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Construction of the Illness Script of COVID 19: What an Unsettled Learning Curve!

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Abstract

Introduction: Initially regarded as a type of influenza, COVID-19 was later identified as a severe acute respiratory syndrome. However, it soon became evident that COVID-19 was more than just a lung infection and that it was a disease with an increasing number of non-respiratory consequences, such as neurological and vascular issues, as well as clinical manifestations. Clinicians were abruptly faced with a difficult, hazardous, and unusual disease for which they lacked a well-defined and organized clinical script. We aimed to deepen and understand how the COVID-19 illness script was being constructed during the early stage of the pandemic. **Methods:** The study population consisted of residents, chief residents, and attending physicians from different departments. Two focus groups and a one-to-one semi-structured encounter were conducted. The researchers closely analysed the data to identify common themes—topics, ideas and patterns of meaning that come up repeatedly. The transcripts were then thematically analysed using both deductive and inductive methods. **Results:** Two major themes emerged from the qualitative analysis: 1) unsettled conditions of learning, and 2) successive steps and content of script building. Our findings demonstrate the challenging situation that doctors faced in an extremely uncertain environment without any prior knowledge to fall back on. **Conclusion and Discussion:** Clinicians have had to undergo awful levels of pressure as a result of the COVID-19 pandemic, and they have had to rewrite their illness scripts to account for this atypical context. We uncovered several main factors that were essential in script construction: clinical reasoning and decision making in an emotional context and

stressful conditions, unsettled learning processes, and perturbed supervision. In this perspective, the COVID-19 pandemic offers a unique opportunity to examine how an unprecedented constellation of contextual factors may impact the processes and performance of clinical reasoning. Crises are characterized as situations that put institutions in jeopardy of failing, exposing their flaws and strengths and occasionally resulting in institutional change. Therefore, this pandemic gives the opportunity to review how to supervise and teach uncertainty, as well as to emphasize the value of patient communication in the process of the construction of illness scripts.

Keywords

Clinical Reasoning, COVID-19, Illness Scripts

"The future is uncertain...but this uncertainty is at the very heart of human creativity."
Ilya Prigogine (physical chemist, Nobel laureate).

1. Introduction

Script theory proposes an explanation for how information is stored in the mind [1]; in this perspective, scripts can be defined as pre-stored knowledge structures allowing to predict about how a particular event is likely to play out or as shared ways of knowing, interpreting events, and acting in the world [2]. Since interpretation depends heavily on prior knowledge, it seems plausible that the composition and structure of an individual's scripts are key for influencing which signals one attends to and how he acts within the world [1].

Built upon this cognitive framework, the concept of illness script was introduced in the medical literature by Feltovich and Barrows, as organized mental representations of a disease [3]. Illness scripts are structured templates built around the triad of enabling conditions (*i.e.*, patient's background information, like age and medical history), fault (pathophysiology), and consequences (*i.e.*, how the disease manifests itself, in terms of complaints, signs, symptoms) [4] [5]. In addition to knowledge about clinical features of illnesses, scripts also contain knowledge about appropriate actions to take [6]. Each script for an illness is characterized by the set of signs and symptoms it contains, and by the relations that link them. Because of this structure, and their particular set of attributes, they also serve as organizers in the memory [4].

As they repeatedly perform tasks and become experts, clinicians constantly enrich their scripts with new situations and reorganize their knowledge network to do the tasks as efficiently as possible and with the most economic cognitive processes [7].

Thus, maturing scripts may be conceptualized as flexible, richly organized and updated networks of knowledge that allow rapid interpretation and effi-

cient decisions and actions [8]. This knowledge organisation is at the very foundation of clinical reasoning, and is fundamental to the development of expertise [9].

Traditional health professions curricula use to devote a lot of time to the acquisition of biomedical knowledge [10]. Students rapidly develop mental structures that can be described as "rich, elaborate causal networks that explain the causes and consequences of disease in terms of general underlying biological or pathophysiological processes" [4] [10] [11]. As students begin to encounter their first patients, they apply their biomedical knowledge and relate symptoms to concepts in the relevant pathophysiologic networks they have developed. According to Schmidt *et al.*, illness scripts gradually arise when students are exposed to patients, clinical situations and related constraints of time and efficiency [10]. Gradually, biomedical knowledge becomes encapsulated into clinical concepts [10]. In other words, a cognitive reorganisation or *restructuration* takes place, emerging from a kind of knowledge fitted to description and explanation tasks to knowledge structures adapted to clinical tasks, *i.e.*, medical investigations, diagnostic process, treatment, and management [1] [10] [12].

This theoretical framework also provides insight into the differences between junior clinicians and experts ones: thus, student's or resident's scripts are typically poorer compared to those of experienced clinicians. Although rich in pathophysiological aspects, they often lack well-developed and refined "enabling conditions" components [4].

Furthermore, numerous research studies on expertise development in medicine have shown that expert clinicians are not distinguished by their superior problem-solving skills, nor by their enhanced capacity for memory retrieval, but by the content and organisation of their knowledge networks, in other words, by the set of individualized scripts they have develop through learning and experience [9] [13]. More surprisingly, based on talk-aloud protocols of experts and novices, Eva *et al.* have highlighted that differences may emerge not in reasoning strategies but in explanatory ability or confidence [14].

Usually, when there is a perfect or close "fit" between the attributes of an illness script and the components of a clinical situation, interpretation occurs quickly and effortlessly in the form of pattern recognition. On the contrary, when there is a mismatch, a more analytical and slower cognitive process begins [1] [9] [12] [15] [16]. In these cases where clinicians are challenged by abnormal findings or events that violate physiological expectations, they may use their biomedical knowledge to understand the situation and to find pertinent hypotheses through a chain of causal reasoning [5]. It is noteworthy that in such cases, where findings do not fully fit any particular illness script, clinicians are at risk to ignore these misfits, which may lead to biases, such as confirmation biases, premature closure, etc., [17] and ultimately to diagnostic errors.

SARS-CoV-2 was first detected in late 2019. As the etiologic agent of the Coronavirus Disease 2019 (COVID-19), it became a major cause of hospitalizations,

morbidity, and mortality in most of the world. At the beginning considered as a kind of flu, then as a severe acute respiratory syndrome, it became clear that COVID-19 was even more than a lung infection, but a disease with an ever-growing number of non-respiratory complications (e.g. neurologic and vascular) and clinical presentations. Given the dynamic nature and multiple presentations of this virus, numerous contradictory guidelines were published, making clinical reasoning difficult [18]. In a completely unexpected way, clinicians had suddenly to deal with a complex, dangerous, and atypical disease for which they had no clear and structured script.

Experts in clinical reasoning have not failed to highlight the risks of this lack of constructed and stabilised scripts [19]. Thus, most common cognitive biases encountered in the peculiar context of the COVID-19 pandemic have been highlighted [20], such as the mechanisms of premature closure in relation to diagnosing COVID-19 disease [21]. However, to our knowledge, no research has been conducted to explain how these clinical scripts were formed in the minds of clinicians faced with the diagnosis and treatment of this disease.

The goal of this study was to deepen and understand how the COVID-19 illness script was being constructed during the early stage of the pandemic, in a context where guidelines and information were continuously changing. We aimed at exploring how these changes impacted clinician's implicit and complex construction of knowledge and their clinical reasoning process.

2. Methods

2.1. Design

Given the exploratory nature of this research a qualitative study was carried out at the Geneva University Hospitals in Switzerland in the departments of in-patient general internal medicine (GIM), emergency medicine (EM), and intensive care (IC), as these departments were directly involved in the care of patients with COVID-19. A purposeful sampling was preferred; in doing so, we wanted to optimise the relevance and depth of the information gathered by exploring specific experiences and accessing expert knowledge [22] [23]. A general email was sent out to physicians who were part of the GIM, EM and ICU. Eighteen physicians agreed to partake to this study.

2.2. Setting and Participants

The study population consisted of residents, chief residents, and attending physicians from these departments. A focus group of seven residents (3 from GIM, 1 from intensive care (IC), 2 from EM) and one focus group of eight chief residents (5 from GIM, 2 from intensive care and 2 from EM). One to one semi-structured interviews took place with three attending physicians (2 from the GIM and 1 from EM). This approach was chosen to consider the different types of exposure to patients in different settings.

2.3. Data Collection

The two focus groups were conducted by JS & MC via Zoom online meeting platform (Zoom Video Communications, Inc.) and the one-to-one semi-structured encounters were conducted by JS and MC, following the semi-structured interview guide (see annex A). The focus groups lasted for a mean of 64 minutes and the interviews with attending physicians 67 minutes.

The semi-structured interview guide was constructed to explore how a usual illness script is constructed. Focus group discussions are often used as a qualitative approach to gain an in-depth understanding of social issues [24]. Both the focus groups and one-to-one interviews were transcribed verbatim.

2.4. Analysis

We paid attention to the inter-rater reliability of our research, and we made sure to develop a systematic approach, including clear coding frameworks, coder training, pilot coding, statistical reliability checks, and discussions to resolve discrepancies. These steps helped us to ensure that our findings were consistent, rigorous, and credible [25].

The researchers closely analysed the data to identify common themes – topics, ideas and patterns of meaning that come up repeatedly. These types of analysis allow themes to emerge from the data and is the preferred method when studies are of exploratory nature [26].

The transcripts were then thematically analysed using both deductive and inductive methods [26]. Five clinical educators from various medical specialties participated in the study.

During the first stage all researchers (JS, MCA, MC, NJP, and MN) read the four transcripts and independently identified key themes and passages. An initial list of codes was developed using a deductive approach, which was based on the conceptual framework of illness scripts described by Schmidt and Charlin [10] [12] [27] and further inductively enriched during group discussions with (JS MCA MC NJP and MN).

Then, JS, MC & MCA coded independently all transcripts and then cross-checked their codes.

Any disagreements were discussed to achieve a consensus. Transcripts were coded using Atlas.ti software for qualitative data analysis (Software Atlas ti). In the final stage, JS and MCA finished the coding and extracted the quotes from the results and organised the results into themes. All translations from French were done by a native English speaker (JS).

2.5. Ethical Considerations

The Geneva Ethical Committee (CCER) waived a full ethical review of the study. Participants signed an informed consent to have their data analysed anonymously. Participants were free to withdraw from the study at any given time.

3. Results

Table 1 presents sociodemographic data regarding participants.

Table 1. Sociodemographic details of participants.

	Role	Specialty	Gender	Age [yrs]
1	Attending physician	Internal medicine	M	53
2	Attending physician	Internal medicine	M	50
3	Attending physician	Internal medicine	M	43
4	Chief resident	Internal medicine	F	32
5	Chief resident	Internal medicine	F	31
6	Chief resident	Internal medicine	F	34
7	Chief resident	Internal medicine	F	37
8	Chief resident	Internal medicine	F	38
9	Chief resident	Intensive care	M	36
10	Chief resident	Emergency	F	31
11	Chief resident	Emergency	M	34
12	Resident	Internal medicine	M	28
13	Resident	Internal medicine	F	29
14	Resident	Internal medicine	F	28
15	Resident	Intensive care	F	31
16	Resident	Emergency	M	31
17	Resident	Emergency	F	29
18	Resident	Emergency	F	28

Two major themes emerged from the qualitative analysis: 1) the unsettled conditions of learning, and 2) the successive steps and content of script building.

3.1. Theme 1: Unsettling Learning Process

"I feel like I didn't learn about the disease but that it just came bearing down on us."

"We were navigating in trouble waters"

All participants describe a learning curve that was sometimes painful, always challenging, and unusual, as summarized in Figure 1 below.

3.1.1. A Remote Disease, Not Feeling Concerned

At the beginning of the crisis, COVID-19 was seen as a remote disease with low probability to hit western countries. The main worry was then to investigate patients' travels history, but not necessarily to understand the details of the disease. With the arrival of the disease to Italy, it became quickly obvious that every

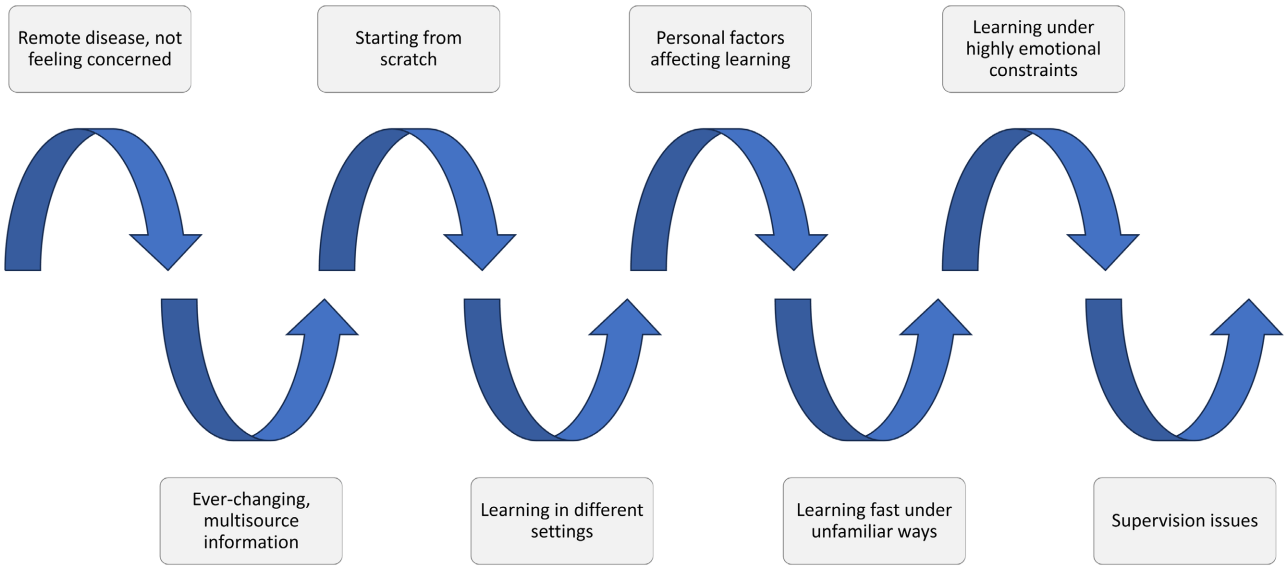

Figure 1. An unsettled learning curve.

physician would have to build sufficient scripts enabling them to manage the many sick patients.

"In my head it was very polarized on China, in fact. (…)The priority was mainly to find out if people had travelled, where they were coming from, so it was mainly a very geographical kind of thing initially." (Chief resident 2, line 26)

"I think I was a bit like many, a bit dismissive; we won't have it in Switzerland at least not to this extent, I wasn't interested, it's when we started to receive phone calls from northern Italy that I gently understood that we were going to take it (laughs) it's not going to be funny. (Attending physician 2, line 15)

3.1.2. Ever-Changing, Multisource Information of Uncertain Reliability

In contrast to the scripts built progressively from organized, reliable biomedical knowledge acquired during their medical studies, the COVID 19 script was built from knowledge or even primarily non-medical contexts.

The first pieces of information constituting knowledge came from different sources—public, lay, professional. They were often uncontrolled, eventually false, and frequently unreliable. For example, residents stated:

"It's true that for me personally, the first image I have is the one on the television where we see a biomolecular image of the virus of COVID, I remember the shape, how round and full it is and all the proteins spikes around it." (Resident 4, line 77)

"I was in the emergency room. The first image, however, it is not the molecule, it's the equipment. It's seeing these images from China, where it was total chaos and finally you could see doors that were closed, shielded, you could see people who were almost like cosmonauts to go and swab." (Resident 1, line 81)

Certain aspects of COVID-19 management depended on political and societal decisions going beyond science but considering other factors, such as economical

or logistical ones.

"So we find ourselves, given the guidelines, saying: "well, we don't really know" then there is hydroxychloroquine, finally the social pressure, will lead to recommend this drug in indications that are not the right ones and then finally two months later the guidelines are that from now on we don't this treatment, but the truth is that we don't know." (Attending physician 2, line 299)

"The problem of the Corona virus is that there was a kind of mistrust because we knew that in fact all decisions had such a political-economic impact. In the end, even we doctors didn't know who to trust (…) What can we allow? What are the economic impacts? In the end, it goes completely beyond medicine, it's a much more of a global thing, which is why it's difficult for us to remain impartial." (Resident 2, line 143)

3.1.3. Starting from Scratch

Many participants contrasted the acquisition of the COVID-19 script with the one of myocardial infarction to express the difficult conditions of learning they endured. In known illnesses, pathophysiology is well known, scripts exist, so that each physician has time, from medical school to graduate and continuous education, to acquire, metabolize, and elaborate them. In the case of the COVID-19 script, the time frame was condensed into months instead of years, since it had to build and grow from scratch, in real time depending on new scientific information and on clinical information from the patients encountered. This context of uncertainty also disrupted the creation of stable scripts.

"(Usually, your clinical reasoning) is acquired by being at the patient's bed and by seeing one, two, three, twenty, thirty, thousand, two-thousand, three-thousand, five-thousand patients. It takes ten years, and you get a bit good at it when you do both, when you confront analytical and intuitive reasoning. (Attending 2, line 65)

"I sometimes had the impression that it was as if I were in my first year of medicine and then I discovered, I don't know, a heart attack for the first time, even if at least I had read the theory before, whereas there, well, I hadn't even read the theory before and then I was faced with something new." (Chief resident 2, line 15)]

"COVID happened quickly (...), we had to build a script where every day this script evolved, well every day or every other day." (Resident 3, lines 127 - 135)

"Our protocols changed almost every day or even several times a day, so we had emails all the time. The protocols weren't always the same, so it was a little hard to keep track sometimes." (Resident 3, 1, line 91)

3.1.4. Learning in Different Settings

Because patients' clinical presentation and needs varied greatly, depending on the setting of care, physicians' scripts were dependent on their working environment, from ambulatory care to emergency room, intensive care, or internal medicine wards. Some physicians were exposed to different setting, thus making their learning process and script construction even more unsettled and complex.

"My perception of the disease was completely different on the intermediate care unit than on the other units." (Resident 1, line 157)

"I think that at the beginning, without any epidemiological criteria, the intermediate care unit didn't understand it at all, it seemed very vague, very polyform" (Chief resident 5, line 131)

3.1.5. Personal Factors Affecting Learning

Personal factors could also influence and complicate the learning process. Many health care providers became ill themselves, contributing to the illness script, but also leading to confusion and anxiety about their own clinical course and consequences.

"And then I had a positive test and it's true that I experienced these symptoms. I did the tour of all my own symptoms to see but it's true that I had this impression of actually discovering the symptoms that were trivialized by the great specialists." (Chief resident 1, line 141)

Learning with the fear of getting the SARS-CoV-2 or bringing it to relatives was another striking issue. Many participants adjusted their social life, not only by refraining to meet vulnerable people, but reducing contact with their families and loved ones at the end of a working shift.

"I have the impression that many of us have had close relatives, even very, very close ones, who were affected by Covid and for whom we had a front row seat. Either because of the impossibility of having contact because they were confined, or because every day we were in front of them and we had to be the caregiver who brought the food, who did the shopping, who did the cooking in addition to our activity. So, I think that there is a very, very emotional tinge beyond the fear of catching it and then not knowing what this disease is because somewhere we were also on the front lines." (Resident 3, line 147)

"As for me, I haven't hugged my mother since March, well, I haven't been back to the family home and that's it. So, I think that this has also had a lot of influence on our behaviour in relation to our loved ones before we go to, for example, to see friends and so on, or for example, before my boyfriend sees his friends, I always ask: "Is it okay if I come?" (Resident 2, line 153)

3.1.6. Learning Fast under Uncertainty

Many physicians had been mobilized with different working schedules, day and night, week-ends and public holidays, making them lose their traditional landmarks.

"Like all the physician assistants in the department, or almost all of them, we were mobilized [clears his throat] all the time for24/, 7 for 7 weeks straight. So, there was no more Monday, no more Wednesday, no more Sunday. And that was the loss of these time references, which was quite destabilizing. But that was really the reality. And in terms of family life, I didn't see my kids during all that time." (Attending physician ER lines 36 – 39)

"So, there's a deprivation of freedom that's certain "but there's no more Mon-

day" (laughter), no more Sunday, there's no more Saturday. So here I came on Sunday and then from that day on, yeah, I admit that every weekend we were there." (Attending 1, lines 229 – 232)

3.1.7. Learning under Highly Emotional Constraints

Because of restrictions, loved ones could barely visit their family in hospitals, so that in certain situations, health care providers became the only support for patients. This also happened during end-of-life stages during which they had to act as intermediates between the patients and their families, sometimes using their own smartphones. Learning had thus to occur during incredibly highly emotionally charged moments, repeatedly interjected into people's intimacy, and potentially leading to emotional exhaustion.

"I experienced things that I have never experienced before because of the absence of loved ones. And I'm still moved when I talk about it because there are people in the background, and these are images that I will keep forever. Excuse me [long pause]. There were people who were in intermediate care or on the wards and who were suddenly not doing so well, and in the end [long pause] they had to go to intensive care, there was no more discussion. And to avoid emergency intubation, the family had to be notified, well, these were patients asking to speak to their relatives. I had to put the phone on speakerphone several times so that people could, that, that, that, (pause) that people could interact with their loved ones and there you witness scenes (long pause) that can be heart-breaking, because it may be people who are talking for the last time, or maybe not. (Long pause) and that exhausted me, emotionally it exhausted me because when it happens once a week it's fine but there it was sometimes several times a day and it really upset me. And I felt like I was invading their privacy, but at the same time who else is there to hold the phone. (long pause). (Attending physician ER,3, line 39)

"I found it very difficult to make this link because we were witnessing very intimate discussions between relatives and the patient, who was often still intubated, and that's also the image I keep of this Covid episode, the emotional distress of the relatives. (Resident 2, line 91)

Paradoxically, despite emotional proximity, building and maintaining relationship with the patients was disrupted by the imposed physical distance, masks, gloves, or gowns, making the usual encounters by which scripts are usually enriched completely reversed.

"I find it very hard to stop shaking hands with patients, wearing a mask and all this equipment puts a big barrier to empathy and to the relationship with the patient. In any case, that's something that I found had a strong impact, I felt like a robot that came in to swab and then there were very factual questions, but the real… the construction of the relationship with a patient who is suffering, who is afraid... (Resident 4, line 185)

Learning occurred by being confronted to burdensome experiences of death, morbidity, vital complications necessitating urgent management, without being

able to predict issues to patients and families.

"The image of patients who were sometimes very hypoxemic without feeling it, surrounded by three or four people dressed like astronauts, and then leaving the room intubated with a central line, an artery line, when they had finally gone home with too much headache, so they hadn't always been prepared for the fact that they were going to sleep for ten days, and that aspect of it left a mark. (Resident 7, line 91)

Learning also occurred while being physically scarred by heat and discomfort under protective materials or skin lesions due to FFP2 masks.

"For about an hour and a half, two hours, and then with the pressure of the mask, which caused a wound via the beginning of an eschar, so that was something that marked me in relation to my colleagues. The impact of the equipment with these people that we/ well, the skin scratches that/ yeah it was, it wasn't nothing as well in terms of yeah...the physical impact we'll say (Resident 4, line 197)

Because of a lack of consensual knowledge, some decisions relied on individual values and convictions, with the burden of explaining uncertainty, and even incapacity, to patients and families, or being blamed by colleagues who would have taken different, personal decisions.

"I, for one of the first times in my life as a senior physician, had my freedom of thought and action taken away." (Chief resident1, line 145)

"But it's true that on the one hand it was very interesting, but there was a very frustrating side, it's true, because there were people who said: "you should have done this, you should have done that, and such and such a treatment and then there you go. I think that over time, in fact, we all did a little bit according to our personal feelings." (Chief resident 2, line 157)

"It was hard to remain neutral, in fact, when we explained it because I think we all had our personal convictions about these treatments and to present it in the most objective way with the state of knowledge we had at the time, it was not always easy." (Resident 7, line 227)

It should be noted, however, that this very specific context also brought some clinicians back into contact with their intrinsic motivations regarding their commitment to care.

"Yes, because there is nothing more motivating than when your work makes sense. But we perceive the meaning much more when we manage to save people. When the guy gets to 90% of the opti-flow oxygen and 4 days later he is reading a book, for the team it is extremely rewarding, you really feel like you're saving lives. (Attending ER, 3, line 67)

3.1.8. Supervision Issues

Mirroring these learning conditions, many participants pointed out the difficulty of supervising in these very specific conditions. Others, however, saw the opportunity to teach new technical procedures, thereby strengthening the skills within the teams.

"I must admit that in supervising young residents in particular, it was difficult. I had a bit of a hard time, I didn't really understand, I would say, the difficulties with the residents because at one point we had three units under supervision, and you couldn't get there, you were running around". (Attending 1 line 269)

"And it's true that it was complicated to have a benevolent and supportive supervision. (Attending 1, line 277)

"In terms of teaching, we've been able to take advantage of, in our intermediate care settings, we very rarely have patients with tracheotomy (…) and there it gives the teams a jump in terms of skills, because it's exposure to those pathologies. It's a more positive effect in terms of training." (Attending ER,3, line 41)

3.2. Theme 2: Successive Steps and Content of Script Building

"In comparison to what is learned in medical school and at the medical faculty, yes, indeed it is completely upside down"

Focusing on the steps of script building three phases could be inferred: first a stage of confusion, then of script organisation and consolidation.

3.2.1. Confusion

Due to different contextual factors developed under theme 1 above, the birth of the script occurred in a confusing way. In addition, it was difficult to build knowledge upon an existing, solid frame. Rather, it was built from scratch, each patient bringing new features of the disease, from an expected severe respiratory disease to a systemic illness involving any system of the human body.

"What surprised me about the first patients I saw was the very systemic nature of the disease, both neurological, of course, but also renal and also dermatological, and also, in short, the whole organism with each time different protocols, we talk amongst us extensively looking for protocols, realizing quickly that it was not a simple pneumonia with an acute respiratory distress syndrome, it's just not that." (Attending 2, line 45)

"It's a kind of blur of information (...) where we've spent hours sitting down and discussing cases, saying: "But could it actually be Covid, or not? So what do we do?" (Resident 6, line 81)

A striking fact was the unexpected, fast evolution of patients towards respiratory deterioration quickly leading to intubation, leading to confusion regarding prognosis and prevention of such issues (from "happy hypoxemia" to intubation).

"And I would say that the patients who were suddenly decompensating in a major way were linked to these RDS tables and the neurological damage that we suspected, I would say, and probably even that the fact of not feeling the signs of dyspnea, the fact of not feeling certain signs that would alert us in normal situations, meant that these patients lasted until they could no longer do so, and that this brutal break that we had. Now, I must admit that on the weekend of March 21st 2020, we saw the patients drop like flies. Everything was going well until a moment when there was no more oxygen and then they decompensated, and they

had to be intubated. And it's true that this was quite characteristic, I think, of this pathology and it's something I discovered, in fact, in the clinic". (Attending 1, line 67)

"We tried to be very reassuring with people and then the next day the patient we sent home thinking that they would be fine. They came back to the emergency room then two days later they were intubated. There were days when I was going to hospitalize patients that the day before I would not have hospitalized and so it's true that this gave an inconsistency in the care that was difficult to manage." (Chief resident, line 149)

Suddenly, all symptoms led to COVID-19 diagnostic hypothesis, despite the possibility of other diseases, leading to confusion and distortion of usual diagnostic reasoning. "*First, swab!*" seemed to have become the predominant way of thinking (or non-thinking).

"As a result, it was very difficult to, well, to affirm or reject certain hypotheses, given that in fact we had no ideas, and in the literature the evidence was still quite meagre." (Chief resident, line 157)

"And even now we don't know. In fact, it's also that, it's that, well, there's no certainty, there's nothing, we were doing systematic screening. We had (…) headaches, chest pains or digestive symptoms... we swabbed everyone, so that doesn't help either." (Resident 2, line 85)

"So, I was following the protocols, even if I didn't understand everything by far, we were navigating in troubled waters, in the sense that we had to follow a line of conduct to be able to manage, and to realize that no one had any idea of what was going on." (Chief resident, line 157)

Confusion also occurred during management reasoning, given the uncertainty about the efficiency of therapeutic agents and the ever-changing protocols of care.

"I find it difficult to really know what has been reliable and how to do it right for the patients. I often thought: "I know very well what this disease is, I don't know what treatment works, what am I going to do for them?" (Chief Resident 4, line 153)

"In any case, for me, these different speeches really delayed a real reflection on my part with regard to patients to such an extent that it was a surreal feeling because I was treating a bunch of patients who were put on their stomachs, but without having any investment in the clinical reasoning and management of these patients." (Chief Resident 1, line 145)

Finally, confusion applied also to the management of supplies: type of mask or gowns to wear in different conditions and settings or packaging of various equipment, to only name a few.

"It was intense… We swabbed every patient and then the protocol changed and we didn't have to use certain protocols and equipment in the emergency room anymore (Resident 2, line 73)

"In my head, I was afraid that we didn't have enough equipment and on top of that, yeah, for me it was an obstacle, that's for sure, in my relationship with peo-

ple." (Resident 5, line 169)

"In the emergency room (…) we lacked protective equipment, that our green coats became thinner and thinner in the first weeks, that we had masks and hand sanitizer that were under lock and key, so there is this emotional tinge too, I think, that characterized the approach of Covid. It was far, far away at first, it was over there in China and all of a sudden it was right here, right in the house." (Resident 3, line 147)

3.2.2. Script Organisation

Since knowledge did not exist, experience with several patients led progressively to a better understanding of clinical features of the disease in terms of symptoms, signs, severity criteria, and clinical course. It became apparent that anosmia, neurological symptoms, or venous thromboembolic disease, for example, were inherent to COVID-19. With experience, and especially by talking with the patients, the criteria of severity and of aggravation risk became better recognized and the indications to various treatments better understood.

"But I would say that I found out the script of the disease with the patients rather than without them. "(Attending physician ER, line 15)

"It's with time and with people's experience, in fact, and what they told us that we started to say: "ah well, ageusia and anosmia are probably also part of the symptoms and then in parallel there were the first papers that came out on the constellation of symptoms related to Covid. But interviewing the patients, it also gave us a little bit of insight into the symptoms and the presentation patterns." (Chief resident, line133)

"It's true that it/ well, I was quite cautious in describing the evolution with the risks of aggravation, which were frequent. There was also this period, Day 7, to Day 10, which was a bit of a fragile period, we'll say, where there were decompensations," (Attending, 2, line 155)

3.2.3. First Elements of Script Consolidation

This phase occurred when the clinicians understood COVID-19 mechanisms sufficiently to be able to relate them to other diseases. For example, endovascular changes, immunological phenomena, hypercoagulable state, all known with other diseases, could be related to other scripts already existing in clinicians' mind. This enabled them to take a step back from each particular patient's history and make more generalizable inferences about the disease.

This script consolidation, however, seemed to happen essentially for more experienced clinicians.

"It's true that it was the observation of the patients that got us thinking about the possible pathophysiology." (Attending 2, line 127)

"I mean, it would have been difficult to say, so I think that it's still the observation that makes you think that and then it's true that you have to remain openminded because if you're too narrow-minded, I think you say to yourself: well, okay, there's a virus, it's a respiratory virus (…) If I had stayed with my initial

idea (laughs), I would have said: "well, it's a virus that gives you colds and probably they have something else, I don't know, a vasculitis (laughs)...". (Attending 1, line 135)

"What can be published in the literature is at risk of being biased, so it's true that we have to be cautious, and I think that it reinforces the fact that clinical experience is a major factor, I would say, in understanding this type of pathology." (Attending 2, line 167)

"So, I guess I don't have a view of the covid patient that is similar to the ones that have worked in primary care medicine it's very different." (Attending physician ER, line 11)

4. Discussion

These results highlight a few key steps in the construction of the COVID-19 illness script, highlighting the contextual elements that made this process extremely challenging. We were also able to highlight the extent to which the process of learning to diagnose and manage this disease has been highly unusual, and disruptive.

4.1. Contrasts According to the Different Levels of Expertise

These results showcase some contrasts according to the different levels of expertise of the clinicians who took part in the research: Attendings were able to adopt a more metacognitive approach and actively develop links and contrasts with their existing scripts in order to build on their COVID-19 script. The hypothesis which can be inferred is that this was made possible because of their expertise and the enriched nature of their illness scripts, but also because they were not "on the front line" and therefore had more hindsight for construction, unlike residents and chief residents who lacked perspective at times. The fact that they had to devote a great deal of time to reorganising services, working teams, etc. allowed, in some respects, the attending physicians to take a step back, which probably made it easier to link up the various elements and enabling conditions of the scripts. On the other hand, the residents and chief residents, because they were "on the front line", were "trapped" in a kind of automatic cognitive functioning in response to the exceptional situation and the ever-changing guidelines and recommendations.

These results corroborate the findings of previous work, showing that experts are those who are able to build rapidly a global representation of the case based on the relational structure of their medical knowledge in long-term memory. This knowledge is structured not only as simple lists of signs, symptoms, and rules, but as a rich and complex network of knowledge tied together by abstract relationships [9] [13] [28] [29]. Durning *et al.*'s research also highlighted differences in information processing: in a recent brain imaging study where participants, were subjected to functional magnetic imaging while they performed a clinical decision making task [30]; Experts (attending physicians)' results showed a more diffuse

pattern of activation potentially reflecting the greater experiences on which they had to draw. Instead, novices [residents] demonstrated greater activation only in the ventral anterior cingulate cortex [30], an area associated with emotional processing [31]. Our results echo these studies.

It was also the attending physicians who emphasised the most the importance of listening to patients, echoing the work of Schmidt, who pointed out that the clinical setting remains the optimal environment for cultivating the development and refinement of illness scripts [10] [32].

We uncovered several main factors which were essential in script construction: clinical reasoning and decision making in an emotional context and stressful conditions, unsettled learning processes, and perturbed supervision.

4.2. Clinical Reasoning, Decision Making Process, and Emotion

Traditionally, clinical reasoning processes and decision making have been perceived as purely rational and cognitive processes needed to evaluate and manage patients' medical problem [33]-[36]. According to the dual process theory, two cognitive systems are simultaneously at play; the first one described as "intuitive", "tacit", rapid and operating on the principle of recognition of a typical configuration of signs, or of similarities with previously encountered similar situations [pattern recognition] [37] [38]. The second one is rather slow, and is described as "analytical", or hypothetico-deductive; it comes from a rational and deliberate judgement based on additional information collected actively by the clinicians [34] [39] [40].

In his "Universal Model of Diagnostic Reasoning" Croskerry acknowledged the influence of affective components in system 1, but not in system 2 [41].

Nevertheless, in the light of what clinicians went through during this pandemic in relation to their clinical reasoning processes, we hypothesise that current clinical reasoning's theories may not sufficiently consider the role of emotions. In this regard, it is worthwhile to note that a number of authors have recently linked emotional intelligence (EI) to clinical decision making (CDM) [42], pointing out that in contexts that are emotionally challenging, clinicians are required to identify and actively manage their own and others' emotions [43]: in particular, when decisions involve conflict or anger, because these emotions may indeed compromise cognitive processes [44]. As a matter of facts, Kozlowki *et al.* found ample evidence confirming that both emotion and cognition are engaged in clinical decision making; as such, emotion constitute a powerful and pervasive driver of clinical reasoning and decision-making processes [42] [44]-[48]. In this perspective, Islam *et al.* highlight the relationship between cognitive mechanisms and social and emotional pressures acting on both 1 and 2 systems of reasoning processes [49]. They have thus identified that the factors contributing to decision complexity include 1) overall clinical picture does not match the pattern, 2) lack of comprehension of the situation and 3) social and emotional pressures [49]. This was indeed the case in the context of the pandemic.

4.3. Stress and Clinical Reasoning

According to Lazarus and Folkman, "a situation is perceived as a threat and thus stressful when the demands of the situation are appraised as exceeding the available resources, and thus endangering well-being or the attainment of an important goal" [50].

Our research clearly confirms this perception and its related risks; our results are congruent with recent research on this topic among health professionals during the pandemic [51]-[56]. They also have the potential to highlight the clinical reasoning issues or pitfalls that these situations can generate such as risks of *premature closure* (that is the tendency to stop considering other alternatives once a diagnosis is reached, (eg. "*everything is COVID*"). Our previous research already identified this risk [57], and are consistent with the results of Pottier *et al.*'s 2013 studies, which suggest that stress may be associated with the breadth of reasoning of learners, as they appear less likely to report signs of differential diagnoses, or consider other alternatives [58].

4.4. Unsettled Learning Processes

Our results highlight the difficult position expressed by the chief residents and residents, of having lost all their references, and feeling that they had to re-learn everything in a context of great uncertainty, without well-established knowledge to rely and build on.

Uncertainty is a key feature in medical practice and has been strongly associated with stress and fear [59]. Uncertainty in clinical reasoning arises from case complexity or ambiguity, a lack of information or experience with specific cases, and the complex and emergent relationship between patient and physician [60]-[62]. All these components were present in the situations encountered and described by our participants.

Ramani *et al.*' recent work suggest that contextual factors may introduce an additional level of ambiguity or complexity that may impede the reasoning process, creating even more uncertainty [63] [64]. As pointed out in their prior work, contextual factors may also increase cognitive load, thus constraining the use of working memory [64]-[67].

Denial is a common defensive mechanism toward uncertainty [68]: in this perspective, premature closure may be considered as a failing attempt to impose a higher level of certainty on a situation (such as dealing with the COVID) than that situation is ready for [69]. This is the view of Guenter, who emphasises the perspective of the learner, experiencing uncertainty: learners indeed tend to avoid situations that will reveal uncertainty. Years ago, Fox identified that uncertainty may be either the result of acknowledging limitations in current medical knowledge, or incomplete mastery of that knowledge base [70]. Distinguishing between personal lack of knowledge and the limitations of present medical knowledge seems to be the main source of anxiety for junior clinicians [69] and we assume that this was indeed the case in the context we describe.

4.5. Supervision

Our results also highlight how difficult supervision was during the COVID waves. They mirror those of recent studies indicating that during these times of stress and increased workloads, clinicians prioritised clinical duties and responsibilities over clinical supervision [71]; understandably, the dual role of clinician and supervisor have been extremely difficult to juggle in such circumstances [72]. Recent studies have also shown that the pandemic has impacted several parameters of clinical supervision, such as frequency and duration [73].

However, it is crucial not to forget the value of supporting and sharing the construction of high-quality illness scripts, especially in a such a context of uncertainty. Supervisors can help junior clinicians at multiple levels, such as recognize uncertainty, manage uncertainty, communicate uncertainty [to patients and families], and normalize uncertainty [74]. Role playing is a highly effective tool for all levels of clinicians and a good opportunity to explicitly discuss uncertainty. Using structured frameworks such as the SNAPPS [75] and the ICU-PAUSE framework may be helpful to encourage discussion and regulation [76]. Other authors also suggest that supporting cognitive switching between System 1 and System 2 helps clinicians effectively manage complex clinical reasoning [49].

Many others strategies have been reported in order to improve the quality of clinical reasoning and support clinicians facing uncertainty; Guenter mentions the main ones, that are; *Tend to emotions*, (encourage clinicians to have self-awareness of emotional response, and a deeper understanding of the triggers for that response) *Slow down for clinical reasoning* (identify that it is time to abandon pattern recognition and go back to the hard work of step-by-step hypothesis testing) [77], *Explore certainty within uncertainty* (Not to be defeated by what one does not know, but to be skilful in identifying and describing what we do know and what we are confident about) and finally, *Join with the patient* (move in *relation with* rather than to *control* the patient). This last strategy draws on the familiar territory of patient-centred care [78], which has positive effects on satisfaction and on health outcomes [79] [80].

In such conditions, clinicians may be reminded to *disclose their own uncertainty* to the patients; to *think out loud* with them following the analytical clinical reasoning process; this involves reframing the problem together with the patient, so that it is less about arriving at a definitive diagnosis or treatment, and more about a partial explanation, a partial plan of action, and a commitment to be in it for the long term. We found this approach in our results, more specifically in the attending physicians' discourse.

To conclude, we feel as important to draw a link with the framework of situated cognition theory which we believe to be of great interest. *Situated cognition theory* [81] suggests that learning and performance are shaped by and inseparable from the contexts of human behaviour, cultural and social practices, such as clinical ones [82]. As studies of clinical reasoning have traditionally been inspired by theories that place emphasis on clinical reasoning residing in the mind of an individ-

ual clinician at a particular time [36], situated cognition theory considers reasoning as emerging dynamically from the specifics of the situation [64] [67]. In this perspective, the COVID-19 pandemic offers a unique opportunity to look beyond the mind of a single clinician and examine how an unprecedented constellation of contextual [situational] factors could not only impact the performance of clinical reasoning, but could also potentially lead to errors [21].

Thus, to make the link with the learning curve and the progressive construction of the illness scripts that we described in our results, situated cognition theory may help to highlight how clinical reasoning processes may therefore be influenced by changes in the physician's body and/or the environment. This continually changing, stressful environment, as described by our participants, has the potential to unduly influence the generation of early diagnostic hypotheses, or lead to incomplete or incorrect data collection, for example. These results are consistent with the work of Boyle [21] and recent research emphasising that situated cognition theory could serve "as a fecund vehicle to learn new strategies to mitigate error within dynamic teams and systems" [21] [81] [83].

5. Future Research

Our results have highlighted the beginning of the illness script construction. More research is needed to explore how this script evolves and stabilizes in the years to come.

Furthermore, we hypothesise that this illness script was not constructed in the same way by family doctors in practice who saw patients suffering from COVID-19 but presenting another constellation of symptoms. It would be interesting to contrast these different constructions of the script.

6. Strengths and Limitations

A clear limitation was that all focus groups were organised through a virtual online meeting platform (© Zoom). Therefore, it was hard to integrate in the interviewer's analysis the body language of participants. As all focus groups were in small groups all physicians were wearing masks including for the semi-structured interviews, again giving us access to less body language and micro-expressions.

Another limitation was that the people who agreed to partake in this study were interested by the topic and the process of being part of the research, which might not have been representative of the whole hospital. However, this can also be viewed as a strength as most participants expressed how useful these moments were to share amongst peers, as these were few and far between during the "crisis mode at the hospital". Most participants expressed how taking a reflective break to give meaning to their clinical practices allowed them to process a lot of what happened on the wards. Also, the heterogeneity of the focus groups (ER, ICU, and the internal medicine COVID wards) enabled professionals to learn about the perceptions of other colleagues, which was rare during these times.

The representativity of different physician experiences in each one of the e ER,

ICU, and internal medicine COVID wards, was another strength.

7. Conclusions

The COVID-19 pandemic has thrown physicians into a traumatic care experience and forced them to develop their illness scripts for this disease in an unusual way. They learned to diagnose and manage this disease while being deeply involved themselves and having to deal with extremely high levels of emotion, uncertainty, and ambiguity.

Crises can be defined as events that challenge the survival of institutions, thus highlighting their weaknesses and strengths, and sometimes leading to institutional change [84]. In this perspective, this time of crisis can also serve as an opportunity to revisit our teaching of uncertainty, supervision practices, and remind ourselves of the importance of communication with patients while developing illness scripts.

Several strategies may be considered to mitigate the contextual challenges and to reduce cognitive errors within a clinical system [18]. It seems essential to alleviate pressure on the clinical community, including trainees, particularly during periods of uncertainty. This can be achieved by decreasing workload, considering time constraints, enhancing clinical reasoning skills through virtual training methods, and promoting teamwork. Complex cases, such as critically ill intensive care patients with multi-organ complications, should not be managed by a single individual; instead, a structured collaborative clinical reasoning process should be implemented to facilitate team-based decision-making [85].

To accomplish these goals and mitigate burnout or staff shortages—which can negatively impact the cognitive performance of the entire clinical team—it is essential to develop a well-structured human resource management system. This system should be flexible and prepared for activation in future health crises, ensuring the long-term sustainability of the workforce both during and after such emergencies [18].

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Annex A

Interview Guide for Focus Groups/Or Semi-Structured interview

Questions

1. How did you construct your representations/images of the disease?

Prompts:

- *When did you start to wonder whether a patient could have had COVID-19?*
- *On what basis did you start to ask yourself this question?*
- *At least 2 months passed between the erupted of COVID-19 in China and the arrival in Switzerland [first case in CH: 25.02; first case in Geneva: 27.02].*
- *Do you remember how you started to think about this disease?*
- *Do you remember your first triggers/tilts, your first associations [i.e. everything that led you to think about a diagnosis of COVID-19], the first 'images' you had of this disease? What factors contributed to the formation of this image?*

2. What made this "construction process easier" or "made it easier to build upon"?

Prompts:

- *Why?*

- *What factors came into play?*
- *A lot of different information about the disease...*
- *From whom and where? How did you manage to sort it all out?*
- *Was the information solid or not?*
- *At what point did certain data become solid/ solidify your script, and why?*
- *How were you able to link them to the other information?*

3. What made it so difficult to build on?

Prompts:

- *Why?*
- *What factors came into play?*

4. How does this construction differ from the way you have constructed your representations/images of other illnesses [e.g. heart attack]?

5. Now, 4 months later, what are the differences with the image of the disease you had at the beginning?

Prompts:

- *Has the script been enhanced or evolved or changed?*
- *Has it been steadied?*
- *If so, how?*
- *Is it still being enriched upon or not?*

6. How have these representations/images of the disease [COVID-19] influenced:

Your work with teams and colleagues?

Your work and communication with patients and their families?

Prompts:

- *How did your script influence your work in terms of the information given to families and patients - e.g. how easily you were able to give information about the duration/treatment/prognosis of the illness?*
- *As a result of the possibly more limited interaction with the patient, did interpersonal/inter-team communication become more important?*
- *Did the experience of others feed into your script?*

7. How did the fact that COVID-19 is a contagious disease influence:

Your relationships with patients

Your personal life, your relationships with those close to you

Prompts:

- *Fear of transmission [fear for yourself, fear for others, e.g. family]?*
- *Could this have influenced your approach?*
- *Were interactions with patients more limited?*
- *Did this influence the way you created a script?*

8. **How do these reports differ from a more traditional illness [such as a heart attack]?**