Chapter 2
How Cities Cope in Outbreak Events?

Growth is inevitable and desirable, but destruction of community character is not. The question is not whether your part of the world is going to change. The question is how.
—Edward T. McMahon.

2.1 Understanding the Progress of Outbreak

An outbreak can cause more problems than just the spread of disease. It can be an antagonistic nemesis to our cities and communities, particularly if we lack preparedness and resilience. Its progress is usually unclear as it can be completely different from case to case, and can react differently in different contexts and with different groups of people. Such reactions may purely relate to climatic conditions, hygienic status, and environmental attributes of the context. Those reactions can also differ from one group of people to another, while the disease has to find its correct host as well the way it can transmit and evolve. Consequently, the magnitude of impacts would depend on many factors, of which the nature of the disease is very important during the whole outbreak progress. In most cases, we have little information about the speed of disease spread, its impacts, its fatality rate, how contagious it can be, how long the whole process could last, as well as many other factors that may take a while to get identified, analysed, verified, and reported. At all scales, the process should be recorded carefully and formally, to ensure all stages are verified accurately, and all measures are considered adequate. Unlike other emergencies and many disaster events, outbreaks can develop progressively in a longer period. Tracking their progress requires careful monitory, and decision making becomes more intense and sensitive. The outbreak's prolonged—yet stage by stage—progression adds to existing uncertainties, as it can reverse or deviate to earlier or later stages, or even intensify further if the particular disease advances, spreads faster, or even mutates. Hence, sudden jumps in infected cases always cause anxiety to a wider group of stakeholders (i.e. particularly medical scientists). And every step is carefully taken to ensure no mistakes happen that may eventually worsen the situation.

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The more recent and unexpected outbreak of the novel coronavirus (COVID-19) has tested the adaptability, responsiveness, and robustness of many cities as they rise to tackle this rapidly growing challenge. With no exceptions, any infected zone had to come up with new measures and practical changes to the overall management of the city. Evidenced through extended literature from multiple disciplines, we can see it was predominantly after the first Ebola outbreak in between 2014 and 2016 (with the first case in December 2013) that issues of resilience and management during outbreak events were taken into consideration (Note: some earlier research on MERS and SARS outbreaks were also found). These examples include multiple perspectives from various areas of research, such as resilient health system (Kieny and Dovlo 2015; Kruk et al. 2015; Dieleman et al. 2016; Haldane et al. 2017), Resilience and smart city framework (Liotine et al. 2016), public health impact and management (Alexandre et al. 2017; Schwerdtle et al. 2017), policy priority areas (Buseh et al. 2015), and community-based resilient health system (Siekmans et al. 2017). Hence, this can be recognised as a breaking point in scholarly research (on outbreak events) that developed new research pathways to also study those issues that are associated with various management and resilience measures. The impacts from Ebola's prolonged first outbreak were so significant that it made resilience research to play a part in studies of outbreak events; even though that some of those resilience studies (Emergency Preparedness 2017; Alexandre et al. 2017; Schwerdtle et al. 2017; Siekmans et al. 2017) only focus on a particular system or aspect. These mostly focused on enhancing health system resilience (Bloom et al. 2015; Kruk et al. 2017) rather than incorporating other systems or sectors of the city resilience. It is partially assumed that other systems are also studied individually, or at most, associated with the health system or emergency medical services/system (EMS) of specific communities and cities. Furthermore, for the first Ebola outbreak, primary reports from the World Health Organisation (2014–16) highlight three main objectives, namely: "*to interrupt all remaining chains of Ebola transmission; to respond to the consequences of residual risks;* [and] *to work on health systems recovery*". The latter is certainly a major highlight of this specific outbreak that helped to shape new recovery measures for infected areas. Again, from the perspective of the broader urban studies, such research innovation is important in the study of outbreak progress.

For the case of cities and communities, the main factors that come to one's mind are methods and approaches to practical 'resilience enhancement' in the progress of the outbreak. These have to be implementable, adaptable, and effective in practice. Hence, they include key factors—but not limited to—adaptability, robustness, responsiveness, and preparedness that should support the city's multi-sectoral management and governance. But where can get "*sources of resilience*" as Schwerdtle et al. (2017) suggest? And how can we guarantee those sources will be ready for the specific time of an outbreak event? To answer these, we have to delve into further studies of resilience management and assess how cities and communities cope in such outbreak events. In their studies about resilience management, Massaro et al. (2018) highlight the importance of 'resilience assessment and management' (Linkov et al. 2013), as an emerging field, particularly from the perspective of practical implementation (Gao et al. 2016; Ganin et al. 2016, 2017) during the time

of need. Massaro et al. (2018, p. 7) then argue that such practical approach should "*evaluate cross-domain alternatives to identify a policy design that enhances the system's ability*", which should be used for during the event itself, in the recovery period, as well as for the ensuing prediction and preparation for the future.

In urban studies, there is no scholarly research that focuses on outbreak events and issues of city resilience. Hence, this book aims to address this research gap. Before we delve into discussions of urban resilience and city management, we have to develop a broader understanding of outbreak events, as well as their impacts on cities and communities. This chapter serves to address this important topic. At first, we verify and study multiple phases (or stages) of outbreak events, before evaluating the outbreak event in each specific phase. By doing so, we will have a better overview of how the outbreak happens, how it is expected to develop, and how it progresses in specific phases. This chapter concludes with a perspective on the development of 'responsive city management' in the face of the outbreak event progression. This chapter's more elaborate discussion on phase-by-phase impacts on cities provides new knowledge to the field of research. The information here will be utilised in the next chapter, where we focus more on measures and practicalities of urban resilience and city management in disease outbreak events.

2.2 Six Phases of Outbreak Events

As important as global health security matters (CDC Global Health 2014; Heymann et al. 2015; Sands et al. 2016), it is vital to study and understand the progress of disease outbreak/epidemic event at its source, and in the known and unknown immediate locations. This may sound like, or even seem like a robbery chase at first, but it will progress very differently soon after. In an outbreak, we are dealing with a case of emergency, not a disaster (although with some overlaps). As described by Lisnyj and Dickson-Anderson (2018), the impacts of such emergencies on communities can be devastating and enduring; arguing in favour of having post-crisis resilience plans, too. This requires a good understanding of multiple phases so that we can develop a range of practical resilience measures at different phases of the disease outbreak event (Cheshmehzangi 2020a, Cheshmehzangi 2020b) and building them over a period of time (Chimusoro et al. 2018). This will eventually lead into the development of a framework (see Chap. 3) that is not only conceptual (DeRose and Long 2014) but is also relevant and applied (Gunawan et al. 2015; Cheshmehzangi 2020a) for the real-life situation.

On their study related to measuring resilience, Linkov et al. (2013, p. 10108) provide a viewpoint that resilience is defined as "*the ability of a system to perform four functions with respect to adverse events: (i) planning and preparation, (ii) absorption, (iii) recovery, and (iv) adaptation*" (also adapted from The U.S. National Academy of Sciences 2012). Linkov et al. (ibid) also argue that resilience is very much associated with the overall scenario of the event and its associated risks, by arguing that:

> …resilience has a broader purview than risk and is essential when risk is incomputable, such as when hazardous conditions are a complete surprise or when the risk analytic paradigm has been proven ineffective. Therefore, resilience measurement must be advanced with novel analytic approaches that are complementary to, but readily distinguishable from, those already identified with risk analysis.

In their attempts to define and assess measuring resilience (ibid), they propose a follow up 'Resilience Matrix' consisted of time of progression and multiple domains affected from a particular event (as well as taken into consideration during the process). In another words, this systematic approach enables to map multiple system domains "*across an event management cycle of resilience functions*" (ibid). In this regard, a theoretical guideline can be generated for each system domain and help to measure the overall system resilience. This approach enables us to have a clearer understanding of progression, in four primary domains of (1) Physical, (2) Information, (3) Cognitive, and (4) Social (also Alberts 2003). And each domain would then need to respond according to those four stages of plan/prepare, absorb, recover, and adapt.

Based on Linkov et al. (2013, p. 10109), each of these domains are explained as below:

(1) **Physical Domain**—In the plan/prepare stage, to have state and capability of equipment and personnel, and network structure. In the absorb stage, to have event recognition and system performance to maintain function. In the recover stage, there is a need for system changes to recover previous functionality. Finally, in the adapt stage, there is a higher need for changes to improve system resilience.

(2) **Information Domain**—In the plan/prepare stage, it is vital to have data preparation, presentation, analysis, and storage. In the absorb stage, it is essential to conduct real-time assessment of functionality, and anticipation of cascading losses. In the recover stage, we anticipate the information domain to make good use of data to track recovery progress, and anticipate recovery scenarios. Finally, in the adapt stage, more support is required for the creation and improvement of data storage, and it is essential to use protocols.

(3) **Cognitive Domain**—In the plan/prepare stage, we have to proceed with system design and operation decisions, with anticipation of adverse events. In the absorb stage, it is essential to have and use contingency protocols and proactive event management. In the recover stage, there is a need for recovery decision-making and communication. Finally, in the adapt stage, we need the design of new system configuration, objectives and decision criteria.

(4) **Social Domain**—In the plan/prepare stage, we have to utilise as much as possible the extent of social network, social capital, institutional and cultural norms, and training. In the absorb stage, we have to be fully prepared to allocate resourceful and accessible personnel and social institutions for event response. In the recover stage, it is essential to promote teamwork and knowledge sharing

to enhance system recovery. Finally, in the adapt stage, we need to pay attention to addition of/changes of institutions, policies, training, programmes, and culture.

Consequently, this type of approach is identified to be closer to the principles of 'Network Centric Warfare (NSW)', which is developed by military scholars (ibid) and is generally focused on "*creating shared situational awareness and decentralized decision-making by distributing information across networks*" operating in those four mentioned domains. According to Alberts (2003, also in ibid), these details are recognised as: (1) a variety of sensors, facilities, equipment, system states, and capabilities for the 'Physical Domain'; (2) the combination of creation, manipulation, and storage of data for the 'Information Domain'; (3) careful consideration of understanding, mental models, preconceptions, biases, and values for the 'Cognitive Domain'; and (4) A range of interaction, collaboration and self-synchronisation between individuals and entities, for the 'Social Domain'. In an example of measuring city resilience, there are four key domains or dimensions of economy, society, governance, and environment (The Organisation for Economic Co-operation and Development (OECD) 2019). In their measurement, they include the following factors of all four domains:

(1) **Economy**—to include factors, such as 'GDP growth rate', 'Unemployment', 'Number of start-ups and business failures', and 'Age and gender of: (i) employed, and (ii) working population'.
(2) **Society**—to include factors, such as 'Migration age and gender', 'Poverty levels', 'Household income', 'Percentage of population', and 'Living 500 meters from services'.
(3) **Governance**—to include factors, such as 'revenue by source', and 'Number of: (i) Community organisations, (ii) Public sector officials, and (iii) Sub-national governments'.
(4) **Environment**—to include factors, such as 'Population density', 'Accessible green area levels, specifically for: (i) percentage of built up areas, (ii) percentage of brownfield sites, (iii) percentage of citizens near open space, and (iv) percentage of new development, and 'Near transit locations'.

The above puts 'city resilience' in the middle of these four primary domains/dimensions.

In order to reach a full state of resilience measures, the author believes that we should first understand how an outbreak progresses in multiple phases. In this regard, the whole progression should not be recognised as a cycle, but should indeed by reflective on how a particular disease outbreak develops from inception to post-recovery. This is mainly for the case of an outbreak and not the resilience that may be required to address the needs of each stage (see Chap. 3 for more details). By understanding those four mentioned stages of progression in resilience development and applications (Linkov et al. 2013), it is then more important to take the time factor into consideration of how an outbreak develops. Therefore, the author proposes six phases that are commonly experienced in outbreak events (Fig. 2.1). These phases are progressive, and can either prolong or reverse at certain points and should our

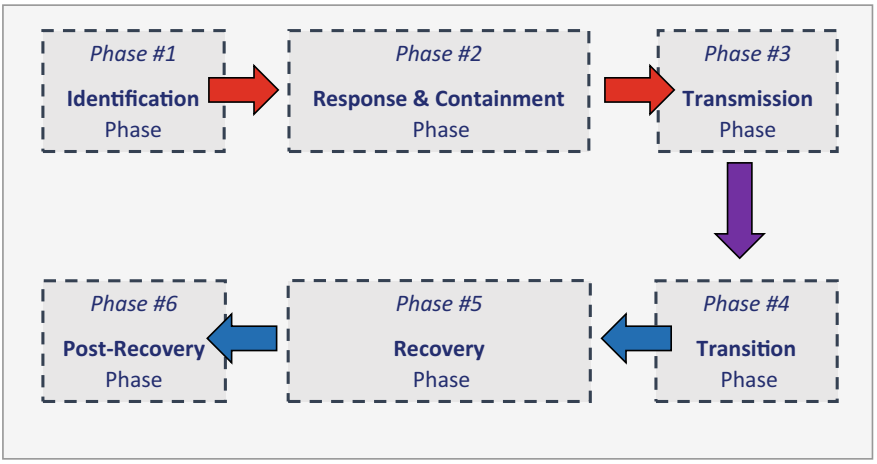

Fig. 2.1 Demonstration of 6 phases of outbreak event from inception to post-recovery, including first three alert/emergency phases, including 'identification', 'response and containment', and 'transmission' phases at the top (with red arrows in between), a 'transition' phase that can have multiple directions (e.g. positive or negative) at bottom right (with a Purple arrow in between), and two phases of 'recovery' and 'post-recovery (with blue arrows in between). Note: two phases of 'response and containment' and 'recovery' are intentionally drawn larger to represent both their longer time and importance throughout the outbreak progression. *Source* The Author's own

resilience and management fail to progress in the right direction. These six step-by-step phases are: (1) Identification phase, (2) Response and Containment phase, (3) Transmission phase, (4) Transition phase, (5) Recovery phase, and (6) Post-recovery phase. As shown in Fig. 2.1, the progress of the outbreak event is linear, but certainly includes a variety of parameters and factors that would be discussed in the next chapter. It is also important to note the difference between different phases of outbreak progression, and different phases of action plans against the outbreak. The former is the focus of what we cover in the following sub-sections.

While theoretically, we can define these six distinct phases of outbreak event progression, the actual boundaries in between all phases are somewhat fuzzy, reflecting on the ambiguous characteristics of the start and the closure of a disease outbreak event. In most cases, there is very little information about the know-about(s) of disease outbreak, its origin, when it started (Berthod et al. 2014; CDC 2014), how it emerged, and how it may progress. Hence, the progress itself is a source of more uncertainties, in terms of 'intensity', 'time', and 'location'. As described by CDC (2014, webpage source), "*a disease threat anywhere can mean a threat everywhere. It is defined by: (1) the emergence and spread of new microbes; (2) globalisation of travel and trade; (3) rise of drug resistance; and (4) potential use of laboratories to make and release—intentionally or not—dangerous microbes*". Hence, certain aspects can lead the path into new difficulties and challenges, or may simply intensify the situation from time to time. This certainly adds more complexity to the already complex situation of the disease outbreak. This may also alter in each phase, and can

transmit between phases as the progress continues. In reality, each phase is intense in its way, and the impacts can differ depending on the nature of the disease itself. As a progressive event, a disease outbreak/epidemic travels from subject to subject, time to time, and location to location. In the latter, broader spatial understanding of outbreak events helps to respond more effectively to spatial attributes (Chanlekha and Collier 2010; Kramer et al. 2016). Furthermore, each phase needs to maintain a range of control strategies (Kawashima et al. 2016), resilience measures of multiple systems (Wallace and Wallace 2008; Yamagata and Murayama 2016), and planning. These factors require a careful assessment at multiple levels (i.e. beforehand, throughout, and afterward) in each step of this progression. In this regard, it is important to elaborate further on each phase, and discuss the characteristics of each phase, before we can assess how cities and communities respond to such adversities. The following six sub-section elaborate further on each phase of outbreak progression.

2.2.1 Identification Phase

The first phase of the outbreak event is defined as the '*identification phase*'. The earlier this phase is discovered, the faster and more efficient the later phase(s) can be in practice. By identifying the causative agent of the disease, we can boost research and support to find suitable treatment and implement control measures (Hansen et al. 2018), when and where needed. Nevertheless, in most cases, it can take some time for a disease to show signs of spread from person to person; hence, this factor may delay its identification and usually delay the official announcement. Another factor that delays the official announcement of an outbreak is that the usually accountable authorities or sectors (associated with the public health) may assume they can contain the situation before it becomes a case of emergency or public health threat.

In this phase, as the whole situation remains obscured, there are potential chances of other disease development (Zaidi et al. 2018) that may even occur at a later stage. A careful monitory is essential as any information remains sensitive and any false step can escalate distress in the society. According to Cope and Ross (2020), the resource demands of surveillance are of much practical value in outbreak studies, particularly in the early stages. In this phase, the health system and emergency medical systems (EMS) are at high alert, while they assess further into the progress. The assessment must be comprehensive enough to shed a light on the situation, even if it does not clarify the origin/source of the disease (which is common in many outbreak cases). The focus should rather be on gaining knowledge about the disease itself, its symptoms, public health risks, and associated information that can support the medical and scientific sectors. In general, we can somewhat argue that the actual outbreak has not occurred yet, as it can take a while for the disease to show its presence and significance. However, since this is associated with the origin of the outbreak, it is therefore considered as the first phase of the overall outbreak progress. Although risks may seem to be at a lower rate, the uncertainties associated with this particular phase should be considered seriously. More importantly, in the identification phase,

time and information are crucial factors; and both are needed for better handling of the outbreak event in its later phase(s).

2.2.2 *Response and Containment Phase*

The second phase of the outbreak event is defined as the '*Response and Containment phase*'. While there is little scholarly research that reflects on this particular phase, the response and containment phase is a very important part of the whole disease outbreak progress. The information provided from the earlier phase would certainly help to better "*inform the decision making processes for outbreak response*" (Cope and Ross 2020). If handled promptly, the whole situation may just turn into an endemic event, which can be regarded as early containment of a disease outbreak. While in most cases this may not seem possible, it is important to have a robust position in the response and containment phase. This requires speed, trustworthiness, surveillance, and precision (inspired from the editorial of Nature Microbiology, published on 22 January 2020) as to ensure enhancing the quality of response and its effectiveness (ibid, p. 228):

> The epidemiological characteristics of the pathogen will, of course, influence how quickly an outbreak can be contained. However, a response based on equipping local communities with surveillance and control capacity at the source, rapid and open communication of epidemiological and genetic information, and international community support, will increase our chances of controlling outbreaks earlier and thus potentially save lives.

In this regard, we can refer to the response and containment phase as a turning point; i.e. either the outbreak continues and worsens, or it can be contained as early as at this phase.

There are many examples of how our response rate can develop from media to practice. The latter is important as it requires enhancement of preparedness and support. A larger scale of such response mechanism is the WHO's main platform of the 'Global Outbreak Alert and Response Network (GOARN)', which also contributes towards 'global health security' by: "*(1) combating the international spread of outbreaks; (2) ensuring that appropriate technical assistance reaches affected states rapidly; and (3) contributing to long-term epidemic preparedness and capacity building*" (WHO webpage 2005, GOARN section). Developed in 2000, this particular response network reflects on the importance of this particular phase in the outbreak event. Through adequate planning, it is vital to have a robust response assessment mechanism that can suggest a series of practical priorities to inform decision making and response deliverables (Polio Eradication 2018; also National Institute for Communicable Diseases (NICD), an online source for 'outbreak response').

In this specific phase, careful planning is essential to develop an inclusive task force of multiple sectors and multiple stakeholders. An example of this is the systematic mechanism that is developed by Singapore in 2018. As a small nation, knowing that outbreaks can turn into catastrophic events in a short period, Singapore's Ministry

of Health (MOH) developed the 'Disease Outbreak Response System Condition (DORSCON), which is a response-oriented guideline (MOH Website 2018). There is a range of prevention and reduction measures that suggest how the country should proceed with a risk assessment (ibid, also Russell et al. 2014) at an early stage (also implemented for the recent outbreak of COVID-19). This particular risk assessment includes four key factors of (1) the disease condition outside Singapore, (2) the disease's rate of transmissibility; (3) the likelihood of disease arrival into Singapore; and (4) its likely impact on the local community (ibid). By doing so, the assessments are conducted and responses are adjusted accordingly.

According to the guideline details of Singapore's 'Disease Outbreak Response System Condition (DORSCON)' developed in 2018, the three primary factors that should be addressed include: (1) nature of disease, (2) impacts on daily life; and (3) advise to public (Singapore's Ministry of Health 2018). The action plans of these three factors are then narrated based on four colour-coded scenarios, namely green, yellow, orange, and red. Here, we highlight details of all action plans under these scenarios:

- ***GREEN***
  - **Nature of Disease**: "*Disease is mild OR Disease is severe but does not spread easily from person to person (e.g. MERS, H7N9)*";
  - **Impacts on Daily Life**: "*Minimal disruption; e.g. border screening, travel advice*";
  - **Advice to Public**: "*Be socially responsible: if you are sick, stay home; Maintain good personal hygiene; Look out for health advisories*".
- ***YELLOW***
  - **Nature of Disease**: "*Disease is severe and spreads easily from person to person, but is occurring outside Singapore. OR Disease is spreading in Singapore but is: (a) Typically mild, i.e. only slightly more severe than seasonal influenza. Could be severe in vulnerable groups (e.g. H1N1 pandemic). OR (b) being contained*";
  - **Impacts on Daily Life**: "*Minimal disruption, e.g. additional measures at border and/or healthcare settings expected, higher work and school absenteeism likely*";
  - **Advice to Public**: "*Be socially responsible: if you are sick, stay home; Maintain good personal hygiene; Look out for health advisories (same as GREEN)*".
- ***ORANGE***
  - **Nature of Disease**: "*Disease is severe AND spreads easily from person to person, but disease has not spread widely in Singapore and is being contained (e.g. SARS experience in Singapore)*";
  - **Impacts on Daily Life**: "*Moderate disruption, e.g. quarantine, temperature screening, visitor restrictions at hospitals*";

  - **Advice to Public**: "*Be socially responsible: if you are sick, stay home; Maintain good personal hygiene; Look out for health advisories; and Comply with control measures*".

- ***RED***
  - **Nature of Disease**: "*Disease is severe AND is spreading widely*";
  - **Impacts on Daily Life**: "*Major disruption, e.g. school closures, work from home orders, significant number of deaths*";
  - **Advice to Public**: "*Be socially responsible: if you are sick, stay home; Maintain good personal hygiene; Look out for health advisories; Comply with control measures; Practise social distancing; and Avoid crowded areas*".

In this guideline framework, we can that the authorities highlight examples of past epidemic/pandemic events, which shows their careful reflection on the earlier experiences as a vital tool for future responsiveness and readiness. Finally, we can argue the response rate plays a major part in informing the later transmission phase, in terms of what actions need to be elevated, what measures should be strengthened, and what practices should be enforced or reinforced. Hence, the response and containment phase is important from a multiple sectorial and multi-objective approach to help the development of guidelines and planning. It should be regarded as a prevention stage, through which containment is achievable. This can also be regarded as a decision making phase, as well as the period when our preparedness is increased according to the intensity of the situation.

2.2.3 Transmission Phase

The third phase of the outbreak event is defined as the '*transmission phase*'. Even though some of the primary characteristics of this phase are similar (or may seem overlapping) to the earlier phase, it should be regarded as a distinctive stage of its own during the outbreak progress. This phase is often regarded as a 'spreading' stage and is centered on the transmissibility and virulence of the disease. As demonstrated by Pigott et al. (2017), disease transmission is generally categorised into three stages that resemble the cases of viral transmission and how it develops into a case of human-to-human transmission from a smaller scale into a larger scale of multiple people, communities, and locations, including (1) index case potential, which is simply the transition from source, known as the reservoir host (e.g. animals, or non-human), to the first human case (i.e. index case); (2) outbreak potential, which is the start of human-to-human transition; and (3) epidemic potential when the disease starts spreading to multiple locations outside the boundaries of the original source (i.e. not in immediate proximity to the source). This is regarded as a conceptual progression of a disease spread, and how it develops in a transmissible process, from one source to another, and from one location to another.

Based on the analysis of the multistage pandemic study, conducted by Pigott et al. (2017), we can verify that transmission as a factor is elongated across multiple phases of outbreak event (i.e. from the inception of 'identification phases' to later phases, and even towards potential endemic or the 'post-recovery phase'). However, it only becomes a phase of its own, when the disease starts spreading at a faster pace, and on a wider scale; meaning that the spread progresses with a higher potential to develop an outbreak into a major pandemic event. Hence, in this phase of scaling up, transmissions are expected to be hostile with the rapid increase of infected cases or even upsurge in the number of deaths.

In this particular phase, scaling up prevention is essential. This is also visible in reports of the recent COVID-19 outbreak in China, suggesting to strengthen multiple aspects of 'disease prevention', 'control systems', and 'detection' (Xu 2020, in China Daily top news). Hence, the immediate plan should help to "*improve surveillance, diagnostic capabilities, and health systems in parallel with the design of policies for optimal responses*" (Pigott et al. 2017, p. 2662). Furthermore, there are also further risks for multi-transmissions, multiple critical conditions, and some unknown possibilities in this pulsating phase. In the case of having better control over the transmission rates and the number of cases, we may see the development of 'cluster of cases' (McCormick et al. 2012). Such a model of transmission is comparatively better than the individual spread of disease in multiple locations and communities. It is easier for speeding up the disease containment, as well as having a more efficient health system in place (ibid). In the case of multiple transmissions in multiple locations (often known as the epidemic event, if not any larger), we may end up with multiple hotspots and secondary zones of multiple cases, which can worsen the spread of disease. On the contrary, in a worse scenario, the progress may develop more aggressively as the outbreak can potentially escalate further through various modes of transmission. If this occurs, the outbreak may turn into a higher level emergency, a possible case of disaster, or a pandemic event. Hence, this can be verified in the fourth phase of outbreak progression; i.e. from the transmission to transition.

2.2.4 Transition Phase

The fourth phase of the outbreak event is defined as the '*transition phase*'. In this relatively longer phase outbreak progression, we expect to see changes in both disease activities and our actions. In some cases, and depending on the actual development of the disease, we expect to transit from reactive to proactive responses (Pigott et al. 2017). In this transition phase, such new responses may change our priorities, as well as our methods of detection, treatment, and control. If successful, we get closer to the recovery of the disease outbreak, and if not, it is likely we may remain in this phase for a longer period. If the former occurs, the transition period is relatively short as progress and control are expected to show signs of improvement. If in the case of the latter, we may require to review and revise our responses and reinforce some of the measures. In a longer transition phase, there are also potential risks

for further mutation of the disease, out-of-control spread, and failures in resilience, health systems, and governance.

While resilience management reaches its peak at a larger scale (Massaro et al. 2018), the transition phase comes with some uncertainties until the steadiness of the situation is eventually reached. In this two-sided particular phase, the outbreak event can either intensity and escalate further or start to improve. Similar to transitions between multiple stages of transmission (Pigott et al. 2017), the transition can also happen for prevention and/or mitigation of the disease, as well as reduction of outbreak impacts. In their study of outbreak analysis, Chen et al. (2018, p. 396) suggest a potential "*tipping point pre-transition state*, *which is a critical state before the catastrophic event*". This reflects on their analysis of detecting early-warning signals of the outbreak (ibid) that may identify critical transitions (Liu et al. 2012) or show signs of abnormalities in the outbreak progression. If so, the already longer transition phase will be prolonged and further forces may be required to support the existing strategies and plans.

Furthermore, we can argue that the transition phase is often presumed as a steady phase towards early signs of either 'disaster' or 'improvement'—whichever the direction of the outbreak progression may be. If the latter occurs, the outbreak progression becomes closer to closure and reaching the crucial phase of recovery (inclusive of full containment). In this transition, should the disease mutates, the challenges will certainly escalate again. This will then further disrupt the systems as well as the progress itself. In such a scenario, this may break the pattern of linear disease progression and instead form into a cycle progression, resulting in a possibility of going back to earlier stages of the outbreak in a high-level emergency scenario. Nevertheless, in most cases, the transition phase is just extended to test and apply better reinforcement measures (if needed) and reach the ultimate results of control and recovery (if not absolute treatment). Since there is a slight chance of having the (new) vaccine to be tested on human trials in this phase, the transition should mainly indicate progress towards improvement, which resembles a good scenario in the right direction.

2.2.5 Recovery Phase

The fifth phase of the outbreak event is defined as the '*recovery phase*'. In this phase, a range of outbreak intervention strategies is developed and implemented towards outbreak containment and recovery, which are recognised to be context-specific and not universal (Kuhn and Calisher 2008). In this phase, treatment cases are expected to increase while the overall situation becomes relatively steady, with intermediate signs of slowing down and gradual decline in the number of cases and spread. If the containment can happen in a smaller cluster or community, then it may just be faster to proceed with treatment and healthcare support (Dwosh et al. 2003). As shown in their example case study, Neylon et al. (2010) highlight the role of the outbreak control team (OCT) in outbreak containment and recovery procedures. The team

should be assembled in particular sites/locations to prevent further cases, to conduct extensive environmental screening, and to provide more meticulous isolation units.

At this particular phase, such underpinning measures will help to ensure the maximum effectiveness of management (van Hal et al. 2009), disinfection strategies (Neylon et al. 2010) and preventive procedures. By expanding on these measures, Lee et al. (2011) suggest a larger outbreak control interventions, including: "*(i) increased hand hygiene measures, (ii) enhanced disinfection practices, (iii) patient isolation, (iv) use of protective apparel, (v) staff exclusion policies, and (vi) ward closure*". While these control measures are applied for healthcare settings, with the potential application at smaller communities, there are also higher probabilities that we have to implement measures of control at different scales. For instance, in some cases, the approach may need to include a specific group of people (Dwosh et al. 2003; Calugar et al. 2006), a larger scale of people (van Hal et al. 2009), and even larger areas at a regional, sub-regional (CDC 2008), and country-wide scales (Leo et al. 2009; Agodi et al. 2011; Schwaber et al. 2011).

It is believed that with an outbreak, there should come a containment plan. This is regardless of how intense and time-consuming the process may be. Time is a crucial factor in the recovery phase, as it helps to have partial control (if not a full control) before full treatment of the disease (e.g. in most cases with a new vaccine). This requires a range of outbreak controllable measures that goes beyond the actions of isolation and tracing (Fraser et al. 2004) and towards enhanced treatment, planning, and management. By uncovering gaps in planning (Balicer et al. 2007) and reinforcing control measures, the containment can be successfully developed into a case of endemic (in less effective cases), and/or towards post-recovery status as the most effective result. As Heymann (2004) argues, the process may require the international response by the development of a response network and intense collaboration in multiple sectors of multiple disciplines, including virology, clinical medicine, and epidemiology, which can help to speed up the process. The recovery phase remains crucial as it is important to develop a steady pattern of outbreak improvement from multiple aspects/perspectives, and not just the decrease in the number of cases. If this occurs efficaciously, then the containment would succeed to put a gradual end and then an eventual closure to the outbreak momentum.

2.2.6 Post-recovery Phase

The final phase of the outbreak event is defined as the 'post-recovery phase'. While in smaller outbreak events, this may occur in a faster pace (White et al. 1986), in most cases it can take a much longer time than it requires to elaborate post-recovery strategies, long-term planning, proactive measures, and community-centered approach to better integrate social capital in the process (Thompson-Dyck and Mayer 2016; Lisnyj and Dickson-Anderson 2018). This phase is also realised as the normalisation phase, different to those normalisations of techniques in predictions and implementation

(Szomszor et al. 2010; Mustaffa and Yusof 2011; Yosuf and Mustaffa 2011), normalisation of early-stage disease detection and evaluation (Yang 2017), normalisation of the conditions of infected people (Kidd et al. 2004; Romantsov and Golofeevskii 2010), and normalisation of testing, the functionality of medical procedures, and treatment approaches (Brady et al. 2016). The term 'normalisation', can also be partially misleading as it can refer to the normalisation of the disease itself. Hence, this phase is named 'post-recovery phase' to avoid potential confusion with other normalisation factors of the outbreak.

It is important to note that post-recovery must only take place under the condition of reaching full outbreak recovery. In the case of an endemic situation, other measures should be taken into consideration before reaching the post-recovery phase. Hence, the system operations of health units and emergency medical services should eventually become more flexible as the situation eases. In this after event situation, it is important to continuously:

(1) Evaluate the recovery progress in every step to ensure no errors or mismanagement;
(2) Undertake a full monitory of any unexpected issues or uncertain conditions (e.g. that could even be from a new associated disease emerging from the outbreak);
(3) Shift to a normal status through a gradual pace, and with the full involvement of the community that should be practiced to compensate damages in the right way;
(4) Consider enhancement of certain units or sectors to ensure rapid recovery of those affected, and in particular, help to revitalise the governance of those sectors;
(5) Develop a set of (new) planning priorities that need implementation, monitory, and further adjustment to ensure they are feasible and practical in multiple sectors/domains; and
(6) Reflect on the whole outbreak progression, to capture and grasp lessons from the experience, and work towards enhancement of specific measures and supporting tools, where needed.

In a healthy process, a post-recovery may (possibly) take a longer time to ensure all units and domains are back to ordinary operation—hence, it is also a normalisation process of its own. As the society may continue to experience certain points of anxiety or mistrust, it is important to continue the outbreak monitory in a good capacity and allow for increasing the visibility of constructive progress and recovery management of them after the event. Therefore, a step-by-step progression is required to ensure support is provided to multiple stakeholders, including and at upmost, the general public. This phase must act as a reassurance period that signifies no further outbreak impacts on the society, or else it should not even commence and should instead remain at the earlier phase(s). As mentioned earlier, the pass to this phase is the full outbreak recovery that should occur in the previous phase of outbreak progression. Finally, public health should remain the priority while the community/city/country prepares to get back to the pre-outbreak operations. This phase must show evident signs of stability, even if prolonged. It also needs to immediately respond to the

requirements of all affected sectors in a short period. The long-term planning would then need to reflect on some of those happenings during each phase, developing a set of enhanced preparedness measures and a more careful monitory for the future.

2.3 Cities During the Outbreak Progression

In all phases of the outbreak progression, cities can suffer tremendously and society may need to tolerate some of those negative impacts for a while. However, from a positive perspective, there come new opportunities for the enhancement of urban resilience and city management, which are the focus points of the book. Each phase of the outbreak progression offers a range of lessons (Hrudey et al. 2002) that should be used in a comparative assessment and should be utilised for the development and/or the enhancement of resilience measures, operational systems, and management factors. As highlighted by Monstadt and Schmidt (2019), we have to look into critical infrastructures of cities (also Carlson et al. 2012) and their governance to have a better overview of how we can enhance their urban resilience. A generalised structure of site assessment contribution to community resilience analysis is dependent on multiple factors. For instance, for critical infrastructures, we have supply chain, economic, governance, and civil society. In their order of importance, supply chain is the most essential and civil society is the least out of the four named factors. For instance, "*if we wanted to assess the civil society subsystem of a community at the same level as the critical infrastructure subsystem analysis, we would need to make use of additional data collection methods and tools outside of the site assessments*" (ibid).

This approach then helps to enhance the city's resilience. In doing so, we are then capable of increasing the "*institutional capacity of the local authorities and utility companies for risk mitigation and preparedness*", which seems to be limited in many of their case study locations (ibid, p. 2353). Through their exploration of multiple cities, Monstadt and Schmidt (2019, p. 2366) also identify the existence of apparent silo city operations of multiple sectors, by addressing:

> Contrary to requests for cultures of inter-organisational preparedness, individual service providers focus at best on the vulnerability of their own system, while urban concepts for integrated emergency management are almost completely absent.

Hence, as it appears hard to break these separated operations, urban resilience urges to enhance management mechanisms that could help tremendously to overcome the side effects and difficulties of outbreak events. Through this, we can address 'infrastructural vulnerabilities' and develop the "*necessarily place-based solutions to urban and infrastructural vulnerabilities*…[which]…*could help to harmonise the local governance of infrastructures*" (ibid, p. 2369). As this is portrayed as a set of procedural standards, such measures could then operationalise those effective and protection strategies in the time of need, and can in return enhance the cooperative operation of multiple units and a larger body of stakeholders. The result of

such planning will be the enhancement of city resilience while reducing an array of vulnerabilities on a larger scale.

In addition, it is clear that in outbreak events, we deal with a range of vulnerabilities (see Chap. 1), as well as a range of affected groups/locales, who could be even more vulnerable than the other groups/locales. In most disease outbreak events, depending on their mortality rate and the response quality for containment and treatment measures, we can identify three distinctive categories of vulnerable groups/locales, who may suffer the most:

- Those individuals who are unaware of the situation, and for whatever reason, they do not know they may be infected or may carry the disease/virus. Hence, they may delay their response by acting at a late or later stage in the disease progression in their bodies;
- Those vulnerable groups of the society who are less resilient to the disease/virus/infection, including the elderly group, the ones with previous health conditions, or the ones at high health risks;
- Those communities, cities, and even countries with a lack of health system infrastructure and weaker resilience OR those that have limited resources without enough equipment, emergency units, detection and verification tools, medical forces, and associated supplies.

These mentioned vulnerable categories represent a wide range of groups, from individuals to a larger scale of cities or countries (or clusters of them). Hence, in outbreak events, the alert level reaches a higher level in the case of an outbreak reaching or staring in poorer nations or those regions with minimal health infrastructure/system, and many other associated factors that represent a more vulnerable locale. Therefore, we have to consider vulnerable groups/locals as the primary point of our resilient planning.

2.3.1 Cities from a Phase-by-Phase Perspective

To summarise here, it is important to briefly highlight how cities cope in the event of an outbreak, and through the phase-by-phase progression that was illustrated earlier in Sect. 2.2. In the first phase of the 'identification phase', cities may seem to operate normally without any unexpected disorders or disruptions. As the search for more information increases, and as the official announcements of a disease outbreak are eventually made, the city operations start to change slightly. Usually, there are only minor impacts, with earlier signs of fewer people in outdoor public places, shopping malls, and busier areas of the city. As this progresses into a more alerting stage of the response phase, other sectors are affected too. The Health system and emergency medical services/system (EMS) become more alert and the cities' operational changes increase more rapidly. The public domain gets the biggest hit, as many public services would gradually lower their operational rate or may temporarily stop their operations. There seems to be more decline in using public places, retails sites of

large scale, public transportation, and other public facilities. In the subsequent phase of the 'transmission phase', depending on the intensity and scale of disease spread, cities would gradually stop the secondary operations. Hospitals and health clinics may turn into hotspots, hence they require further support to avoid vast spread in those critical locations. In this phase, cities will face major difficulties as most businesses, industries, and retail units may stop (or may be asked to stop) their operations. If this occurs, apart from the existing impacts on society, the impacts on the economy will become more perceptible, too. This leads to a further decline of multiple systems as cities face further disruptions in their operations. In this phase, economic resilience and management are crucial as many critical infrastructures and key institutions are under significant pressure. The cities' economic foundation suffers while society becomes more worried about the rapid increase of cases and mortality rates/cases. In this phase, the city lockdown is not necessary but it may seem essential if the response rate is not so fast at the early stage. This lockdown approach can be partial to avoid the negative impacts on a larger number of sectors. The situation should eventually become steadier, and the peak may be reached towards the end of this phase, or throughout the next phase.

The two-sided 'transition phase' usually starts with a moment of halt. This is a sensitive time for any city, as the progress may change direction. The outbreak can worsen and this may hit the city the most as it can put all operations in halt, with only health systems and EMS to operate on the ground. Food systems and other industries become significantly vulnerable as transportation comes to a near halt. If the outbreak shows signs of improvement in the transition phase, then the city operations will only start improving towards the end of this period. This becomes a gradual process for the city to slowly shift from an alert/emergency situation towards a safer phase of recovery. In the transition phase, if the situation worsens, the outbreak can also shift to a case of disaster with higher risks than anticipated in the response phase. If this occurs, then the situation requires further support at multiple governmental levels, and it may turn into a full lock-down situation (if it did not happen earlier). This means significant impacts on nearly all primary and secondary sectors of the city. However, if the situation starts improving in a steady pattern, then the situation will get closer to the next phase of outbreak recovery.

In the 'recovery phase', cities must adopt and implement the maximum level of monitory and control. To enable early containment, all operations should be either on halt or should run under an all-inclusive and careful monitory and control. Cities should not take any further risks to increase the vulnerabilities and should rather reach a decision to accept some temporary economic losses. The impacts should be temporary and can be compensated, should the recovery becomes a success through full outbreak containment. Any adversities in this phase would potentially prolong the situation and intensify the outbreak, which can ultimately put more pressure on the city authorities and the overall city operations. It will then become harder to maintain adequate operations of multiple systems/services, hence it is important to experience a temporary difficulty than longer-term adversity. Once the situation is shaping its steading pattern (after a certain period), then the operations may start gradually from primary systems/services to secondary systems/services. This gradual shift should be

carefully managed before recovery is reached and the situation is under full control. In this phase, the city should boost its health systems to ensure increasing the treatment probabilities and then supporting the overall procedure of treatment and recovery. Once this occurs, the situation will gradually move towards full outbreak recovery. The pathway to do so should be paved by high security, high monitory, high level of risk management, and high resilience to any unexpected change.

Succeeding from the recovery phase, society will start to become more relaxed. It will eventually move into the final phase of 'post-recovery'. This occurs once the regular operations of multiple sectors, services, and systems become widespread and visible. As highlighted earlier in Sect. 2.2.6, it is important to make all improvements to be as visible as possible. Such an approach enables to improve the sense of distress in the society and reassure businesses and industries for their planning of regular operations. In this phase, it is crucial to be inclusive by all means and in all sectors, as one system can help the other in a healthier ecosystem of resilience and city management. Disruptions are expected to become minimal throughout this phase, and society needs the highest level of support to ensure having an early recovery. In this stage, the more people-centered and community-oriented operation should shape and revitalise the overall operations of the city. Careful monitory should remain in place to avoid any unexpected adversities. In doing so, we will be able to bring all sectors back to regular operations and retain the conditions of all systems and services to their original regular patterns. Throughout the end of the post-recovery phase, the city should recharge its resilience and maintain and/or improve its main institutions. Finally, the most important of all is to develop 'responsive city management', which will be the main concluding point of this chapter.

2.4 Progress Through Responsive City Management

In a broader sense, there are many theories about resilience and its applications (Carlson et al. 2012; Barrett and Constas 2014), but there is a significant difference between theoretical aspects of resilience and how we can develop it in the planning practice (Coaffee 2013; Coaffee and Lee 2016; Cheshmehzangi 2020a), as well as through multi-sectoral city management—i.e. how resilience theories can then form into effective and efficient practices that are appropriate, implementable, and integrated into multiple systems. This chapter has highlighted the importance of outbreak progression and the phases it contains. Much of the focus here was to cover this important topic before we look further into the context of the city. This is the first time in any scholarly work that we can see such elaborate knowledge of multistage outbreak progression. This chapter offers valuable knowledge to those studies that would like to focus on the specific phase of outbreak progression, as well as those that aim to assess the progression of one disease in a particular location, or in between multiple locales. Moreover, the importance of resilience is partially covered in some of these discussions, but we have not fully addressed them from the city perspective. It is in the next chapter that we delve into this major factor, and

will provide a comprehensive overview of 'urban resilience and city management in disruptive disease outbreak events'.

Now onwards, the book focuses more on the context of the city, in particular the ones in need of outbreak and adversities. There are many cases of disruptions, society failures, economic decline, and health system collapses. Our job, as urbanists, should then be to respond more effectively and responsibly to those significant urban pressures of extraordinary situations (e.g. disease outbreak events). Therefore, cities and communities are important subjects of the study as we see significant impacts of outbreak events on them, as we see their decline in such disruptive events, and as we witness their success and failures. Through a better understanding of urban resilience (including a holistic overview of measures, applications, and practices) and multi-sectoral city management, we can propose for better responsiveness and a more enhanced preparedness in the face of the disease outbreak events. Our highlights here will be mostly driven from existing practices and experiences of outbreak events, through which we propose for responsive city management (Cheshmehzangi 2020a), which is comprehensive, multi-dimensional, and practical.

We learn from many city examples, many tools, and many frameworks that address urban resilience and city management from various perspectives and/or in various conditions. As mentioned in Chap. 1, the adversities of outbreak events are exceptional, more of an emergency than a disaster situation. Thus, it is important to not only study what can be done but how they can be implemented in practice. The unfortunate recent outbreak of COVID-19 has been inspirational for us to understand resilience from various perspectives, of which most of them are associated with this very important situation of the disease outbreak event. More importantly, it is evident that resilience is key, and managing the city is the ultimate answer to many of those practicalities. Resilience is scenario-based, but it is essential for the city and how it can survive various adversities, of which, the outbreak is just one. It is then important to note that city operations cannot stop for long, and cities cannot be neglected. The more we understand how cities can cope in such events, the more we can improve their resilience and support their management. Hence, it is believed that only by bringing together a range of systems and thinking holistically, can a city be truly resilient.

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