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Organizational innovation under constraints: the case of Covid patients' flow management in Parisian Hospitals

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Abstract

The COVID crisis has put hospitals under great stress over the past two years and some institutions came close to their breaking points. This has often forced decision makers and the entire institutions to change their practices and the organization of the hospitals in order to continue operating despite limited resources. It has also led some hospitals to develop and implement organizational innovations. This article is based on a qualitative case study analyzing the case of a crisis unit that has implemented various innovative medical and organizational actions in order to manage the flow of resuscitation covid patients in a large group of hospitals in Paris. This team has implemented a new evaluation scale of resuscitation needs in order to better manage quantitatively and qualitatively the patients' flow; it has defined medical criteria to select the patients eligible for transfer; it has organized one hundred patients

transfers to other hospitals' intensive care units, in and out of the region, involving private hospitals and private ambulances for a new collaboration.

The case allows us to understand innovation in the midst of an extreme situation, when material and human resources are highly constrained, and with very strong time pressure. We highlight the importance of implementing flexible organizational processes and staffing the crisis team with physicians and nurses with specific and complementary skills and experience in flow management and crisis situations.

Organizational innovation under constraints: the case of Covid patients' flow management in Parisian Hospitals

Introduction

Most innovations in hospitals take place over long periods of time, whether they are scientific innovations, innovations in patient care¹, or managerial innovations². The COVID crisis has put hospitals under great stress over the past two years and some institutions came close to their breaking points. This has often forced decision makers and the entire institutions to change their practices and the organization of the hospitals in order to continue operating despite limited resources. We have identified a case of innovative organization in Parisian hospitals (APHP), corresponding to significant organizational breakthroughs, which have made it possible to temporarily modify practices in the hospitals concerned and to stimulate collective dynamics that are essential in times of uncertainty and tension. These innovations have made it possible, at a given moment, to provide a new and disruptive solution to the problems encountered. They deal with the flow of patients in intensive care, at the heart of the COVID crisis. We analyze this case trying to answer the following research question: how to develop and implement organizational innovations under strong resource and time constraints?

The case presented here allows us to understand this issue in the midst of an extreme situation: the COVID crisis, when material and human resources were highly constrained, and with very strong time pressure. We highlight the importance of implementing flexible organizational processes and of carefully staffing the crisis team with doctors and nurses having complementary competences, and in accordance with the needs of the situation. In particular, we stress the unusual and fruitful integration of a tactical physician within the team.

In the first part, we define crises and extreme situations in hospitals and refer to the first analyses conducted on managerial and hospital innovations during the Covid crisis. Then, in the second part, we present the empirical study. In the third part, we analyze the factors that enabled these innovations and discuss their contribution to a better understanding of hospital innovation.

Innovation in crisis times and extreme situations

What is commonly referred to as "COVID crisis" is actually both a crisis and, above all, an extreme situation according to the criteria proposed by management research. A crisis is characterized by an exceptional, sudden and rapidly escalating event that leads to the development of a process of high turbulence³. Faced with a crisis, teams often find themselves stunned and saturated, and find it very difficult to grasp the event as it is happening⁴. Disasters can then occur, when teams are unable to grasp the meaning of the situation, they often fail to interpret the course of the event⁵.

In order to deal with the crisis, there is the need to "change the software"⁶, to move from a paradigm of operational routine to a paradigm of attention to the signals, even weak ones, sent by actors but also by the external environment. Teams must be prepared to demonstrate acute situational awareness and to operate with a high degree of autonomy and flexibility while remaining finely coordinated with their networks and the rest of the organization.⁷

In the context of the covid crisis, the interviews conducted with professionals in the sector⁸ show all the experiences of these professionals in the face of the first wave and note the difficulties in interpreting and qualifying the crisis: the suddenness of the deterioration and the acuteness of the situation; its unexpected nature; the difficulty in framing it and the unpreparedness of the minds which made it difficult to understand the crisis; there was a need for strong and adequate leadership⁹.

The crisis is an abnormal situation, not meant to last. However, the "Covid crisis" started in French hospitals in mid-February 2020 and lasted several months before slowing down and starting up again, with a long-time span. Therefore, its characteristics lead us to turn to the literature on extreme situations to refine our understanding of the "Covid crisis".

An extreme situation is highly exceptional, evolving, uncertain, and risky¹⁰. Major crises can be part of it. However, some organizations evolve permanently in extreme situations, such as polar expeditions, air force aerobatic teams, or police intervention teams. Operating in extreme contexts does not necessarily mean that teams are regularly confronted with a crisis. However, these teams require heightened vigilance to detect problems as early as possible, frequent training practices and significant improvisational and adaptive skills¹¹. Given their high reliability and low accident rate, they can be considered as high reliability organizations or

HROs¹². For some HROs, the extreme situation can mostly be interpreted as a necessary control of risk. The risk is at the same time carried by the technicality, the procedures and the human being. The organization of an operating room must therefore be an HRO in order to avoid accidents and any form of crisis, but also to find agile responses in the event of a problem. This is the case of Trauma centers, also presented as fast-responses organizations operating in extreme situations¹³.

These organizations facing extreme situations can be sought as laboratories for innovation. Extreme situations are then experienced rather as phases of intense experimentation, involving risks and a lot of uncertainty, but which are an obligatory passage to accomplish technological or human feats. This is for instance the case of the first heart transplants. Teams that have prepared themselves for a long time, having evolved in these unknown situations, draw an undeniable benefit afterwards: the extreme situation can be considered as a formidable moment of individual and collective learning.

Many observers consider that hospitals do not have enough of a crisis management culture. They are less prepared for crises than organizations in other sectors, according to the very words of the medical directors of crisis of the Paris Area hospitals¹⁴. This situation is long-standing and predates the COVID, as shown by the difficulties faced by hospitals in the Paris' region during the 2003 heat wave, and the different ways in which they improvised to deal with the urgency of this crisis¹⁵.

In the context of the first wave of Covid 19, hospitals and especially resuscitation and intensive care departments had local responses, often very different from one institution to another. Facing an unprecedented situation requiring the absorption of an unusual flow of patients in a very short time, many hospitals were forced to rethink their organization and managerial practices. As the adaptation of the usual methods appeared to be ineffective, these establishments or services were placed in a mode of "forced innovation"¹⁶ and created new regulation devices; reorganized patient reception by differentiating Covid and non-Covid patient flows; transformed beds in other departments into Covid + units; transferred patients in other regions; built military field hospitals...

In healthcare crisis management, disaster physicians have always been at the forefront. Disaster physicians are specialist doctors dealing with and preventing collective emergencies, disasters and exceptional health situations, particularly in the field of emergency assistance and care for

victims. They are in the frontline after earthquake, terrorist attacks, massive flow of refugees. They can be specialists in emergency medicine, surgeons, anesthesia-resuscitation, ... with a specific complementary training for collective emergencies. Among disaster physicians, tactical physicians are those doctors integrated in the intervention forces of the police, the army, the fire brigades. In the performance of their duties, a fundamental activity is to coordinate and collaborate with other medical services, especially hospital services, particularly in preparation¹⁷. During terrorist crises, particularly when attacks are carried out on several sites at the same time, or during natural or industrial disasters, all the emergency services work at the same time, and in parallel with the fire department, police and hospital structures¹⁸. Coordination must therefore be total with a global strategy, not focused on upstream or downstream but on the entire upstream flow, in situ capacity and downstream flow. These medical teams face process discontinuity, increasing ambiguity of decisions, important interdependencies, which make coordination within the team and between teams and sites more complex, and finally a global understanding away from cleavages and self-sufficient management¹⁹.

On the other hand, tactical physicians continue to practice a more traditional medical activity in hospitals, military, public and private medical structures. Thus, several hospitals have atypical profiles of tactical doctors or nurses within their team. Tactical doctors can thus maintain their conventional medical practice but also remain in phase with the organization of hospital services and culture. Some hospital services have developed new practices in crisis management thanks to the participation of these physicians. In the context of the covid crisis, these physicians were particularly mobilized, as presented in the case hereafter.

Dynamo case

This case was selected among various cases of organizational innovation in French hospitals, as a paradigmatic case with insightful elements²⁰. It advances our understanding of organizational innovation under time and resources constraints. We adopted an interpretativist²¹ approach, based on the representation that the actors make of reality.

The context: Paris Sorbonne hospitals resuscitation for Covid patients

Paris Sorbonne hospitals are part of the global Paris Hospital (Assistance-Publique des Hôpitaux de Paris). Paris Sorbonne groups seven hospitals in Paris : Tenon, Saint-Antoine, Rothschild, Armand Trousseau, Charles Foix, and La Pitié-Salpêtrière University Hospital.

On March 19th 2020, the Crisis Medical director was appointed for all Paris hospitals and, under his responsibility, the Crisis Medical director for the Paris Sorbonne hospitals. This director had a long experience on Crisis management since Paris 2015 terrorist attacks: he had been setting up procedures and training on crisis management with police tactical doctors. He requested the head of the police tactical forces with whom he had collaborated for years to coordinate a group in charge of managing, optimizing and accelerating the flow of "Covid+" patients: i.e. those presenting signs of major severity and requiring heavy resuscitation. The objective was to guarantee the quality of care for all Covid+ patients requiring intensive care and therefore to be able to accommodate a much larger number of patients than the available places in the intensive care unit allowed. This crisis unit was not foreseen in any plan built before the crisis. Two other anesthetic-resuscitation doctors and two head nurses, specialized in the coordination for organ transplants, joined the unit. They decided to call this unit Dynamo, referring to the operation to evacuate British troops from European soil in June 1940²².

One author participated in the unit observed. Another author was involved in the governance of crisis management in this hospital. Other authors completed interviews via zoom or face-to-face and followed crisis unit meetings during which the use of this unit was pushed.

Dynamo team and organizational innovation under constraints of time and resources

Dynamo was activated on March 27, 2020, through April 22, 2020. It operated 7 days a week during business hours. It received 149 requests for patients' transfers and accepted 105. The peak in the number of requests occurred on April 1st, with 19 transfers made for 23 requests. The median age of the patients proposed for transfer was 62 years.

In order to maintain a permanent capacity for patients requiring resuscitation and to guarantee the quality of care for all Covid+ patients, the hospital crisis unit decided to create a flow between the resuscitation units, which was completely new for the departments involved. It was based on the principle that not all Intensive Care Units have the same level of expertise. Indeed, recently transformed units cannot reach in a few days the same performance as a multipurpose resuscitation team, expert in respiratory distress syndrome. Therefore, the hospital crisis unit team has proposed that patients whose clinical condition does not require

the highest level of expertise, because it has improved for example, be transferred to less specialized units. As the crisis medical director summarizes, the idea was to "fit a 10-litre can into a 5-litre can". Thus, the strategy of the Dynamo cell was to organize a flow of patients within the intensive care unit, so as not to reach the breaking point and thus have to exclude certain patients from care.

To do this, the hospital crisis unit decided to sequence the resuscitation pathway into three different levels, from traditional heavy resuscitation (intubation, artificial respirator, possibly dialysis, patient on the stomach, etc.), to lighter resuscitation, especially for patients who are improving significantly. The criteria to be eligible for transfer were: intubated for at least 48 hours, no prone position for at least 24 hours, $FiO_2 < 60\%$, hemodynamic support by noradrenaline $< 1\text{mg/h}$.

Outside of a crisis situation, the patient is managed in the same place for the entire resuscitation course. Sequencing this resuscitation course has made it possible to direct patients requiring lighter resuscitation to adapted structures, freeing up, in turn the heaviest resuscitation places, which are also the rarest. The Dynamo unit had to have reliable information, in real time, on all the heavy resuscitation beds in its area. This information needed to be permanently updated, as some acute care beds were being transformed. Dynamo mobilized the intensive care units, recovery units and operating rooms of hospitals and private clinics in the Ile-de-France region in order to keep the heavy intensive care beds available for patients who absolutely needed them. The aim was to avoid saturation, and always have some of the heaviest beds available for the highest critical incoming patients. As a matter of fact, Dynamo had to closely follow the evolution of the patient flow in order to anticipate the demand and always preserve some beds. Medical logic and the interest of the patients always came first, but the optimization of flows was also an undeniably important factor, enabling to take more patients in need of care. Actually, at the worst moment of this first wave, Dynamo succeeded in always keeping at least one bed available for the heaviest level of resuscitation. It avoided the hospitals of the zone being saturated.

The challenge of this dynamo cell was also to find a solution to accelerate the downstream flow of patients in intensive care, without consuming additional logistical and human resources. "*We had to be creative: the transfers were carried out with the resources available: anesthetists, surgeons, etc. and most of the time we called on a private ambulance company, which is not our usual practice*". Dynamo therefore coordinated the flows between four types of teams,

different for each transfer: the requesting department, the transfer teams (which it formed ad-hoc according to availability and needs, each day), the transfer vector (mainly ambulance, train or air for 14 patients), the receiving department. As reported by one of the nurses: *“after two days, we perfectly mastered the process. It's simple, we had a request form, two vector files - one for the ambulance and one for the team providing the transport - and one form for the recipient. We had one form for the ICU with the medical criteria. We validate, determine the appropriate time and place, and then create the bridge between the two, generally we find a private ambulance. Then we put two doctors in it for transport”*.

Results

The main destination for transferred patients was the temporary resuscitation service created inside La Pitie-Salpêtrière hospital (37%); then, the adult resuscitation service created inside the resuscitation service at pediatric Trousseau hospital (6%); then, the private hospital Geoffroy St Hilaire (5,5%). 69% of the transfers were sent to public hospitals, 26% to private hospitals, 5% to private non profit structures. 13% of the patients have been sent outside the Parisian area, in public hospital in Western France, with specific transfers in high-speed trains, aircraft or helicopter. No major incident occurred during the transfers.

The rejected demands were due to a deterioration of patient's health (22 cases), the difficulty to find a place for a patient with a need for persistent hemodialysis (7 cases) or with major overweight (4 cases).

As the crisis medical director summarizes: *“Thanks to their capacity for innovation and their ability to work outside the box, [the doctors] were able to find solutions where there were only problems. Thanks to Dynamo, more than a hundred patients were safely transferred to resuscitations and continuous monitoring units outside the perimeter of AP.Sorbonne University's resuscitations, freeing up as many beds to accommodate patients there, [which helped] to protect the front line and ensure access to care for all patients who came to our hospitals”*.

The principle of Dynamo organization was to operate in a fluid, non-hierarchical way, with real-time information: reliable information on the occupation of the different intensive care units, communication between the different interlocutors, including those outside the public system such as the private ambulance drivers and some local private clinics which participated by creating intensive care units. In order to be easily reachable by all the resuscitation services,

Dynamo created a unique email address and a dedicated phone number and the team used an Excel file to report information about patients' transfers. The two computers of the team were linked to the information systems of the Paris hospitals. A very concise transfer request form was created and made available to all the departments concerned.

A team with complementary skills

The dynamo unit included three doctors and two experienced nurses. The two nurses were initially transplant coordinating nurses and in charge of organizing organ transplants. They were therefore used to making a lot of calls at short notice and had connections with different departments. They are used to talking with doctors, presenting patients' cases, understanding the patients' pathology and detecting whether they meet the criteria for discharge and transfer. They were particularly efficient for this type of job and managed to establish good relationships with the medical teams involved. They indeed hold important relational skills and know how to talk to various interlocutors (family, legal, medical). Finally, they have managed to build up a network of relationships with downstream structures and trust was created through repeated phone contacts and evidence that they were keeping their word: "They saw that the patients we presented to them had the criteria we had announced. And we promised to take them back if their condition deteriorated."

The two nurses were in charge of the secretarial and administrative work and had a lot of autonomy: they were able to organize everything by themselves and the doctors only intervened for the strategy and when there were medical discussions about the patients. The two nurses were not themselves the initiators of the innovations brought about by Dynamo, but they facilitated them because they understood the spirit of Dynamo. They also provided solutions and ideas thanks to their tactical autonomy. The context was very chaotic and the whole team had to be agile in such a context. Transfers were decided at the last minute and the nurses had to work outside the process, which they did.

The dynamo unit also included three anesthetists: the tactical physician; another physician who had an experience of overload in intensive care and hospital crisis and the Parisian hospital environment (APHP); the intern who had a good knowledge of the management of patients in the ICU, and of the skills of the doctors who were going to take charge of the patients.

The physicians' main task was to facilitate the flow of patients taking into account organizational and medical parameters. They were also in charge of medical assessments of

the patients before their transfer and the staffing of the doctors who were going to do the transfers. They received the assessment files from the requesting intensive care units and sorted the patients (eligibility, feasibility, health status, stability of the patients, level of care needed) with a medical arbitration each time to evaluate in which intensive care unit they should be transferred.

As exposed by a physician, referring to WW2 Dynamo: “Dynamo works like an airport control tower, which finds, or even prepares, as many small airports as possible to allow planes that are not used to landing there”. As a consequence, this strategy of sequencing the resuscitation pathway doubled the natural flow to resuscitation, a valuable gain in the midst of the Covid-19 crisis when resuscitation slots were saturated.

In our analysis, we consider that this innovative process could be designed and implemented thanks to the complementarity of the Dynamo cell members. Beyond their medical competence, they held complementary managerial and organizational skills. The two anesthetic-resuscitation doctors brought their knowledge of the APHP services and medical teams. The two nurses, specialized in transplants, are used to working with strong time constraints, and to dealing with various departments, which enhanced their relational and communication skills. This was essential in implementing efficient relations with the downstream units. Last but not least, the tactical doctor incorporated into the Dynamo team played a key role. He translated some of the disaster medicine principles into the hospital context. This could have been perceived as not acceptable by the head of the various resuscitation departments without the five-year collaboration between his tactical group and the anesthesia and critical care department from Paris Sorbonne hospitals. As the head of the medical team of a French police special forces unit, he had strong experience in patients flow management under strong constraints.

Translating experience from tactical medicine

Counter terrorism special forces unit of the French Police has had operational medical support since 1993. The physicians who make up this tactical emergency medical service combine regular medical activity in emergency or intensive care unit departments with tactical medicine activity within the special forces.

Entering a space under terrorist attacks supposes to overcome some mental boundaries - on top of physical and social ones - as very few people can cope with such a distressing and stressful situation and keep their ability to act in a coordinated and consistent manner. In a way, these tactical physicians are trained to ascribe meaning to unknown and chaotic spaces as they sensorially move across them. The training that they get is just not about learning patterns or sequences of actions. Rather, it is to sense and response to what is being felt and learned in situ as they move across an unfamiliar space.

Tactical Emergency physicians are completely integrated in the special operations forces group. They share the trainings and the intervention. Tactical physicians' main task is to take care of any injured police officers of the unit, or victims of the attacks like a Mass Casualty event. They are equipped with ballistic protection and have specific equipment for intervention: flexible stretchers, triage tools, hemorrhage, and blast advanced medical equipment, etc...

These medical team played a decisive role in the organization of the wounded rescue during mass casualties attacks in France. They have taken the necessary decisions to optimize evacuation to "traditional" rescue services, which are not allowed to enter the fire zone. Making decisions is commonplace for a doctor specializing in life-threatening emergencies, but making them in constrained, complex and "out of the box" situations is the specific challenge of these tactical emergency physicians. Tactical medicine is necessarily agile and disruptive because it is confronted with extremely rapid changes in the initial context, a lack of resources and information on the situation, strong security issues that impose themselves on any "standard" emergency care procedure, etc.

Tactical emergency physicians have a key competence in the management of patient flows. In disaster medicine, as in tactical medicine, managing the flow of victims is key. Teams try at all costs to avoid reaching the saturation point of the care capacity, which leads to disorganization, creates enormous stress and loss of chances for many victims. The management of flows in degraded conditions is one of the key subjects of reflection and learning for these medical specialties. These doctors have developed a strong expertise in flow management and know how to manage them in a global and dynamic way. They continuously balance the incoming flow of victims (by distributing them to the different points of care), the capacity (human factors and material resources, for example by increasing capacity by asking police officers to help with stretching, by transforming veterinary resuscitation equipment for humans), and the outgoing flow (for example by organizing transfers, and sometimes, during certain major

crises, by discharging patients with little chance of survival). This flow management is very different from hospital practices, which are not used to a massive flow of patients in trauma and intensive care units. The contribution of tactical doctors is a key for the teams who need to find new solutions that are appropriate to the human and material situation of the hospital and avoid the structure breaking point.

In Dynamo case, the tactical doctor knew the members of the teams and the hierarchy of the services thanks to the five-year collaboration with the newly appointed medical crisis director, at that time head of anesthesia and critical care service. They have designed and organized training sessions for several years, under the patronage of the Deans and heads of departments, which has enabled them to gradually make hospital teams understand how they function in the midst of a crisis, and what support the hospital could provide. As a matter of fact, by incorporating a tactical physician, the Dynamo unit could benefit from his competence in managing the flow of patients, and his ability to mobilize different frames, to propose a new organization, with a new way to evaluate the acuity of resuscitation patients and involving private hospitals and ambulances.

Discussion

This case shows what organizational innovation can be amid an extreme situation. In the midst of the COVID crisis, the Dynamo cell has worked as a small community of practice, with doctors and nurses having strong and complementary skills. This has led to design and implement an innovative process. The first innovation was from the hospitals' medical crisis director who appointed a physician who did not hold a full-time position, to lead the group. Then, tactical medicine principles translated into hospital context, have allowed for real innovation, by managing the situation they were confronted with in a disruptive manner. Each member of the team brought skills and contributed to the success of this innovation: capacities for thinking outside the box and knowledge of private structures (tactical doctor), knowledge of the internal structure (anesthetist), knowledge of the network of anesthesia interns (second doctor), relational skills to interface with structures outside the hospital (nurses).

While there have been other reported cases of transforming acute care beds into resuscitation beds and transfers to private hospitals, this case is unique in the implementation of a new resuscitation scale and the leadership of the unit to an external doctor. It corresponds to fast

and frugal innovation²³, which “does not mean low quality but instead means the ability to provide safe healthcare in the best way possible under given circumstances and constraints.”

Beyond the various advantages listed above for the patients and the stability of their condition, in a context of scarce resources, the optimization of medical teams and equipment is essential. Dynamo was launched when it was impossible anymore for the SAMU to handle patient transfers because of their major involvement in primary care. It also relieved the services from the search of downstream beds, saving them precious time and energy. The teams were led to develop an unprecedented solution, by conducting a real investigation logic²⁴ : the search for possible solutions, elaborate them progressively by developing the steps, the conditions, by looking for innovative tracks in the different registers of action that tactical medicine or disaster medicine may have listed, but also allow themselves to conceive solutions out of the box, to evaluate them by dialoguing with colleagues and non-medical staff; progressively build an action plan involving remote hospitals, physicians and transporters, and have the capacity and legitimacy to have it accepted and implemented. Previous work on extreme situations has mainly shown creativity and organizational innovation outside of a crisis phase, or a phase of high risk, during the preparation phases²⁵. In crisis, or in the operational critical phase, the actors focus on coordination and the choice of predefined action sequences. It shows the importance of sensemaking in healthcare emergency settings and highlights the key role of coordination practices.

This case also highlights some of the conditions that facilitate the transition from invention (i.e. the new idea) to innovation (i.e. the implementation of the idea). By constantly striving to make sense of it in relation to the need, the Dynamo cell members have allowed the initial idea to be appropriated by all the partners. This appropriation gives meaning and efficiency to the novelty, allows it to be made one's own and to build a usefulness in relation to a project. However, this process requires the abandonment of certain ideas: this was the case for the Dynamo cell as with the transport of patients in buses, for example. During the discussions, these ideas were considered as being too “out of step” with current practices. This case reminds us that any innovation must be confronted with the social order, but cannot be built against practices, at the risk of being dogmatic and not very effective²⁶.

The diffusion of innovations depends on the capacity to connect the members of the network (here upstream structures, downstream structure, ambulance, doctor, surgeon, etc.) around the resolution of the critical situation. The success of this linkage was based on social dynamics:

the personal networks that the physicians had established with the hospital's internal ICU prior to the crisis were mobilized, thus facilitating the recruitment of patients who were discharged and the physicians who provided transport. The articulation with the external services benefited from the personal affinities that the nurses managed to build, at a distance, with the downstream intensive care units, through their daily exchanges, their kindness and above all the respect of the given word. All in all, the technical and relational skills of the members supported the necessary process of translation, making it possible to gather around the same objective the various entities constituting the innovation network²⁷.

Finally, the case shows the importance of the temporal dimension in crisis and extreme situations. During the Covid crisis hospitals faced a double temporal challenge, as they were running both a marathon and a sprint²⁸. Tactical physicians, trained and accustomed to dealing with these different temporalities, allowed the hospital teams in which they were integrated to be able to modify their organization and implement innovative modalities designed to deal with these disruptive situations. It opens avenues to further better link temporal and spatial perspectives in healthcare management, and in particular to enrich our views on patients' flows²⁹.

According to the Dynamo cell members, they acknowledge that they would have been more efficient if they could have better communication processes between the various partners. Some partner institutions were private, other public, other non-profit. There was no unified communication network, nor practices. They had no specific time to join or dedicated instant message system. They sometimes lost time to get in touch with the right people. They also acknowledge that they would have needed to interact more and in an easier mode with the medical crisis direction and the regional health authorities, to better organize in advance, according to the forecasts, and better coordinate with other types of regional actors.

The Dynamo cell was ready to re-activate during the two following Covid waves in Paris area, under the demand of the medical crisis director, but with different nurses as transplants did not stop during the following waves. However, it was not needed, as the hospitals could manage differently the patients' flow: the forecasts were more reliable, and the medical crisis direction could better help to organize. However, anesthesiologists, emergency doctors and nurses have learnt that thinking out of the box and agility was not easy in traditional hospitals services, and that this had to be learnt and prepared. They raised their concern for the possibility to face other crisis in the future and the need to better organize.

The Dynamo experience was short in time. It emerged through specific circumstances: previous collaboration between tactical forces and the hospital; the availability of the tactical doctor and the transplant nurses. Of course, this specific encounter cannot happen strictly everywhere. However, it shows that thinking out of the box, mobilizing resources outside the traditional set, can help to change rapidly and efficiently.

Practical implications

The case analyzed here suggests practical implications. First, regarding crisis and extreme situations in hospitals, it highlights the importance of flow management and the key role of hybrid teams with tactic physicians who have both competences in crisis management and in more classical medicine. While these physicians are not always part of the traditional hospital organization, they can bring their experience and knowledge in crisis management by being integrated into the crisis organization. Moreover, Dynamo unit, incorporated into a larger crisis organization, shows the role of agile and decentralized teams. It reminds that, despite what has been planned or prepared for crisis management, the organization must be adapted to the specificities of the crisis, its rhythm and pace. Improvisation is not disorganization. It is a way to keep flexibility, to adapt existing routines and procedures to the situation, and to be able to innovate under time pressure and resource constraints. To be able to innovate, propose and implement relevant solutions, the crisis units must be composed of members trusting each other, and acknowledged as legitimate by the rest of the people with whom they will interact, in particular the heads of the medical departments more impacted by the crisis. More generally, regarding the ability to innovate in the healthcare sector, this case sheds the light on the role of communities of practices³⁰ with practitioners with different backgrounds and mixing physicians, nurses, paramedics, or other persons with specific competences that may enhance the hospital's perspectives.

Last, the case of Paris Sorbonne hospitals confirms the importance of preparing heads of departments and head nurses to crisis management. The training to crisis this hospital has developed could ease the department's doctors for disruptive solutions.

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