incorporating walkability into neighborhoods has an environmental advantage. Research has shown that including walkability into the urban spaces has environmental benefits as well as on health, economy and other aspects (McAslan, 2017); (Giles, 2017).

b. Street design

The most serious challenge facing the post pandemic cities is to reconsider the approaches to deal with the diseases and fight them in every place where people come into contact with them. An essential part of the solution is to re-design the streets. However, this requires providing alternatives for other uses (AlNuaimi, 2019) undeniably, it is necessary to enhance the use of paths in the re-design of streets (Weinberger, 2012). These strategies in the streets will reduce pollutions in the post-pandemic era, and may involve solutions such as adding another lane for the users such pedestrians and cyclists (A. M. Abdulwahab, 2018) . They will create socially defensible cities and towns that help the citizens in times of the pandemics. Litman for example examined healthy urban areas, which he concluded are places where people live in walkable public settings with low risk prospects (Litman, 2020); (Honey, 2020). These will help community isolation and let the widest spaces between users. It could also mean banning cars from some roads and offering more places for walkers and cyclists that fit the spaces in low carbon green cities (Rueda, 2018). In this regard, some cities such as Barcelona have been directed to study street traffic and redirect them in a way that prevents congestion and reduces human gatherings (Zografos, 2020). In fact, several cities have begun work on expanding roads in the towns (Anderson, (2020). For example, "Vienna, Boston, Auckland and Philadelphia" have stopped the expansion of roads in order to distribute spaces for walkers and cyclists as a preventive response to the pandemic. The city of Bogota has

extended the bike lanes and has introduced additional permanent lanes for pedestrians (Impact, 2019); (Sohrabi, 2019). This shows that by reshaping roads and increasing the areas for walkers, healthy spaces can be achieved. This may also mean creating spaces such as those for turning away during queuing, which requires providing the widest sidewalks and lanes, leaving a safe distance of about 2m. Addition of extra areas to provide the waiting areas at the entries to community services and other facilities (Rueda, 2018) are also proposed.

c. Public Areas

An urban structure consists of a set of public spaces and spaces for social interaction including theatres, museums, public libraries, and sports facilities, etc. These are places where people can gather and engage in social activities. One of the most basic measures to confront this pandemic is social distancing policies and limiting gathering in public places. As a result, governments have encouraged people to stay at home and, or cancel or postpone large public events. Events calling for gathering and activities of theaters, museums, libraries, sports facilities, schools, universities, factories and markets have been reduced if not abandoned. Sometimes complete closure, as well as restricting presence in public places according to a scheme to stop and move within calculated spaces have been introduced.

To achieve social distancing (Chen, 2020); (Hassanzadeh-Rad, 2020) numerous tactics have been employed. They include, placing signs to enforce respect for a distance of not less than one meter between users of a space, the organization of seating in public places by leaving a seat between every two seats, placing markers for standing at a distance of at least two meters in corridors and waiting areas, organizing standing locations in shopping areas, and placing adhesive tapes on the floors or defining the standiing spots. Public spaces such as stadiums and conference centers have been used for emergency hospitals because they could no longer accommodate the huge numbers of patients in ordinary hospitals. The quickest practical approach was to adapt the existing buildings. No matter how primitive these temporary hospitals may seem, they are currently the best option.

The scenario is the same all over the world, where there are closed hospitals. Many are reopening, many hotels are vacant or stadiums are being upgraded for healthcare (Chen, 2020); (Martín, 2014). However, the vast majority of those hospitals are designed in open areas described as plazas. Public places have always been a destination for people, and many of them have been religious and cultural centers for celebrations (Polko, 2013). Therefore, designers' could rediscover social and recreational uses and redesign them according to people's needs to create resilient and epidemic-resistant spaces (Samuelsson, 2020). After the epidemic is gone, new guidelines may come into being to describe public spaces, and design in terms of distances and densities avoiding any public health risks (Freeman, 2020) (Fig. 4) bellow.

Fig. 4: Social distance in urban spaces
Source: Organization, 2020

d. Parks and green spaces

Green spaces are parts of urban spaces and they help people to reduce stress and improve mental and physical health. In the pandemic era, these areas turned into safe isolation areas, and this was the challenge in terms of controlling the transmission of Covid-19 in the external

environment (Rojas, 2019). Of course, the trend in healthy design will be to provide green spaces as there are several research that deal with the status of visual contact with Nature which enhances psychological and physical health of people (Velarde, 2007) .Re-assigning of open spaces and parks inside the cities have also taken place. The healthy urban spaces may need new spaces and practices for particular use in landscape design such as growing running tracks, that was done in several parks. For example, the Brooklyn Gardens, the Domino Park in New-York, and Dolores the Gardens in San Francisco (Wang, 2019) have done so. It is a great idea to propose green infrastructure, which can improve public health.

There are also other ways to make cities and buildings healthier, affecting future epidemics, making people less susceptible to disease while avoiding its severe consequences. For example, the company "SOM" has begun adding outdoor spaces in its designs even in high-rise buildings. The importance of having outdoor spaces is that they could address the issue of vitamin D deficiency, which is so prevalant among people. Several studies have linked the lack of vitamin D to the dangers of acute breathing infections.

Likewise, the ease of access to parks and gardens encourages people to spend more time outside the houses and indoor spaces. Parks encourage people to exercise and reduce pollution that causes several health problems such as asthma, high blood pressure and diabetes, all of which are linked to the risk of a person's exposure to the new Corona virus. In fact, this arrangement is suitable even more than the expansion of gardens. The parks could be reserved for the residents and facilitate communication with Nature (Wang, 2019); (Hall, 2017). A classic example is found in Singapore where a PCN - "Park Connected Network", has been designed which is a green system which can connect among zones of highly densed populated areas and natural zones. In Singapore, everybody can discover the cities through the green streets that depend on the different rings of the island (Ogren, 2000) as shown in Fig. 5.

Landscaping is often regarded as an effetive way of humanizing spaces. With the need to increase the green spaces, the styles and arrangements of landscapes also need to be planned, since improper compositions of the types of trees can lead to a range of diseases. Thomas Leo Augren has analysed the influence of gardening the plants on sensitive responses [46] and has shown the value of green spaces. Once the present disaster ends, cities could review the unused spaces and construct roofs and roof gardens [47]

Fig. 5: The idea of the park connected network- pcn
Source: https://www.nparks.gov.sg/gardens-parks-and-nature/park-connector-network

e. The design of the buildings

Although many may have clear ideas for the design of urban spaces in response to the current crisis, what will happen indoors is somewhat unclear. Most likely, new life styles will emerge and the interiors of buildings will also need to adapt to these changes. For example, it will involve changes of standards in response to the changing behaviors such as needs for self-isolation. The concept of forcing so many people to live long periods of time in box-like towers is inconsistent with the new ways of living emerging in homes. From a public health point of view, living in home-like atmospheres is healthier than living in apartments.

Many researches have examined the increased sicknesses and the absence of social well-being in apartments compared to homes (Ranson, 2002). A study reported (González, 2020) in the book titled "Design Disorder: Experiences and Turbulence in the City", point out the changing future, based on new approaches, and new needs and demands in buildings design. It asks the designers to show their concerns for creating varied zones that allow people to blend without filling them in spaces like sardines, and urges them to keep in mind the basics of design of buildings (Ghaffarianhoseini, 2020).

> "From the point of view of contemporary urban social behavior, residents spend a large part of their time indoors where they are forced to Work from home. Thus their health is directly affected by the area of residence, and this can negatively affect public health if the design is poor" (Gillis, 2015).

Undeniably, this requires moving away from the old-fashioned ideas of household functions: "becoming a place to sleep, play children and occupy perhaps in the future" (Mohammed, 2020). The inclusion of natural features might be a valuable way to decrease the feeling of psychological isolation and other effects (Kellert, 2018); (Gang, 2016), and to take care of the roofs of buildings and turn them into living cool roofs (Alnuaimi, 2021). Others have also suggested re-considering the unused spaces such as building roofs (Velarde, 2007) "Also, the importance of preserving the idea of the veranda as an outdoor space has many benefits, such as connecting with Nature, green urban landscape, and offering social contacts between neighbors" (Li, 2017); (Allam,2020).

Fig. 6 shows a simulation of how the virus spreads through housing (Eltarabily, 2020) from the point of view of public health. "The building can cause diseases, which is known as the sick-building-syndrome and evidenced by the effect of the building design on human health and the diseases that the building can cause to humans" (Yu, 2004).

For example, the towers which contain apartments with combined entries, internal areas, stairs and elevators are perfect atmospheres for the spread of the diseases in the absence of any cleaning and sterilization routines. From these, we can imagine the future design of buildings that reduce the risk of infection in the form to be comprised of low level buildings with separate entrances at the ground floors with the need to provide wide places for walking (Nieuwenhuijsen, 2020). See Fig. (7)

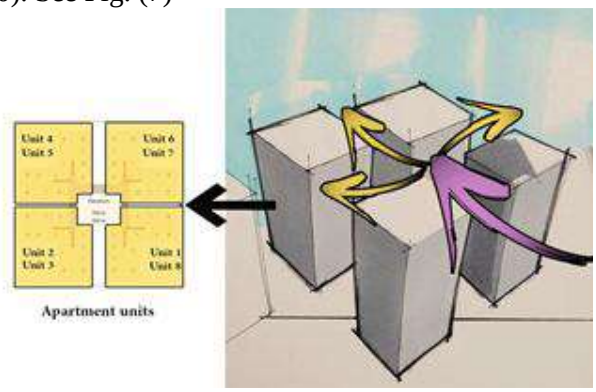

Fig. 6: Simulation of how the virus spreads through housing
Source: Eltarabily, 2020

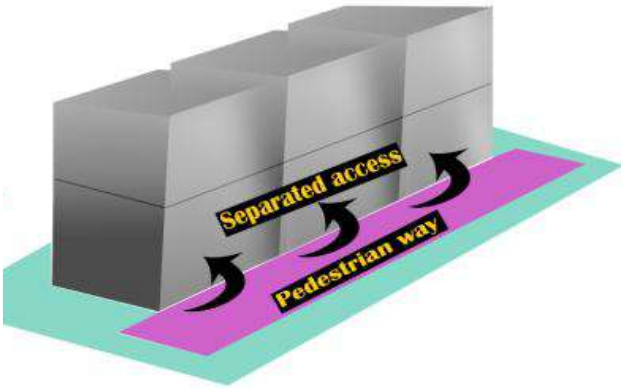

Fig. 7: Low rise building proposal with separate entrances
Source: Allam, 2020

f. The technologies of "smart cities"

The new termenology of the smart cities be can help for people immensely in this regard. They will do for this epidemic and future epidemics as well, "as some rules have resorted to using smart city technology and may turn to relying on digital data tracked by mobile devices and remote sensors to diagnose people infected with COVID-19" (Inn,2020). For example, some of the reasons for the success were the rapid development of the COVID-19 test equipment in a short time and the use of the isolation information efficiently by using smart technologies. Intelligent information gathering and gaining patient movement history to support them on time (Shaw, 2020); (Day, 2020). has been found to be very useful. What happened in China illustrates its knowledge on these aspects as it had resorted to the use of the technologicallly advanced companies with new technologies to track the spread of the desease. Thus, smart cities are safer places when it comes to health as the spread of Covid-19 has been followed using "big data" investigations by technologically advanced companies such as "Alibaba and Tencent" who had dispatched groups to predict where new hotspots will emerge next (Calderon, 2017). Authorities from coronavirus tracking have found that "smart cities" such as "Songdo or Shenzhen" are healthier than many other cities.

Concepts Derived from Previous Studies

Through the identification of dimensions and factors affecting the re-reading and formation of the urban space of cities, a set of significant ideas have been derived which can be helpful in the transformation of urban spaces in the pandemic and beyond. See Table No. (1)

Table 1: General Concepts for the transformation of urban spaces.
Source: Author

No	General concepts for the transformation of urban spaces	
1	City density	• Decentralizing designs and increasing the interfacing of spaces. • Integration of micro-neighborhoods in terms of homes, services, jobs, utilities...etc • Dismantling the city into mini-nuclei (urban nodes). • Creating segregation spaces (EPA) in each of the city's neighborhoods. • Incorporation of the "walkability index into the urban environment and its beneficial effects on health", economy and extra features. • Regulations indicating avoidance of crowding and closing of gathering places at peak times. • Reducing the density of cities through policies that encourage residents to live In less dense cities. • Precautionary actions towards the use of of transportation and "active places and points where the virus can spread".

2	Street design	• Re-designing the streets to provide alternatives for other uses besides the movement of the car. • Including pedestrians and cyclists in the alleys and streets. • Studying the traffic in the streets and redirecting them in a way that prevents congestion and reduces people's gatherings adding a lane to the path and enhancing it with fun services from spaces for pedestrians and cyclists that transform "the city into a green low-carbon city". • Expanding streets while imposing social distancing as a kind of response to the epidemic. • Increasing the width of sidewalks. • Adding waiting spaces in front of public facilities. • Providing seats for the elderly.
3	General places	• Placing signs to enforce respect for a distance of not less than one meter between space users. • Organizing seating in public places by leaving a seat between every two seats. • Standing at least two meters apart in the corridors. • Organizing parking spots in shopping places and paying bills by defining parking locations. • Rediscovering social and recreational uses and making them flexible and epidemic-resistant spaces. • Re-designing flexible and epidemic-resistant spaces according to people's needs. • Restricting presence in public places according to a scheme to stand and move within calculated spaces to achieve social distancing
4	Gardens and open spaces	• Creating more spaces for individual use. • Emphasizing visual contact with Nature that enhances physical and mental health Individuals. • Re-zoning green spaces and parks within cities. • Expand running paths. • Attention to neighborhood gardens "as one of the new solutions" that allows people to "enjoy public parks and to do what is called social distance circles.'' • The idea of a park-connected network "a green network that can easily communicate between densely populated areas and natural areas". • Adding minor improvements to promote "public health, such as incorporating new elements into the landscape, eg;" Temporary handwashing stations become public culture • Revisiting untapped spaces and building rooftops.
5	Buildings design	• The end of the era of multi-storey buildings with high population density. • Designing residential buildings to include other functions integrated with housing such as play, work and movement using the biophilic design approach to design buildings. • Paying attention to the designs of building roofs and using them as a means to reduce the feeling of isolation and communication with Nature. • Enhance the idea of the balcony as an external space for it has many benefits such as social contact and communication with Nature • Interest in designing the ventilation systems in buildings and creating ventilation spaces between buildings. • Post-pandemic building designs are low and with separate entrances to each building.
6	Techniques for smart	• Relying on digital data to confront epidemic crises. • Adopting artificial intelligence techniques • Adopting mobile devices and remote sensors to diagnose infected people • Smart quarantine by collecting patient movement information and anticipating the emergence of new foci of disease Using control and remote sensing techniques • Using smart transportation systems • Providing digital culture for citizen services To reduce the effects of social isolation

The Concept of Preventive Space.

Through the identification of general concepts that may be helpful in the re-definition of urban spaces derived from the previous research, a group of urban spaces from different cities in the world are re-read by analyzing the selected spaces. This will involve two time periods at the same place to study the extent to which these urban spaces have been affected by the pandemic and the changes that have occurred. The focus is to identify the ways in which they have been reshaped for environmental prevention. This will enhance the idea promoted in the research: the idea of the preventive healthy space.

- The urban space in the city de Londres (City of London):
  According to the environmental responses of this city, it has changed the design of the streets to provide other alternatives for movement by reducing the vehicular traffic and making places for walking. By offering places for walkers and cyclists, the designers have turned the urban space here into a green health place because this solution also leads to low-carbon consumption. This has also been enhanced with the addition of parking spaces in front of public facilities and providing seats for the elderly. As for the public squares, the design produces flexible and epidemic-resistant spaces responsive to the needs of the people. Gardens and green spaces have been created for individual use, rather than communal with an emphasis on visual contact with Nature. These enhance the health and well-being of the people physically and psychologically. The design of the streets with car-parking previously located in the main square of the city de londres since 1976 has shifted to parks. Public green spaces and recreational green seating areas have been created for families 2021 as in Fig. 8. This is among some of the best examples of what is required to re-orientate the urban spaces in the time of the pandemic.

Fig. 8: Re-orientating the urban spaces in the city of Londres (City of London) in 1976 (above) – and in 2021 (below)
Source:https://zhcn.facebook.com/gigitheplanner/photos/pcb.1064911664278357/1064911470945043

- In the city of Buston, Eua, a complete redesign of the urban space can be observed between 1987 – 2021.
  This involves the removal of the bridge area that had existed since the end of the eighties of the last century transforming it into an area of parks and green spaces as in Fig. 9. This shows the change of the urban landscape and the creation of new green urban spaces commensurate with the environmental need in a way that enhances public health. It has redirected traffic in a way that prevents congestion and reduces people's gatherings. In the streets, a lane has been added for the use of the pedestrians, enhancing it with environmental pleasure services. The city has banned vehicular traffic in some areas and has made them only walking areas.

Fig. 9: Re-orientating the urban space in the City of Buston, Eua, 1987 (above) and 2021 (below)
Source:https://zhcn.facebook.com/gigitheplanner/photos/pcb.1064911664278357/1064911457611711/?type=3&theater

- In the city of Curitiba, Prague, the urban space has been re-organised and the movement of cars has been limited for the purpose of reducing congestion and reducing the density of the city. There has been an increase in the spaces between people with the introduction of precautionary measures for the use of transportation. This has involved changing the use of streets and providing spaces for pedestrians.
  This has reduced the density of users of the same urban space; a response to prevent any epidemic, as shown in Fig. 10.

Fig. 10: Re-reading the urban space of a city (Curitiba, Pr.) between 1945-2020
Source:https://zhcn.facebook.com/gigitheplanner/photos/pcb.1064911664278357/1064911450945045/?type=3&theater

- The city of Toronto in Canada has redesigned the use of urban space reducing the public parking area and increasing the public plazas and planned green spaces as an environmental and functional response to provide breathing space for the city. It has created mini urban nodes to reduce the density, while increasing the width of sidewalks by adding lanes for the public. Seating areas and trees have been provided to create natural shades to improve the walkability into the city. These have undenoably enhanced health, economy and other features, as seen in Fig. 11.

Fig. 11: Re-orientating urban space in Toronto, Canada, 1970 (above) and 2021 (below)
Source:https://zhcn.facebook.com/gigitheplanner/photos/pcb.1064911664278357/1064911444278379/?type=3&theater

- In the city of Toulouse, Franca, the urban spaces that were used as parking lots have been changed to green spaces and public seating areas near the river. More spaces have been made for pedestrian movement, in addition to providing new social urban spaces that contribute to social interractions. It has replaced parking areas with squares open to public, as shown in Fig. 12.

Fig. 12: Re-orienting the urban space in the city of Toulouse, Franca, in two different open spaces in the city
Source:https://zhcn.facebook.com/gigitheplanner/photos/pcb.1064911664278357/1064911464278377/?type=3&theater

The Outcomes of Reading Urban Spaces in Cities after the Pandemic

Many cities over the world have made many attempts to avoid the spread of the pandemic. With the increase in population and the sizes of cities, it makes sense to change the way the cities are designed. Certainly, there is a need to improve the cities and make them more prepared to meet the future needs arising from the fears of potential spread o deseases and pandemics.

By engaging the concepts and ideas derived from the survey of literature, that have dealt with the transformations of urban spaces after the pandemic as listed in Table No. 2, the re-oriented cities can be read from the following perspective.

The new urban spaces need to meet the demand for better spaces that have health and well-being of the people as a focus in order to avoid the spread of deseases and control them. In otherwords, these spaces need to be preventive of the spread of deseases emanating from viruses and bacteria, that may move from animals to people from people to people. The people should be able to use them even in such environmental crises; they should possess opportunities for isolation and should exist in every urban area or neighborhood. They can therefore be called "preventive healthy spaces". As urban spaces, they should be comprsied of "decentralized" spaces with mini-neighborhoods integrated in functions and public utilities with specific housing densities to meet the requirements of social distancing.

Moreovere, they require the provision of places designated for precautionary measures in the places and active points where spread of pandemics can be halted. These may involve the provision of open urban spaces (outdoor) dedicated for sports and walking, and lanes for the pedestrians in streets enhanced with services. They should possess increased street widths re-directing traffic to avoid congestion and reduce gatherings of people. They must take into consideration the allocation of car free areas and promote the movements by walking or cycling; in otherwords, clean means of transportation similar to the technologies of green cities. They may involve increased widths of sidewalks in the presence of parking spaces in front of

public facilities providing seats for the elderly. They should involve regulating standing and sitting in public places in spaces apart from each other by placing permanent signs. Multifunctionality of public spaces has to become become the norm with flexible of spaces promoting multiple use. There should preferably be more open urban spaces for individual use.

The promotion of garden neighborhoods is one of the novel ideas that would let people to like community parks. This promotes the idea of the "park connector network", which is a green grid that can enable the communications among zones of high population densities and green areas by means of bicycles and walking without cars. The spread of sterilization and hand-washing stations in public spaces has to become a public culture. Attention must be paid to ensuring the upper limits to residential buildings to make them vital spaces to reduce isolation and to achieve contacts with Nature. The spread of low-rise buildings with separate entrances at the ground floor level need to be promoted. Using the biophilic design approach for building design, which adopts the concept of green architecture must be the norm rather than the exception. Multifunctional buildings with flexible spaces need to be increased. Finally, it is wise to adopt a smart healthy city strategy that engages the technically advanced methods to help monitor and collect data on contagious deseasesa dntheor spread through a databank.

Conclusions

This research dealt with a historical overview of the impact of pandemics on urban space and especially the Covid-19 pandemic, which has affected the urban spaces and has re-orientatedthem. It looked at many solutions with new approaches to achieve the safety and an health of the environment for the people. It pointed out that the buildings must be well designed to face the spread of infectious diseases.

Th efollowing conclusions have been arrived at.

1) The urban spaces may be transformed after the covid-19 pandemic employing the concept of "preventive space".

2) The preventive spaces depend in their design on smart technologies and social isolation strategies based on artificial intelligence techniques.

3) The concept of smart healthy cities must be adapted as the strategy to provide better urban spaces invested with the possibilities to engage in modern urban life even in the midst of a health crisis.

4) It is recommended to use the concept of biophilic design method at the level of urban blocks to create healthy urban spaces.

5) It is recommended to design environmental friendly transportation routes that connect high-density urban spaces to the green areas of the cities in the form of interconnecting networks so that people can access more parks and green areas in the urban spaces.

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