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► **Citation:** Hiller M, Spohn K, Hering R, Hohn A, Lahm A, Bergrath S, et al: Multi-professional and interdisciplinary solutions for the sustainable optimisation of intensive care capacity use. *Anästh Intensivmed* 2021;62:385–395. DOI: 10.19224/ai2021.385

#### Acknowledgements

Very special thanks to the following colleagues for their participation in the online survey rounds with a variety of measures described in great detail, and their constructive elucidation and classification: Prof. Simone Scheithauer, Universitätsklinikum Göttingen; Prof. Christian Karagiannidis, Klinikum Köln-Merheim; Prof. Jürgen vom Dahl, Kliniken Maria Hilf; Dr. Robert Deisz, Philips Healthcare DACH; Markus Thur, Kreiskrankenhaus Meckernich; Dr. Thomas Baltus, Thomas Böcker, Guido Leinders, Heinz-Gerd Schröders, Städtisches Krankenhaus Heinsberg; Dr. Gereon Blum und Dr. Bernhard Heising, Krankenhaus Düren gem. GmbH.

#### Notice

Excerpts of this publication were summarised and published as *Dtsch Arztebl* 2021;118 (1):A18–22.

#### Conflicts of interest

M.H.: External salaried PhD candidate at Philips Medizin Systeme Böblingen GmbH, Service department, in cooperation with Erasmus University of Rotterdam, The Netherlands.

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#### Keywords

COVID-19 – Critical Care – Data Management – Communication – Workforce – Intersectoral Collaboration

## Summary

**Starting point and problem:** The aim of our research was to identify structures and new forms of collaboration which were established during the COVID-19 pandemic and possible continuation of which beyond the pandemic might provide additional benefit to everyday clinical practice.

**Methods:** A three-stage survey of 22 experts (senior physicians, hospital hygienists, nurse managers and representatives of hospital management) from six municipal hospitals situated in a hotspot region was used to identify measures pertaining to management of intensive care capacity and patient flows, as well as to the flow of information and data. Those measures were rated using a Likert scale. Results were subsequently structured in the setting of a round table.

**Results:** Over the course of three evaluation stages – which saw high response rates of 82–91 % – the 43 initially identified measures were reduced to 14 which received the highest levels of approval. At the round table, 10 of those 14 most relevant measures were categorised in one of three fields of action: 1) interdisciplinary management of patient flows, 2) flexible human resource (HR) concepts and 3) establishing new communication and information structures. Practical examples were formulated for each of the three fields of action and have in the meantime proven their value in everyday clinical practice.

**Conclusions:** Using a structured decision process combined with holistic

## Multi-professional and interdisciplinary solutions for the sustainable optimisation of intensive care capacity use

### Lessons learned in a crisis – from the COVID-19 pandemic to the new normal in everyday clinical practice?

reflection on the organisational structure of hospitals, strategies were identified which had proven themselves under extreme conditions and which should be implemented in everyday clinical practice outside the setting of the pandemic. The flow of patients, resource management and communication structures can be influenced beneficially by closer interdisciplinary and intersectoral collaboration within a “new clinical routine”.

The practical examples and recommendations put forward for each of the fields of action could provide an impulse for other healthcare providers to examine their HR concepts and communication strategies as well as their management of care capacities and patient flows, adjusting to the challenges of new everyday realities with interdisciplinary and intersectoral approaches.

## Introduction

From the start of the pandemic, intensive care capacity was increased across the country in a matter of weeks, as shortfalls threatened in isolated hotspot regions, and the number of patients requiring intensive care was expected to rise dramatically. Hospitals had to acquire monitors, ventilators, medical imaging devices and laboratory equipment, and fulfill technical requirements for intensive care beds. Specialised staff had to be recruited and trained, hygiene measures reconsidered, information and patient data networked, and patient-, staff- and

workflows restructured. A good number of these measures not only had to be implemented promptly but were then put to use under extremis in everyday clinical practice to treat patients both with and without SARS-CoV-2 infections in a timely and impartial fashion.

Based on this experience, the aim of our research was to identify examples of best practices which were established during the pandemic, and extension of which beyond the pandemic would benefit everyday clinical practice. This was to be achieved in the context of an expert round table. Special attention was directed towards such measures related to managing intensive care capacity, intrahospital and intersectoral patient flows, and those measures information and data management. For each measure which was recommended for continuation, specific examples were formulated which could assist other hospitals, but also regional networks or associations, in more efficient use of acute care resources, achieving better control of patient flows or more productive information and data flows. With that, patient safety and tailored care can be enhanced in everyday clinical practice and maintained even in emergency situations.

An interdisciplinary working group accrued from municipal hospitals in the Heinsberg, Düren, Mönchengladbach and North Eifel districts was involved in the project. Following an outbreak of COVID-19 in the aftermath of a carnival event in Spring of 2020, these regions were amongst the first hotspots with more the 2000 confirmed cases.

## Methods

A three-stage Delphi survey technique employed over six weeks during August and September of 2020 involved 22 experts (senior medical staff, hospital hygienists, nurse managers and representatives of hospital management) who were invited to respond via an online survey platform (Welphi.com). In the first round of the online survey the participants were asked to identify those measures

established during the pandemic and pertaining to **management of intensive care capacity and patient flows**, as well as to the **flow of information and data**, which they considered worthwhile carrying forward into everyday clinical practice. In a first step, those measures were described by the participants based on a predefined questionnaire. In a subsequent step, duplications were removed by project management, and similar responses were bundled. In the second round of the survey, participants were presented with an aggregated list of suggestions made during the first round, and asked to appraise individual measures. In the third and last round those measures were then rated by the members of the expert group on a 6-stage Likert scale (Fig. 1).

The results obtained during the third round of the online survey were used as the basis for detailed appraisal and drafting of recommendations in the context of a face-to-face workshop (round table). Those measures which had gained a simple majority (approval rating of >50 % on the Likert scale) in the categories “measure to be retained in everyday clinical practice”, “measure to be tested in everyday clinical practice for a limited period” or “measure to be retained as an emergency concept for pandemics and crisis situations” were selected for further prioritisation. In addition, those measures which gained >66 % cumulative approval rating in the categories “measure to be retained in everyday clinical practice” and “measure to be tested in everyday clinical practice for a limited period” were included. The measures selected this way were considered in-depth in the context of a moderated debate. Using various prioritisation techniques, they were evaluated within a matrix with respect to their impact and ease of implementation, as well as urgency and timeframe for adoption. The measures were subsequently grouped into fields of action which contained those measures deemed relevant by the experts to be promptly implemented in everyday clinical practice. Finally, realistic examples were devised for each of those fields of action.

## Results

### Results of the online surveys

In the first round of the online survey, which saw a response rate of 91 %, 43 measures were put forward. After duplicates had been discarded and similar proposals had been consolidated, 30 measures were entered into the second round of the survey. That round saw a response rate of 82 % and numerous comments being made on the listed measures; three additional measures were suggested. No measure was determined by consensus >25 % to be “unsuitable”. The 30 measures entered into the second round were subsequently entered into the third round of the survey (which again saw a response rate of 82 %) together with the three additional suggestions emanating from the second round. Measures suggested in the second round also led to the introduction of a previously unanticipated sixth category on the Likert scale (“measure to be retained as an emergency concept for pandemics and crisis situations”).

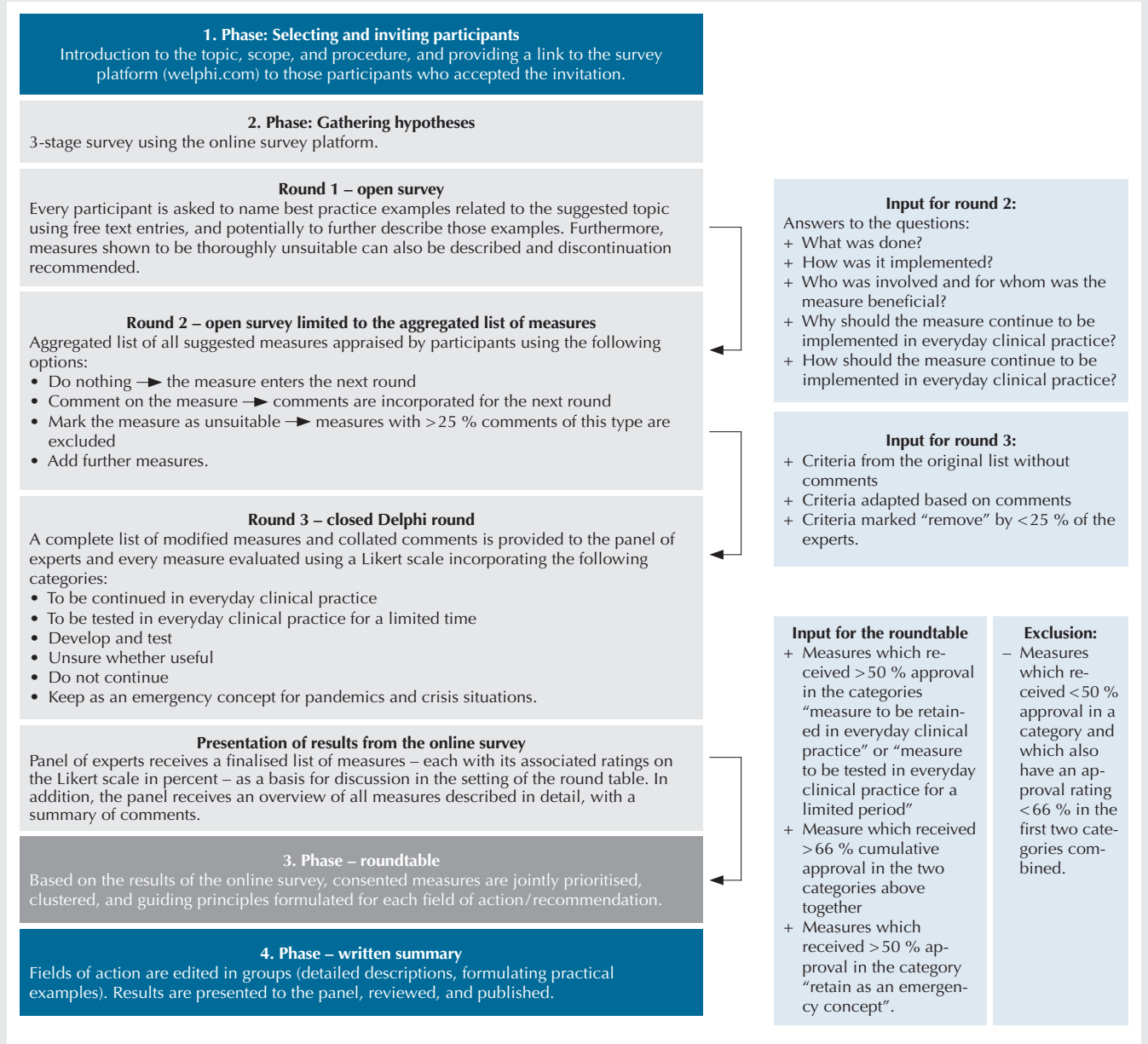
As before in the second round, no measures were classified “unsuitable” on the Likert scale in the third round of the survey. 14 measures attained either an approval rate >50 % in the “measure to be retained in everyday clinical practice”, “measure to be tested in everyday clinical practice for a limited period” or “measure to be retained as an emergency concept for pandemics and crisis situations” categories, or a cumulative approval rate of >66 % across the first two aforementioned categories, and were forwarded to the roundtable for in-depth consideration (Fig. 2,3).

### Results of the round table

All 14 measures were evaluated with regard to both their impact (added value) and feasibility of their implementation in everyday clinical practice, and represented in a matrix (Fig. 4).

10 of the 14 measures were grouped into fields of action at the discretion of the panel of experts, and a guiding principle was formulated for each field (Fig. 5).

Figure 1



Schematic representation of the overall process and the methodology employed, with a detailed look at the Delphi survey.

For each field of action, the following section presents case vignettes and practical examples taken from clinical practice.

### Practical examples for measures included in fields of action

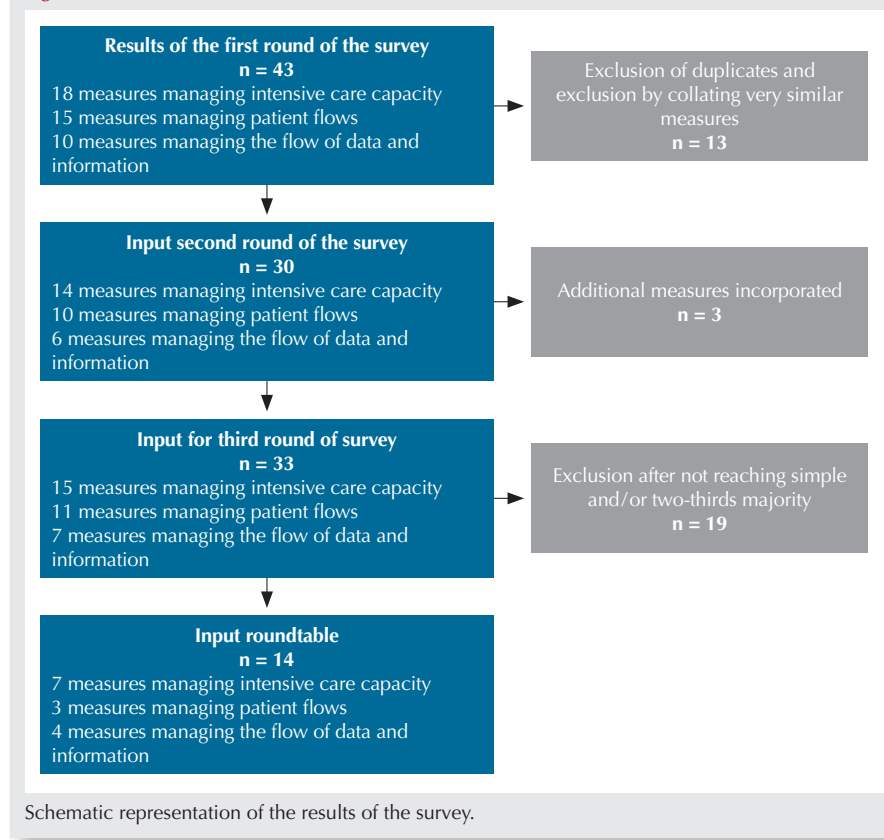
#### Field of action: “interdisciplinary management of patient flows – the right patient at the right time in the right place”

##### Creating a Stop-Triage-Point prior to entering A&E

A floor marking in the ambulance entrance and just before entering acci-

dent and emergency (A&E) was established as a Stop-Triage-Point for patients arriving by ambulance (Fig. 6). Here, early management of the patient and their treatment pathway was directed by a registered nurse using a standardised systematic questionnaire (Fig. 7). This made it possible to separate potentially infectious patients from those with non-infectious disease at an early stage,

Figure 2



and for specially trained staff to provide care for those potentially infectious patients in a separate location (A&E 2) equipped with appropriate technical facilities.

#### Focused capacity-dependent management of patient flows and urgency-based weighting

Emergency physicians in the accident & ED used a newly introduced checklist (Fig. 8) to record parameters based on history, clinical, laboratory and radiologic findings; patients were triaged into green (out-patient care), orange (in-patient care) and red (intensive care) categories based on those parameters, and handed over for appropriate on-going care.

#### Early determination of treatment goals in A&E

Early evaluation and determination of treatment goals during the A&E phase of patient care made it possible to put

individual patient's wishes into practice and preserve intensive care resources. A case vignette from Mönchengladbach [1]: A 70-year-old male presented to the ear, nose and throat outpatient clinic complaining of recurring epistaxis. He collapsed whilst being examined. Following successful cardiopulmonary resuscitation and once a cardiac cause had been ruled out, computed tomography of the chest was performed. This demonstrated bilateral pulmonary infiltrates characteristic of COVID-19 disease (CO-RADS 5) [2]. The situation was subsequently discussed in A&E with the patient's son – who held power of attorney – to determine the goals of treatment. Taking into consideration multiple pre-existing conditions, advanced dementia and honouring the patient's presumed wishes, palliative care administered on an isolation ward was determined to be appropriate and intensive care was forgone.

#### Determining treatment goals in intensive care

Using a standardised document based on recommendations made by the Ethics Section of the German Interdisciplinary Association for Intensive Care and Emergency Medicine (DIVI) [3], a system of determining treatment goals within 72 hours – incorporating the patient's (presumed) wishes – was implemented. On the one hand, this made for definitive treatment recommendations and provided a clear-cut treatment pathway; on the other hand, it avoided treatment not beneficial to the patient, such as inappropriate intensive care. This preserved resources, making them available to other patients.

#### Optimising the flow of intensive care patients

Using a collaborative, multifactorial approach, an intersectoral analysis was performed to determine the causes of constraints on capacity. This showed common causes such as missing or non-standardised criteria for discharge from intensive care, beds closed due to isolation of patients or through lack of staff, medical complications, or a lack of beds or staff on regular wards. To better manage the flow of patients, criteria were developed for discharge from intensive care and harmonised with the admission criteria of the receiving wards, providing for a transparent and safe transfer process.

#### Field of action "modern human-resource concepts safeguarding patient care and staff satisfaction in highly specialised fields of acute care"

##### Creating staff pools providing flexible support on intensive care units and as a concept for managing staff shortages or increasing staffing levels

8 registered nurses acquired from regular wards were introduced to intensive care in the context of a 6-hour complementary training session consisting of three modules on an interdisciplinary intensive care unit with 24 ventilator beds. Those modules covered monitoring, infusion devices and ventilation [4]. Subsequently, these nurses continued



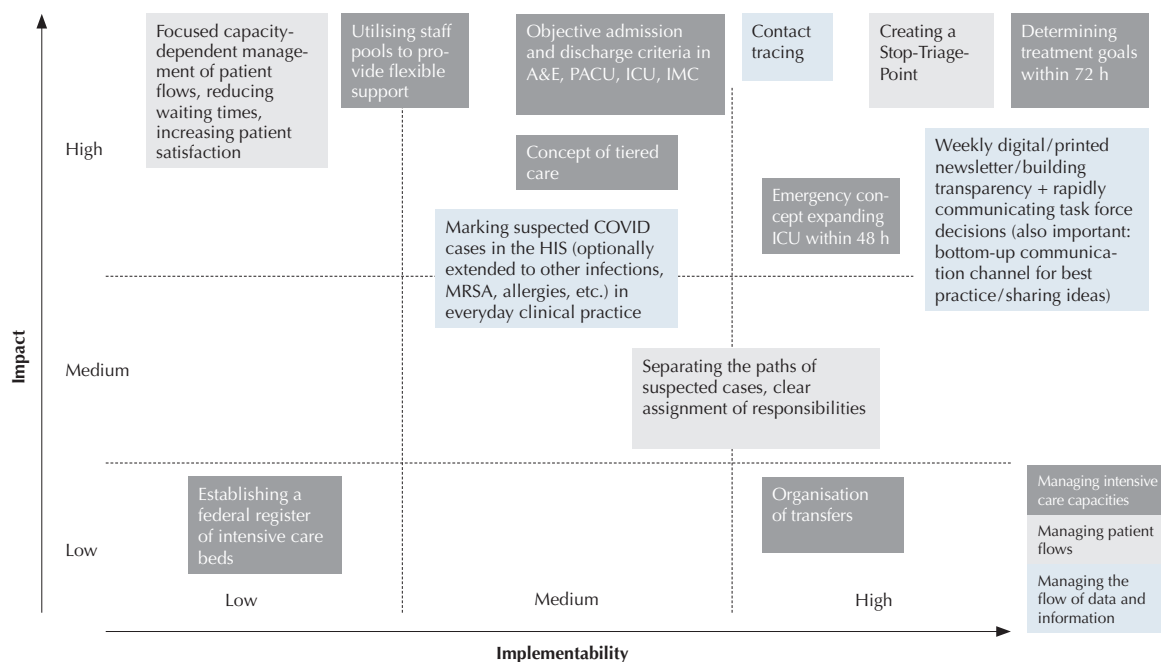
Figure 3

	Managing intensive care capacity	Managing patient flows	Managing the flow of data and information
Measures	<ul style="list-style-type: none"> <li>Define goals as recommended by the sepsis guidelines, treatment goals on ICU defined within 72 h at the latest to avoid unwarranted intensive care (77 %/65 %)</li> <li>Interdisciplinary specification of objective admission and discharge criteria for the various areas of acute care to optimise resource allocation and to avoid primary and secondary inappropriate admissions (83 %/65 %)</li> <li>Continue the concept of tiered care (high care, low care, rhythm monitoring) and converting available space for use in different tiers (–/53 %)</li> <li>Create staff pools to provide flexible support on ICU and as a concept for staff shortages and increasing staffing levels during high occupancy phases (88 %/–)</li> <li>Place the organisation of transfers in the hand of one person with interdepartmental responsibility, create an SOP for patient transfers (89 %/71 %)</li> <li>Establish a federal register of intensive care beds with automatic “live” display of the current bed situation to aid in managing occupancy and use of available ICU beds (–/59%)</li> <li>In pandemics/crisis situations: establish an emergency concept for expanding ICU capacity into operating theatre areas within 48 h (–/59 %)</li> </ul>	<ul style="list-style-type: none"> <li>Remove third party areas and outpatient clinics from A&amp;E to ensure separate pathways for patients with suspected infections (–/59 %)</li> <li>Focused, capacity-dependent management of patient flows, weighting based on medical importance and urgency (–/53 %)</li> <li>In pandemics: create a “Stop-Triage-Point” for emergency services, using a standardised questionnaire administered by a nurse prior to entering A&amp;E; create a second A&amp;E with isolation rooms in a separated area (82 %/53 %)</li> </ul>	<ul style="list-style-type: none"> <li>Retain information policy and communication as an important management tool for creating transparency and encouraging corporate culture and employee engagement (83 %/71 %)</li> <li>In pandemics: regular status meetings and decision-making, and rapid dissemination of proficient information to staff via established communication channels suited to the situation (–/59 %)</li> <li>Implement an organisational structure to record SARS-CoV-2 positive staff, patients, and their close/proximate contacts in accordance with RKI guidelines (contact tracing) to ensure the health of staff and to efficiently manage staff availability (71 %/–)</li> <li>Provide for markers in HIS to directly mark and trace suspected COVID cases (71 %/53 %)</li> </ul>

Measures listed for in-depth review in the setting of the round table: results of the adapted Delphi process portraying measures per field of action (managing intensive care capacity; managing patient flows; managing the flow of data and information) and the approval rating in percent as ascertained from the Likert scale (consensus to “retain the measure in some way” > 66 % [“measure to be retained in everyday clinical practice” + “measure to be tested in everyday clinical practice for a limited period”]/consensus in one category > 50 %).

ICU: intensive care unit; SOP: standard operating procedure; A&E: accident & emergency; RKI: Robert-Koch-Institute; HIS: hospital information system.

Figure 4



**Impact analysis:** Evaluation of measures within a coordinate plane: y-axis = impact/added value of the measure in everyday clinical practice; x-axis = implementability of the measure in everyday clinical practice, colour-coded by field of action (see bottom right of the fig. for legend).

Figure 5

<b>“Interdisciplinary management of patient flows – the right patient at the right time in the right place”</b>	<ul style="list-style-type: none"><li>• In pandemics: create a “Stop-Triage-Point” for emergency services, using a standardised questionnaire administered by a nurse prior to entering A&amp;E; create a second A&amp;E with isolation rooms in a separated area</li><li>• Focused, capacity-dependent management of patient flows, weighting based on medical importance and urgency</li><li>• Interdisciplinary specification of objective admission and discharge criteria for the various areas of acute care to optimise resource allocation and to avoid primary and secondary inappropriate admissions</li><li>• Define goals as recommended by the sepsis guidelines, treatment goals on ICU defined within 72 h at the latest to avoid unwarranted intensive care</li><li>• Continue the concept of tiered care (high care, low care, rhythm monitoring) and converting available space for use in different tiers</li><li>• Place the organisation of transfers in the hand of one person with interdepartmental responsibility, create an SOP for patient transfers</li></ul>
<b>“Modern human-resource concepts safeguarding patient care and staff satisfaction in highly specialised fields of acute care”</b>	<ul style="list-style-type: none"><li>• Create staff pools to provide flexible support on ICU and as a concept for staff shortages and increasing staffing levels during high occupancy phases</li></ul>
<b>“Implementing situational communication”</b>	<ul style="list-style-type: none"><li>• Retain information policy and communication as an important management tool for creating transparency and encouraging corporate culture and employee engagement</li><li>• In pandemics: regular status meetings and decision-making, and rapid dissemination of proficient information to staff via established communication channels suited to the situation</li><li>• Provide for markers in HIS to directly mark and trace suspected COVID cases</li></ul>

Three fields of action: consolidated measures and guiding principles for each field. Recommended for continuation in everyday clinical practice.

Figure 6



Floor marking in the ambulance entrance to A&E. Source: Julia Sellmann Photography.

to “on the job” training in the context of care teams consisting of one experienced critical care nurse and one regular nurse with complimentary training, supervised by the head nurse and senior physician [5]. After just a few days, these newly trained members of staff were able to disburden regular critical care staff and to work independently under supervision. In this way, it was possible

for a team of one critical care nurse and two regular nurses with complimentary training to provide supervised care for four patients.

**Common staff and induction concepts for interdisciplinary emergency care**

A pre-existing common personnel concept and induction programme for medical staff, covering interdisciplinary emergency care in A&E and medical intensive care units proved itself in relation to quantitative and qualitative staffing capacities in the early phases of the pandemic. The concept entailed an initial four-week phase consisting of a structured introduction to A&E and resuscitation room care, and included user training on medical devices, airway management training in the main operating room (2 weeks) and basic training in medical intensive care, as well as a one-day European Resuscitation Council Immediate Life Support course. In a second 4-week phase, staff were familiarised with the medical intensive care unit and partook in an Advanced Life Support course. A common duty rota conveyed increased reliability and made it possible to provide intensive care within A&E following the initial resus-

citation room phase and whilst awaiting decisions regarding treatment goals and/or the availability of an appropriate bed and staff.

**Field of action “Implementing situational communication”**

**Establishing a multidisciplinary expert group**

At the start of the pandemic, a multidisciplinary expert group was established, initially meeting daily. Decisions and measures taken by the group were communicated to staff within a small number of hours in the shape of brief minutes circulated via the intranet. In addition, minutes of the meetings of the emergency task force, directives, SOPs, checklists etc. were immediately made available to all staff via a location accessible to all – ideally the intranet – or distributed via the hospital’s e-mail system. Where required, receipt was confirmed by recipients. This ensured all staff were rapidly provided with clear and comprehensive information. Offering bottom-up communication into the expert group ensured that numerous valuable suggestions from various disciplines were implemented in a practical manner. Furthermore, regular briefings within departments and units were a pre-

Figure 7

**1. Has the patient suffered any of the following symptoms in the past 14 days?**

• Fever	<input type="checkbox"/> yes	<input type="checkbox"/> no
• Cough/otherwise unexplained respiratory symptoms	<input type="checkbox"/> yes	<input type="checkbox"/> no
• Tiredness	<input type="checkbox"/> yes	<input type="checkbox"/> no
• Sore throat	<input type="checkbox"/> yes	<input type="checkbox"/> no
• Altered sense of taste	<input type="checkbox"/> yes	<input type="checkbox"/> no

**2. Have they had contact with a confirmed or suspected COVID case or spent time outside the country in the past 14 days?**

↓

High risk of infection  
A&E 2 ☐

↓

normal risk of infection  
A&E 1 ☐

Signature \_\_\_\_\_

**3. Does the patient have any of the following risk factors?** ☐ yes ☐ no

☐ Hypertension / ☐ CAD / ☐ COPD / ☐ Diabetes / ☐ Malignancy / ☐ Other

**4. Type of presentation**

☐ Outpatient / ☐ Elective admission / ☐ Emergency admission

**5. Details of planned procedure**

• Low-risk procedure <input type="checkbox"/> (e.g., sonography, radiology, outpatient consultation)	• High-risk procedure <input type="checkbox"/> (e.g., endoscopy, surgery requiring intensive care, chemotherapy)
• Urgency of the procedure	
<input type="checkbox"/> Emergency <input type="checkbox"/> Urgent <input type="checkbox"/> Planned	

**6. Are additional results required?**

If yes: ☐ Temperature ☐ Chest CT  
☐ SARS-CoV-2 PCR ☐ Other

**Comments** \_\_\_\_\_

Date, Place \_\_\_\_\_

Signature responsible member of staff \_\_\_\_\_

Form used for evaluating the risk of infection in patients (A&E 2 = additional accident and emergency department set up in response to the Covid pandemic).  
Source: Düren Hospital.

## Discussion

The dynamics of the pandemic made timely comprehensive adaptations necessary throughout hospitals. They included setting up isolation units within A&E and intensive care, as well as on regular wards. The pandemic placed renewed emphasis on the necessity of directing patient flows and proactively managing healthcare capacities within hospitals [6]. Management of capacities in areas providing acute care such as A&E and intensive care units during the pandemic has been the topic of numerous publications [7–9]. However, these publications generally concerned local processes and capacities in individual hospitals, and primarily focused on the setting of the pandemic. Even if Germany currently ranges at the upper end of availability of intensive care beds [10], and even though hospital-wide management of capacities is a major factor in successful care for patients and positive economic results of a hospital [11], almost no established structures exist for intersectoral management of patient flows [12,13]. As in other countries, faced with the pandemic, it has become necessary in Germany to develop new strategies for proactive interdepartmental management of the transfer of patient care together with concerted admission and discharge criteria both in and between hospitals to better manage and adapt resources in response to regional and interdisciplinary requirements. It is these strategies – which have proven themselves under extremis – that should now be formalised and preserved beyond the pandemic. In this way, continuing closer interdisciplinary and intersectoral cooperation can exert positive influence on both the management of patient flows and resources and on the communication structure within a “new clinical routine”.

With this perspective in mind, the health care experts on the Delphi panel prioritised their “lessons learned for everyday clinical practice from the early phase of the COVID-19 pandemic” in terms of their additional value and feasibility of their implementation beyond the

requisite for the bidirectional exchange of information. This increased trust in the approaches adopted by the expert group provided for broad acceptance of decisions and helped to develop team spirit. A further channel of communication catered for primary care physicians, public health authorities, collaborators, and the public. Here too, clear and open communication suited to the recipient and using homepages, flyers, press conferences, telephone conferences and notices on wards etc. proved invaluable.

### Including a “COVID attribute” in the electronic health record

COVID-19 testing strategies as mandated by public authorities or exceeding those mandates based on internal concepts

were adapted numerous times over the course of the pandemic. To ensure those providing care to the patient down the line were made aware in a simple and direct fashion that **COVID-19 testing** had already been performed in A&E, an “attribute” was introduced and displayed in the digital ward overview (Medico, CGM) as a colour-coded “visual diagnosis” symbol (Fig. 9). That attribute offered additional information via mouseover to those involved in the patient’s care, such as the type, scope, and results of testing (PCR test and/or point-of-care test with result, barcode number for tracking results, etc.); this ensured that staff and departments were kept informed in an effective and timely manner.

Figure 8

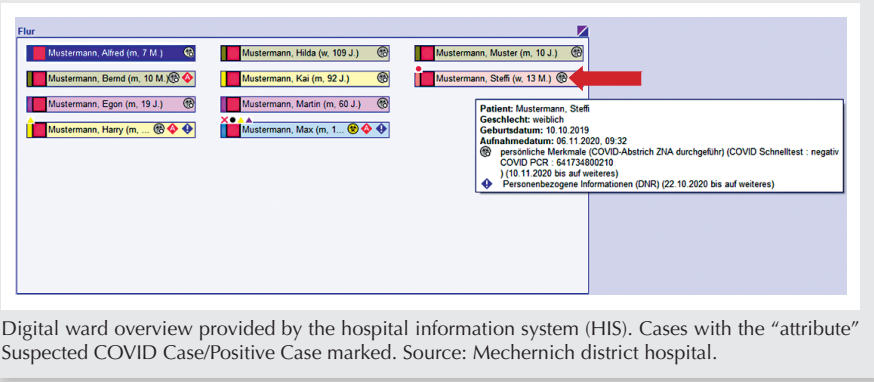
Criteria for initial assessment of COVID-19 patients			
Consciousness	awake	drowsy	sopororous
		somnolent	comatose
Respiratory rate/min	12–20	21–32	> 32
Heart rate/min	50–80	81–100	> 100
			< 50
Blood pressure mmHg	110/80–140/90	141/90–160/100	> 160/100
			< 110/80
SaO <sub>2</sub> %	> 97	90–97	< 90
Temperature deg. C	> 37.5	37.5–38.5	> 38.5
Comorbidities	none	malignancy, kidney failure, immuno-suppression	hypertension
			diabetes
			CAD
			COPD
Age	< 40 years	40–65 years	> 65 years
	Only green scores: consider outpatient treatment	Predominantly orange scores: consider care on regular ward	Several red scores: consider care on ICU

Checklist used for initial assessment of Covid-19 patients. Patients were triaged into one of three categories (green = out-patient care, orange = in-patient care, red = intensive care). Source: Düren Hospital.

identified, nor the measures and practical examples contained within claim to be exhaustive with regard to sustainable improvement of the above points in everyday clinical practice. Instead, they aim to stimulate others to search for “positive lessons from the pandemic” and to select further proven measures for formalisation and continuation.

The structure chosen for achieving consensus between hospital management, nurse managers, hospital hygienists, as well as emergency physicians, anaesthesiologists, and intensivists from six individual hospitals with the aim of initiating sustainable structural change beyond the pandemic is a new approach. It is likely to be suited not only to the local requirements of those hospitals involved, but more broadly to other hospitals, too. The selection of hospitals involved in the project included primary, secondary, and tertiary level hospitals and was, as such, representative of the services offered in Germany outside of university medicine.

Figure 9



Objective admission and discharge criteria for specialised units, early determination of therapeutic goals in accordance with patient’s individual wishes in both A&E and on intensive care units, and organisational restructuring were identified as approaches for improving bed capacity management. An important lesson learned was that every measure implemented, or structure changed during the pandemic needs to be critically reviewed in a holistic manner to determine possible effects on other areas of care; not every measure which appeared expedient during the pandemic for those patients afflicted with infections necessarily meets the needs of other patient cohorts requiring elective or emergency treatment [14]. As such, prior to expanding intensive care capacity, use of available capacity should be optimised using flexible care concepts, thereby conserving available resources and ensuring uniform operation across the hospital. This includes adequate resource planning and proactive management of patient flows. The

pandemic. Measures which had proven themselves during the pandemic were categorised into three fields of action for continued implementation and ongoing development in everyday clinical practice: 1) interdisciplinary management of patient flows, 2) flexible human resource (HR) concepts and 3) establishing new communication and information structures. Those measures which were prioritised were judged to

provide significant benefits if implemented in everyday clinical practice or reserved for and implemented in emergency situations. Benefits were expected with respect to interdisciplinary management of patient flows, appropriate care, patient safety and intersectoral cooperation. To aid other organisations in implementing the measures, practical examples and recommendations were formulated. Neither those fields of action



associated recommendation of targeted capacity-dependent patient management was determined by the experts on the one hand to offer significant benefit in everyday clinical practice, but on the other hand to be difficult to implement. Optimal realisation in everyday clinical practice would require broader networking of patient and capacity data, possibly using artificial intelligence, to process the significant quantities of data and find links within them, making it possible to take timely objectifiable decisions and shape sustainable health care. Furthermore, critical debate on the questions of how much intensive care is ethically tenable and medically viable, and how intensive care capacity can be managed based on ethical principles (see case vignette) is important. Unambiguous advance directives, ideally written prior to hospital admission, take on an especially important role in this context.

As was almost to be expected, the development of modern human resource concepts was defined by this project as an important field of action – but here, too, the feasibility of implementation in everyday clinical practice was seen critically. Whilst in one of the hospitals involved in the project, a pre-existing interdisciplinary induction programme for medical staff proved itself (see practical examples), the precarious staffing situation in nursing just became all the clearer. With this in mind, structured and curricular programmes have now been developed [15] with the aim of rapidly qualifying nursing staff. Those hospitals surveyed established qualification and induction programmes for regular nursing staff at short notice to prepare them for deployment on intensive care units. A structured approach proved successful, consisting of initial theoretical training and familiarisation with medical devices followed by practical training of regular nursing staff by an intensive care nurse within a persistent team.

Continuing implementation in everyday clinical practice requires assessing whether aspects of those concepts can prove themselves as long-term strategies;

an example might be regularly deploying both medical and nursing staff to work in emergency and intensive care, thereby maintaining their competences and meaning they are qualified to bridge staffing bottlenecks. This initially requires a transparent analysis of the extent to which human resource capacities are actually available for flexible deployment and the requisite training without causing staffing shortages in other areas. Furthermore, despite all the expedient measures taken at a local level, in the long term, it will be essential to upvalue certain occupations with the help of political support through qualification and shifting areas of responsibility, moving from vocational to academic training, and providing fair pay.

The large number of measures which had to be implemented at short notice by hospitals during the pandemic put high demands on the flow of information and led to the development of new communication structures, such as daily task force meetings (see practical examples), working groups, video conferences or regular newsletters. Effective communication via defined communication channels is essential for team structuring, coordination of work processes and connecting with employees [17,18], and conveys a feeling on those involved of a work relationship characterised by competence, safety, trust, and accountability [17]. The binding character, nature, scope, and interval of decisions taken must be communicated in a transparent and clear fashion.

In addition to the higher demands on internal communication, hospitals found themselves faced with major challenges in managing the flow of information. New systems – mostly IT based – had to be developed for recording COVID-19 positive cases and managing contacts. Whilst these were easy to implement in some cases (see practical examples), the pre-existing digitalisation gap in hospitals often necessitated significant human resource deployment for contact tracing.

For each of these instruments which were successfully deployed during the

pandemic, a decision should be taken at a local level as to whether they can and should be adopted in everyday clinical practice. Hospitals as central providers of health care in their respective regions experienced intense media attention during the pandemic, raising public awareness of their requirements, current shortfalls, and infrastructural backlog. These insights, and the growing appreciation of situational bottlenecks, established routines, and patient pathways should be used in the long term to better network the regional population with local health care facilities.

## Conclusions

Measures established during the pandemic pertaining to the management of intensive care capacity, patient flows and information were evaluated in a modified Delphi study by experts from hospitals in a regionally and functionally distinct cluster. Those measures which had proven themselves in respect of their practicability and their positive influence on demand-oriented patient care, interdisciplinary collaboration, and patient and staff safety were prioritised for continued implementation beyond the pandemic. Most of the experts felt that this kind of close collaboration with insights into and understanding for other disciplines would soon be lost without a degree of institutionalisation and continuation in everyday clinical practice. It was this point that aroused motivation to standardise the lessons learned from the COVID-19 pandemic for interdisciplinary acute care and to operationalise suitable concepts for continuation in everyday clinical practice. The practical examples and recommendations provided in the various fields of action are intended to animate other health care providers to critically question their human resource concepts, communication strategies, and their management of capacities and patient pathways, and to adapt them to the challenges of a new clinical routine using holistic, interdisciplinary, and intersectoral approaches.

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