GE HealthCare

Why Command Center Software from GE HealthCare?

Because care teams need a real-time and predictive control system for ongoing care orchestration. And because existing systems cannot meet the need.

This brief describes the ***why,*** ***what*** and ***how*** of GE HealthCare's Command Center solution, including:

What is Command Center Software?

"Command Center software" is a real-time and predictive control system for ongoing patient care orchestration. Staff use it to collaborate in rounds and huddles; to see, get ahead of- and track risks; to communicate between teams, and to prioritize.

This relatively new type of software is distinct from EMRs and business intelligence. Such software was first deployed by GE HealthCare at The Johns Hopkins Hospital in 2015 to power their Capacity Command Center. GE's Command Center Software Platform has steadily evolved since. It's now used by about 250 hospitals in four countries for a range of applications from daily care orchestration to regional capacity management to deterioration and sepsis quality to predictive staffing and outpatient schedule optimization.

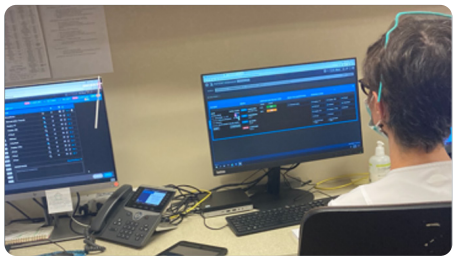
GE HealthCare's Command Center Software Platform (CCSP) is purpose-built to streamline these essential activities so they are easier, faster, smarter, consistent and connected between disciplines. The first big impact is saving time.

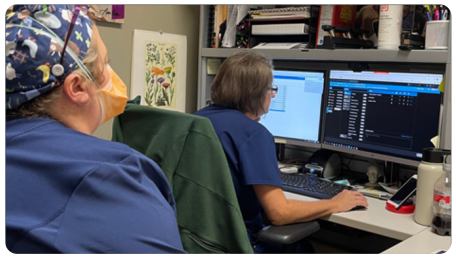
CCSP is "modular", meaning that components are selected and configured for each health system, and that they build on each other in terms of both smarts and adoption. For example, "patient manager tile" initially supports daily throughput but readily expands for ICUs, sepsis, post-acute transitions, risk of harm, deterioration and others.

GE's Command Center software is source system agnostic, meaning that it ingests data from any software or device as needed. It's also hosting agnostic; hosted by GEHC, in client cloud or in client data center. Most information on the tiles is updated every 30 seconds and some algorithms re-forecast every few minutes or hourly.

The "catalog of CCSP tiles" as of this writing includes Patient Manager with 15 optional expansion modules, 4 resource optimization tiles like Census & Staffing Forecast, and 4 specialty tiles like ED Expediter and Surgical Growth.

Overall, GE's Command Center software is a leading example of a new type of software used for ongoing optimization and communication using real-time, predictive, fine-tuned and connected information.





Command Center Software in use at various Ecosystem organizations

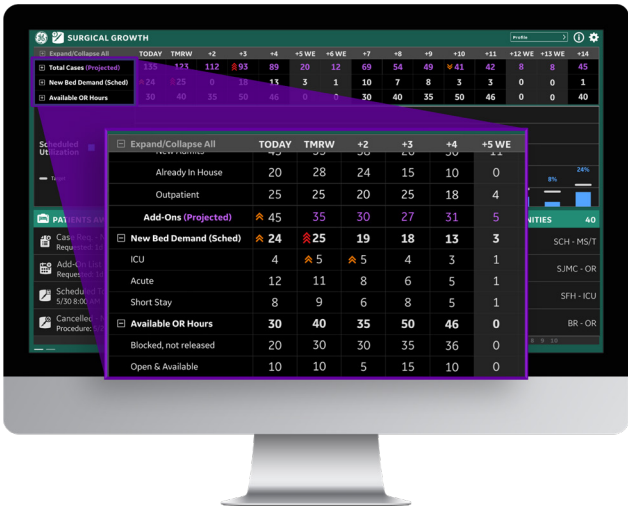
What is the purpose of Command Center software?

The purpose of Command Center software is to achieve and sustain a level of quality, throughput, access and utilization that is otherwise not possible with existing tools by making it easier to:

- **Orchestrate daily patient care operations**
- **Backstop quality**
- **Constantly prioritize discharge activities to create the right capacity for today's actual and tomorrow's predicted patient demand**
- **Ensure new and/or temporary staff are provided tools to work in accordance with organizational standards**
- **Coordinate patient care across units, teams, departments and services**
- **Spot future bottlenecks and suggest action to prevent them**
- **Generate nuanced and always-current patient lists (aka cohort lists)**
- **Track real-time nuanced indicators like current boarders by type**
- **Enable unit teams to escalate issues and get help**
- **Empower new or novice staff to participate in daily operating system activities**
- **Elevate huddles from information exchange to problem solving**
- **Constantly track adherence to hospital-defined protocols**

Command Center software's Tile Library and features have evolved through problem-back-design with caregivers, a process which begins with observations and working sessions with front-line staff to isolate critical moments where a particular caregiver could take a different action with certain information. For example, here's a summary of the development of the Surgical Growth Tile:

- **Problem 1:** There is daily stress about how many surgical cases can be accommodated in the next few days. It's difficult to accurately project which pending cases will require same day acute admission, same day ICU admission, or an overnight stay in the short-stay unit as well as accommodate predicted add-on cases.
- **Problem 2:** Two staff members spend 2-3 hours per day pulling reports and crunching data in an effort to determine the answer, but the resulting analytics quickly age, tend to use old information as inputs, and are not produced when key people are on vacation.
- **Problems 3-5:** Surgical utilization is not as high as it could be; some cases are postponed unnecessarily; and staff are stressed.
- **Resulting Tile:** Surgical Growth Tile. The top half of this Tile recalculates the needed projections every 30 seconds, with greater precision and reliability than the manual process. It also extends the forecast window and adds new insight about potentially under-scheduled days. This Tile is used by surgical administrators, their teams, and expediters.
- **Impact:** 750 person-hours saved per year, higher surgical utilization, less stress for staff.



How is Command Center software different from EMR software?

Command Center software fills gaps where EMRs struggle. These gaps tend to be where multi-modal information is required, where the information regularly changes on a minute-to-minute basis, where a predictive algorithm is needed to make a decision now, where protocol logic is complex, and where staff must rapidly collaborate across disciplines. EMR architecture makes all of these difficult.

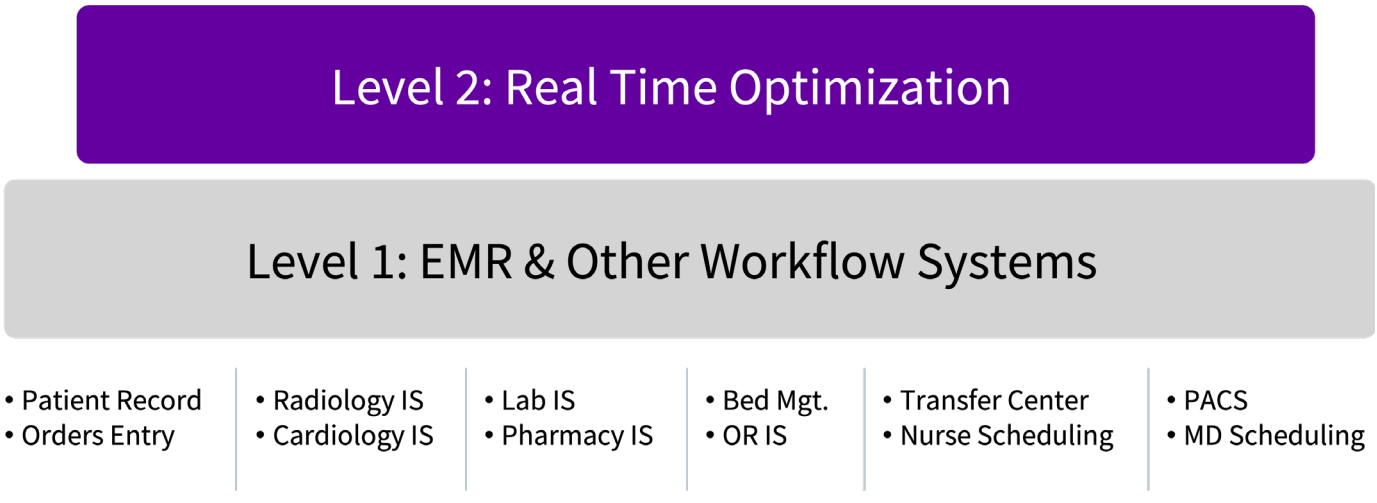
As a result, staff in even the most sophisticated hospitals today still use spreadsheets, phone calls, clunky EMR reports and sticky notes for daily cross-functional coordination. Valuable time is lost as they search for basic information or try to connect the dots themselves rather than moving to the next step. For example, they may need to manually indicate that a pending CT read is a barrier to discharge in a discharge tracking tool in the EMR - even though the open order, scan, and read status are all available in the same system as the discharge tracking tool. Why not do that for the caregiver? Because the architecture of the EMR does not support it.

GE HealthCare's Command Center software was born out of the urgent need to give caregiver the information and tools they need in real time. In order to connect the dots in real time (and then create all the intelligence that such a real-time cross-system data model makes possible), CCSP was built to constantly ingest real-time streaming messages from various systems, process-parse-and-persist those messages in sub-seconds, organize them into a data model, constantly re- compute algorithms running against that data model, and serve users with apps designed with users to meet the expectations of modern intuitive software. This approach unlocks a host of orchestration, forecasting, resource allocation, care delay identification that could result into risk and other use cases which are otherwise impossible.

When comparing to the EMR, many users also point to the usability of Command Center software - it's integrated with communication pathways, configured to each health system's protocols, personalized for each caregiver and yet easy enough that almost no training is required. While these do tend to be differences between Command Center software and EMRs, they are less foundational than the data structure issues which are the 'sine qua non' of real-time optimization software.

This is not to say that EMRs are flawed or low-value. To the contrary, EMRs are a massive achievement. They are testaments to innovation and persistence which create tremendous value for health systems every minute and contribute to a foundation of digitization upon which other types of value will be created for decades.

To understand the architectural differences as well as the interconnectedness between the EMR and CCSP, consider this: the CCSP is a Level Two platform, which means it uses data from Level One systems such as the EMR, clinical workflow software, devices, and other sources in new ways.



The image above illustrates how Level 2 software is needed to connect data from the many Level 1 systems (including the EMR) in near-real-time.

What is an EMR? Is an EPR the same thing?

The terms EMR and EPR are used differently around the world. Here is a brief explanation of the difference.

- The term "Electronic Medical Record" (EMR) is used in North America to mean a collection of software sub-systems including the patient record, order entry system, lab information system, radiology information system, cardiology information system and so forth. In the 1990s and 2000s, there were competing vendors for each sub-system. Leading vendors today provide an integrated solution which includes many or most of these sub-systems, with the largest providing 20 or more modules. EMRs were once typically hosted in health system data centers, but are increasingly hosted in either health system-managed 3rd-party cloud or EMR vendor-provided cloud.
- The term "Electronic Patient Record" (EPR) is used worldwide to refer to a software system which digitizes the patient chart or record. It is usually accompanied by a Patient Administration System or PAS. EPRs and PASs are sometimes referenced synonymously with EMRs, but this risks confusion on the actual scope of software being provided.
- GE HealthCare's Command Center software is agnostic to EMR/EPR/PAS topology. Data is ingested from whichever sub-systems as needed (based on Tile and Module selection) and harmonized within the CC software platform. Current deployments include as many as 14 distinct EMR instances feeding a single CC instance, which provides Tiles to users with seamless enterprise-wide information.

What are the main uses of Command Center software?

Command Center software is used in many ways. Here are some of the most common:

Supporting frontline caregivers

- Facilitating a fast and smart unit-level care coordination rounds and huddles, such as the daily discharge huddle, line huddle, long LOS huddle, observation patient management, etc.
- One-touch escalations from unit to command center with audit trail and in context

Streamlining patient flow

- Prioritizing patients for consideration for the next available bed by type from all portals of entry based on the hospital's protocols and guidelines
- Predicting issues with upcoming outpatient imaging, surgical and procedural schedules
- Prioritizing service queues in imaging, lab, pharmacy, PT, OT, and SLPT
- Tracking each patient's readiness to downgrade or transfer to another specialty ICU
- Prioritizing discharge activity to create capacity in the beds which will be in highest demand over the next few hours

Elevating quality and compliance

- Identifying patients at risk of a service or protocol breach
- Backstopping quality protocols
- Providing the right visibility to patients known to be at risk of complications from CLABSI, CAUTI and medications combinations
- Suggesting action to maintain compliance with certain protocol, such as order a PT assessment for patients with certain fall risk score
- Tracking compliance to sepsis, perinatal, hospice and palliative care protocols

Eliminating bottlenecks and delays

- Anticipating patients who will not be ready for surgery, procedure, imaging or clinic
- Tracking Covid census, Covid critical resources and Covid patients not in target locations
- Predicting census and boarders by unit for next 48 hours (by hour) and 14 days (by day)

Balancing workloads and resources

- Predicting treatment team workload for the next several shifts
- Suggesting action to balance mismatches between expected nurse staffing and predicted unit demand
- Tracking and forecasting stress on physician treatment teams
- Balancing resource utilization (beds, equipment, staff) across a multi-site network
- Surge management of patient care resources (staffed beds, vents, ECMO, PPE) for all hospitals in a region, state, or province regardless of EMR or entity

Tiles present and aggregate information gathered from other systems to improve visibility and workflow efficiency, based on hospital defined standards.

Tile users have the ability to filter information and organize information for their needs. Tiles do not make clinical determinations and are not intended for patient monitoring.

What benefits have been documented with Command Center?

Organizations have publicly announced a range of outcomes including those below which are consolidated from Johns Hopkins Hospital, Humber River Hospital, OHSU Health, Tampa General Hospital, Virginia Mason Franciscan Health, and AdventHealth. Please keep in mind that different health systems use slightly differently language, thus these are grouped by common theme:

Metrics	Impact
Increased EDD compliance	20% - 40%
Reduced caregivers minutes per bed-year in unit "MDRs"	1,500 - 2,000
Reduced excess days, acute conservable days or length-of-stay ratio	10% - 47%
Created virtual beds	3% - 6%
Reduced length of stay (for adults)	1/2 to 1 day
Balanced system utilization (less variance between sites)	12% - 20%
Increased transfer acceptance or reduced declines	30% - 60%
Earlier median dc time of day, or earlier median patient exit	40 - 60 min.
Reduced CT, MR and US Order-to-Scan Time	11% - 25%
Increased surgical utilization or prime utilization	5 - 15 pts
Reduced patient waiting in ED, PACU, OR and EDLWOBS	40% - 70%
Reduced Code Blues	42%

*Results will vary. Outcomes range by provider based on tile selection and other provider factors. GE HealthCare does not guaranty or warrant any specific outcomes.

Source: gehccommandcenter.com/sources

How does Command Center Software help hospitals' Daily Operating Systems?

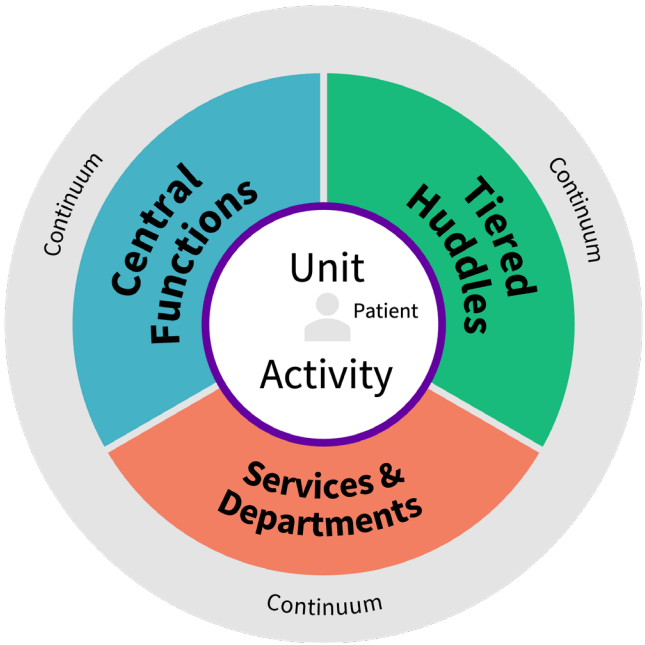
What is a Daily Operating System?

Daily Operating System (DOS) refers to the set of practices through which physician teams, unit nursing teams, clinical departments, support services, partner organizations, and administrators work together to safely progress patient care from admission to discharge. The DOS must ensure compliance to care protocols, and efficiently transition patients to the next step in their care journey.

Every hospital has a daily operating system, although it may be formal or informal. It may go by several names - or not be named at all. Virtually every senior nurse or hospital administrator is immediately familiar with their hospital's DOS even if this term is new.

Key elements of the DOS are unit-level coordination rounds, house-level daily huddles, prioritization practices for imaging, expediting practices for transfer acceptance and so forth.

Daily Operating System



What is the problem with Daily Operating Systems?

A well-designed and routinized DOS has a massive positive impact on throughput, quality, and staff satisfaction. Yet, most experienced health system leaders also know that:

- A high-functioning DOS is tough to achieve and even harder to sustain as staff turnover and operational challenges constantly mutate
- At worst, efforts to achieve a high performing DOS can become counterproductive, creating extra work that distracts from actual daily operations

This situation and challenges are common worldwide. The pressure to achieve and sustain a high-performing DOS, with its many complex facets, has been a primary driver of the feature-set of CC software.

How does Command Center software transform the Daily Operating System?

GE HealthCare's Command Center software has a transformational impact on this system. It provides the underpinning of a DOS that is effective, straightforward, and sustainable over time and turnover.

CC software has evolved to make the DOS:

1. Easy for front-line staff to learn and use.
2. Efficient, saving caregivers time and effort.
3. Effective in reaching and sustaining a step-function increase in throughput and quality performance.
4. Smart. Automation, data, and algorithms are used to reduce cognitive load, pull forward key information, facilitate collaboration, spot risks, forecast and prioritize.
5. Scalable across the continuum and to partners.
6. Interdisciplinary. Connects all parts of the care team with processes & tooled tuned for the various participating teams.
7. Scaffolded. Naturally supports DOS practices such that new and novice staff need virtually no training to participate and confirm the feeds.

How is Command Center software used in the DOS?

Command Center software is used in several ways in the DOS:

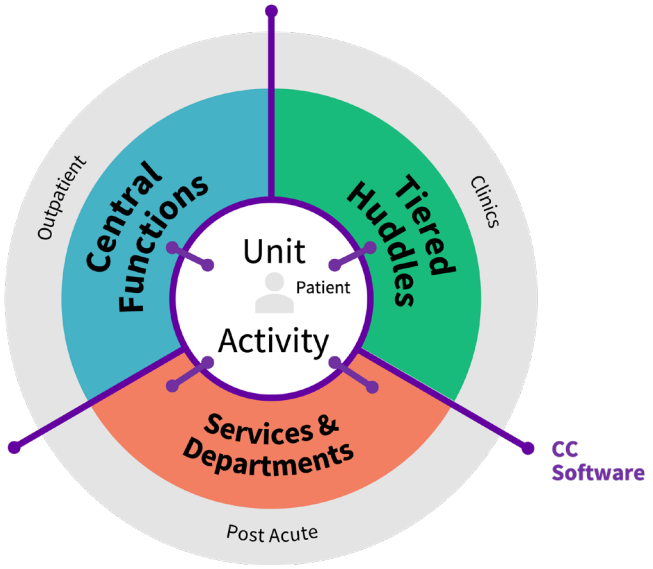
- Facilitation tool for group work in rounds and huddles
- Worklist for expediting practices
- Situational awareness tool in command centers and elsewhere
- Escalation management from front-line to departments and central teams
- Communication tool for operational notes

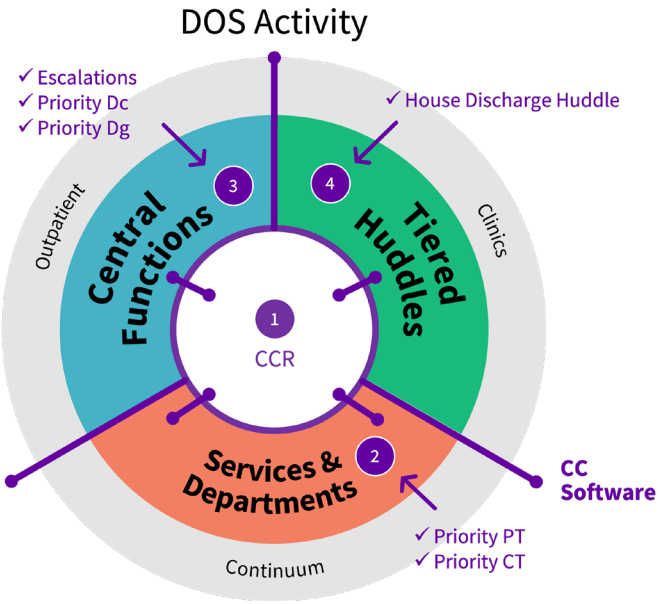
The top image to the right shows CC software as the thread that connects the units, tiered huddles, services and departments, and the central command center in daily coordination. The “stitches” between the units and surrounding activity indicate just a few of the communication, escalation, prioritization, and synchronization pathways enabled by the CC software.

Users experience Command Center software through “Tiles”, such as Patient Manager Tile which is the main Tile enabling the overall Daily Operating System. Patient Manager is a real-time application within CC software platform which is used as an active facilitation tool during in-person (or virtual) care coordination rounds on nursing units and ICUs; as an active facilitation tool during a hospital-wide daily discharge huddle with a mix of in person and virtual attendees; and as communication pathway for escalations from the front-line…to name only a few of many such uses.

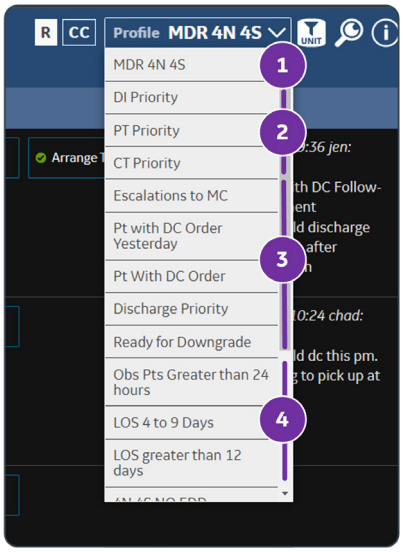
The middle and bottom images show how DOS activities appear as profiles in Patient Manager. There are different views and a high speed “find patient” feature. Each user has their own tailored profiles, which can be pulled from “profile library” or created fresh. Filters, sorts, and views are all adaptable to serve different DOS activities.

CC software also includes additional Tiles which target certain high value problems and users. For example, Patient Placement Prioritizer Tile is used by the access teams in the command center department to much more easily triage the needs of patients seeking access from all portals of entry. This has the effect of saving these highly trained staff as much five to ten minutes per patient in background research, and more effectively and consistently matching scarce capacity to patient need. The algorithm is derived using machine learning, but can be tuned by client staff on an ongoing basis. There is also Census Forecast Tile which can be used by the Transfer Center team to help plan beds for the next hours, days, and weeks. With the Staffing Module for Census Forecast Tile, the Staffing Office can much more easily identify mismatches between planned staffing and forecasted patient demand.





Profile Selector in Patient Manager Tile



Organizations can also add “Modules” to Patient Manager which add new automation or smarts to support different types of activity. Examples include the ICU Downgrades Module for Patient Manager to help speed up ICU downgrade huddles or Risk of Harm Module which gives the right visibility to the care delivered to patients known to be at risk of CLABSI or CAUTI and certain medication combinations determined by the client organization. With the Lines and Drains Module, organizations can facilitate their weekly or twice-weekly lines and drains quality huddle in Patient Manager as well.

All together there are about 15 Tiles and 10 Modules available to date. More are being added regularly through continued innovation within the CC Ecosystem.

GE HealthCare’s View on Best Practice DOS

Command Center software is designed, built, and continuously refined to better serve the needs of hospital daily operating systems.

When needed, GE HealthCare helps client organizations design and activate their daily operating system. In some cases, this takes the form of a wholesale transformation co-led by GE HealthCare and the client. In other cases, GE HealthCare suggests targeted change. In every case, Command Center software is tailored to the needs, terms, and context of each great health system we serve.

In general, GE HealthCare suggests that a DOS be organized with the characteristics below, always adapted to local context, custom, and goals.

Unit Level

The core of the DOS is daily or twice daily Care Coordination Rounds in each nursing unit. These are sometimes called multi-disciplinary rounds (MDRs), lighting rounds or other. These should be jointly led by nursing and case management, with either the charge or unit case manager facilitating on any given day. By using Patient Manager, the team can align on each patient’s i) care goal for the day, ii) barriers, and iii) EDD & disposition and agree on necessary follow-up in less than 30 seconds per patient on average. If more time is needed, a follow-up discussion is taken offline. Pharmacy tech, social work and other allied health often attend. Bedside nurses rotate through to review their patients. In some cases, there is a small huddle before the first nurse’s patients for announcements and so forth.

Services & Departments

This section of the DOS connects clinical services and departments like physician specialty groups, lab, pharmacy, CT, MRI, physical therapy (PT), occupational therapy (OT), speech language pathology (SLP), ultrasound, discharge lounge, environmental services and so forth. Each of these services conducts normal business for each patient in their EMR or clinical information system. They should align their activity to support house-wide needs for overall patient flow for all patients. Common uses cases in CC software involve prioritizing patients with a discharge order who are awaiting sign-off from the service on the forward-looking busiest unit, maintaining situational awareness of patients at risk of a service breach, pulling patients to their service under certain conditions, and tracking certain cohorts for expediting.

Command Center

Command Center refers to a central department which includes functions such as bed management, transfer center, flight and ambulance dispatch, nurse staffing office, clinical expediters, bed planning and sometimes virtual care and remote video monitoring. GE HealthCare has helped to design, create, and operationalize more than 20 such departments, some of which are listed nearby.

Top functioning command centers play several vital roles in the DOS:

1. Keeper of the DOS. The Command Center department is the team who documents the DOS, informs others, and regularly iterates as the situation evolves over time.
2. Real time optimization. The CC department is constantly involved in minute-to-minute optimization of patient care operations including orchestrating transfers, bed assignments, and so forth; resolving escalations; proactive barrier busting; and prioritizing critical activity for patient flow and quality.
3. System dynamics. The CC department is the lead entity in studying hospital and health system dynamics regarding utilization and patient flow. In this role the Command Center helps to inform surgical block schedule design, new facility investment strategies, unit allocation and bed mix planning and partnership options.

List of GE HealthCare-designed and operationalized Command Center departments

Organization	New Department Name	# of Hosp.	Ft²	Video Wall (s)
The Johns Hopkins Hospital	Judy Reitz Capacity Command Center	1	5,200	2x4x2, 2x1x3
Humber River Hospital	Command Center	1	3,000	3x11
Oregon Health Sciences U	Mission Control	3	2,000	2x3
Tampa General Hospital	CareComm	1	5,500	2x10, 2x2T, 2x4
Virginia Mason Franciscan	Mission Control	10	4,000	2x10
AdventHealth	Mission Control	23	15,000	2x4, 2x5, 2x8, 2x12
Bradford NHS FT	Command Centre	1	600	2x4
Mission Health System	Interventional Platform Command Center	1	100	2x4
Duke University Health	Carehub	3	1,500	4T mounted
HCA – West Palm Beach	Clinical Command Center	3	2,500	none
Providence Oregon	Patient Logistics Center	8	4,000	2x4
Providence Swedish	Staffing, Transfers & Operations Center	7	18,000	2x9
Leiden University	Capaciteit Centrum	1	1,000	2x4
Saudi Ministry of Health	National Health Command Center	308	4,500	2x6
Dubai Health Authority	Dubai Health Command Center	4	3,500	2x6
Children’s Mercy	Patient Progression Hub	2	4,200	2x6, 1x3, 1x3
Deaconess Health	D-CARE	6	5,000	tbd

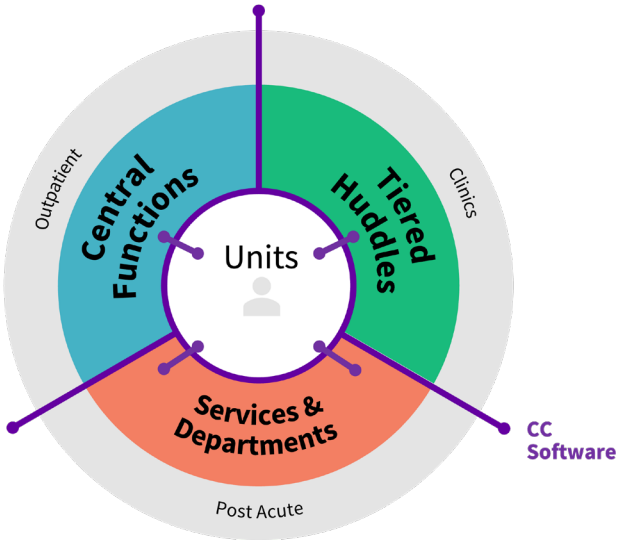
Tiered Huddles

GE HealthCare recommends several recurring huddles. These can be new huddles or modifications to existing huddles. In this case, huddles refer to activities that involve multiple nursing units or services, and is usually a mix of in-person and virtual attendees. Before CC software is implemented, these meetings are usually facilitated by a spreadsheet which was generated from an EMR report. The spreadsheet often includes counts like “number of discharges yesterday” or “number of discharges expected today.”

The first recommended huddle is a Daily Discharge Huddle. This huddle can sometimes best be structured as the CFO Discharge Huddle, meaning that it’s led by the CFO in concert with nursing, operations, and case management. CFO participation sends a message about its importance and helps to keep the finance team up to speed on current front-line challenges. A key change from current practice is often to transition this meeting from reviewing counts in spreadsheets to an action orientation. This is done by using CC software to create actionable, easy-to-use real-time patient lists such as “high priority discharges by unit occupancy” and “observation patients over 24 hours” and “patients with discharge order, no barriers and disposition to home.”

Other common huddles are a weekly “Long LOS Huddle” and twice weekly “Lines Huddle.” There are many other huddles, each of which should be connected with the DOS and streamlined for team efficiency.

The image below summarizes some of the key DOS activities which are often supercharged with CC software.



Units

- Care Coordination Rounds
- Shift handoff
- Ad hoc problem solving

Tiered Huddles

- Daily DC Huddle
- Long LOS Huddle

Services & Departments

- Priority PT/OT/CT/MR…
- Patient Readiness
- Future Schedule Deconflicting
- Cohort Tracking
- Case Mgt Expediting

Command Center

- Expedite Access & Discharge
- Proactive Barrier Busting
- Escalation Pathways
- Cohort Tracking

Why the emphasis on “real time”? What is meant by “real time”?

In this context, “real time” indicates that information in Tiles is updating every 30 seconds for users. These updates are based on changes in the CC data model which have occurred since the prior update to the user (30 seconds ago). The CC data model is updated constantly by streaming data being ingested into the CC platform. For example, at a CC client in Florida, the CC platform ingests about 23 HL7 messages per second or two million per day.

Such timeliness is important in an acute care context because orders, results, locations, statuses, etc. are changing constantly.

This timeliness is also remarkably different from current practices in health systems -- even with the most cutting edge EMRs. The difference is often more significant than leaders realize until they experience it. Changing from periodic EMR reports or spreadsheets to real-time apps is like changing from the newspaper to the stock ticker. Both are useful, but they are quite different. And when the market is volatile, a live price ticker is vital for good decisions.

How does Command Center software help a “Command Center department”?

GE HealthCare’s Command Center Software Platform was named for the first uses of the software in new command center departments which GE HealthCare also helped to design and operationalize. Those use cases were characterized by the need for real-time, all-the-time, predictive and actionable information. And while the software was immediately used outside the physical command centers, the name “Command Center” stuck because users quickly associated the term “command center” with actionable information. It turns out that many users and use cases outside a command center can be transformed by real-time actionable information.

Command Center departments remain heavy users of Command Center software. For example, Boarders Expediter Tile and Patient Placement Prioritizer Tile are used primarily by bed management, transfer center, and related staff. Clinical Expediters and remote case managers in command center departments also use Patient Manager to manage escalations from the front-line; and various profiles to proactively eliminate barriers and expedite discharge.

Each Command Center department is also a critical node in the hospital’s Daily Operating System as described herein.

Many GE HealthCare clients have a GE HealthCare-designed CC department and use CC software. Some GE HealthCare clients have a GE HealthCare-designed CC department but do not yet use CC software. Some GE HealthCare clients use CC software but do not have a CC department.

What is the Command Center Ecosystem?

The Command Center Ecosystem is a community of practice facilitated by GE HealthCare. Members are those organizations using GE HealthCare’s Command Center software and/or whose command center department was designed and operationalized with GE HealthCare.

The Command Center Ecosystem includes:

1. Ad hoc practice sharing between members. Examples include roles and responsibilities for command center positions and process maps for escalations, etc.
2. Ecosystem Forums focused on specific topics like “Care Coordination Rounds with Patient Manager” where different organizations present their approach followed by Q&A. These Forums tend to be at the user level.
3. Ecosystem Grand Rounds focused on topics relevant to both users and executive level members. Examples include designing a command center, developing a transfer back program, and decreasing avoidable days.
4. Ecosystem Annual Event. These are annual gatherings of the Ecosystem, in person or virtual as the situation permits, with a broad range of presentations from Ecosystem members.
5. Innovation Collaboration. From time to time, Ecosystem members collaborate with one another on a voluntary basis to advance an innovation. For example, clinicians from four Ecosystem members in three countries provided feedback on the design of the Perinatal Module first deployed at Humber River Hospital.

Johns Hopkins Hospital Command Center

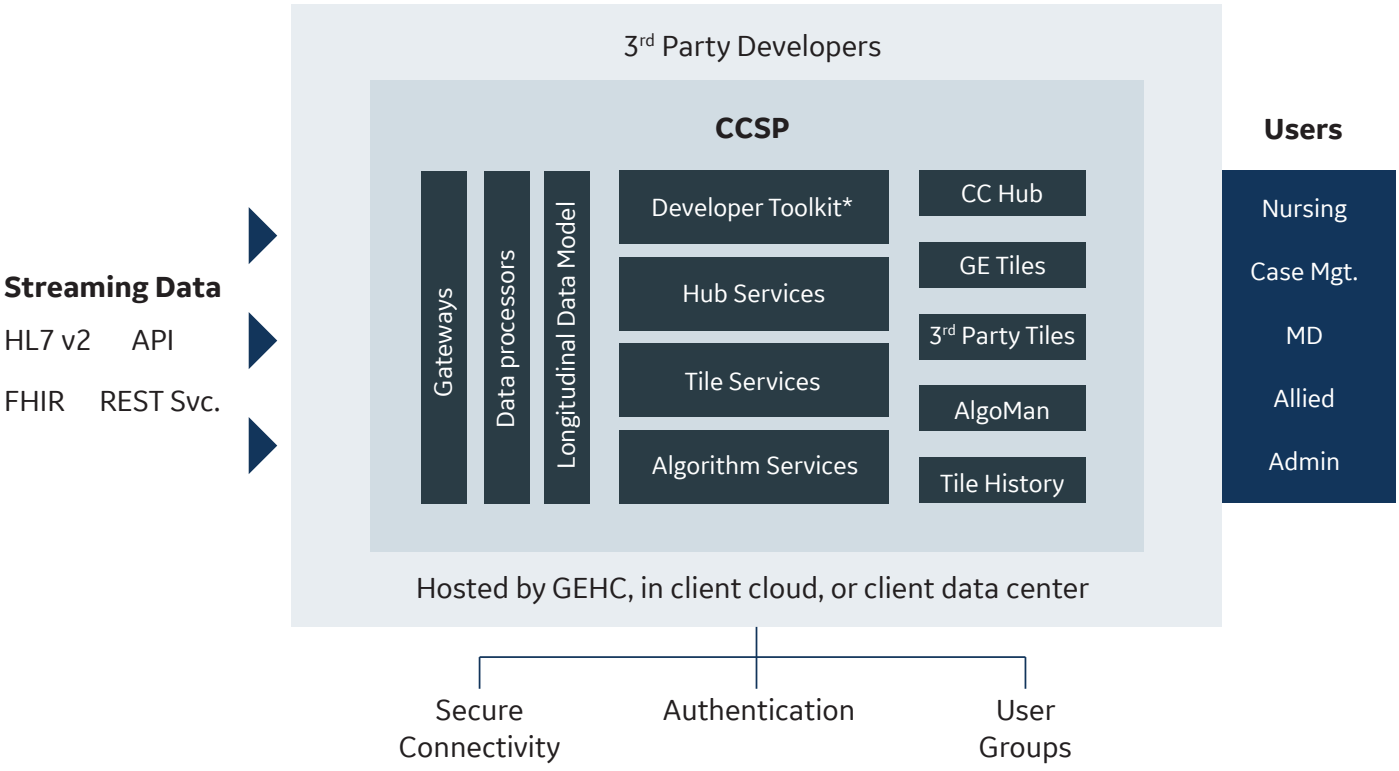
Humber River Hospital Command Centre

What is the Command Center software architecture?

Command Center Software Platform is a typical software platform with a single infrastructure layer supporting many apps with a common user experience.

The diagram below depicts the architecture. Key points:

- GE HealthCare specifies outbound data services for client to build from source systems to GE HealthCare. Common HL7 v2 message types include ADT, ORM, ORU, RDE and MDM. FHIR may also be used as it becomes available.
- CCSP instances can be hosted in GE-provided cloud, client-provided cloud, or client data centers with secure connectivity, network, active directory, and user management integration.
- User access is managed by integration with each client's active directory. AD groups determine which users can access CCSP, which Tiles they can access, and whether or not they can see PHI.



*In development

What Machine Learning Algorithms are in use?

Some Tiles and Modules use machine learning to forecast constraints. These algorithms re-forecast every few minutes, and then train every 24 or 48 hours. CCSP also tracks the accuracy of each forecast.

The table below summarizes the algorithms live and in use at various CCSP deployments today.

ML Algorithm	Tile	Forecast Window	Forecast Frequency
Day of Discharge Forecast	Patient Manager	5 days	3 hours
IP Disposition Forecast	Patient Manager	n/a	3 hours
Census Forecast	Census Forecast	14 days, daily	hourly
Census Forecast	Census Forecast	72 hours, hourly	hourly
ED & PACU Boarders Forecast	Census Forecast	14 days, daily	hourly
PACU Arrival Time	Pre/Post Optimizer OR Snapshot	Next 12 hours	3 minutes
OR Wheels In Time	Pre/Post Optimizer	Next 12 hours	3 minutes
Treatment Team Workload	Treatment Team Workload	Next 48 hours	hourly
Transport Turn Around Time	Transport Optimizer	48 hours, hourly	hourly
Housekeeping Turn Around	EVS Optimizer	48 hours, hourly	hourly

Command Center Tile Catalog

Listed below are the Tiles and Modules available to date. Tiles are web apps in the Command Center Software Platform. Modules add new automation or algorithms to a Tile.

1. **Patient Manager (PM) Tile.** Visualizes real-time patient-level alerts, risk scores, pending, context-relevant intelligence, and the plan of care to provide a holistic view of the patient; keeps the care team in sync; triggers timely completion of patient care activities; and streamlines the daily operating system of rounds, huddles, shift handover, ad hoc discussions and more. Includes context-rich flags, alerts, and algorithms to support care progression and discharge planning activities.
    - **Deterioration Module for PM.** Provides visibility to patients at risk of deterioration and the reasons why using early warning scores and vital sign recordings from the EMR so care teams can intervene early and mitigate the risk. This supports compliance to assessment protocols by surfacing overdue and incomplete assessments and helps prioritize the work of busy Rapid Response Teams.
    - **Discharge Prioritizer Module for PM.** Adds more discharge barriers to the Tile and an algorithm which prioritizes likely discharges based on their importance for house-wide patient flow. Indicates if the patient's bed has already been pre-assigned to the next incoming patient.
    - **Lines, Drains & Airways Module for PM.** Helps support compliance to protocols for cleaning, changing, and removing lines and drains by providing a single, filterable view of all patients across the organization with lines/drains, the date of insertion, and current information about line type, location, date of last dressing change, etc.
    - **Observation Module.** Ensures efficient progression of Observation patients scattered across the organization by tracking their actual LOS vs. Target LOS, and by tracking the timing of the most recent assessment as well as pending tasks.
    - **Post-acute Transition Module for PM.** Adds automation and algorithms to identify and suggest early courses of action related to difficult and complex transitions from inpatient to post-acute care.
    - **Risk of Harm Module for PM.** Provides visibility to critical clinical information and risks as defined by the hospital (e.g., CLABSI, CAUTI, falls, critical lab result and no treatment ordered, medical combinations, declining hemoglobin, etc.) as they are emerging in real time so caregivers can intervene early to mitigate the risks.
    - **Advanced Illness Module for PM.** Provides visibility to patients who are rapidly deteriorating or who have multiple chronic end stage conditions by indicating the status of palliative care and hospice consults and by surfacing critical clinical flags.
    - **Day of Discharge Forecast Module for PM.** Machine Learning algorithms predict patient discharge dates and their most likely post-acute destinations. Adds high value insight into daily rounds to support care progression and discharge planning activities.
    - **Perinatal Module for PM.** Provides visibility to important information about mothers in labor (e.g. delayed assessments, abnormal fetal heart rate, risk of post-partum hemorrhage) and newborn babies (e.g. cord bilirubin, yellow bilirubin, glucose, weight loss).
    - **Sepsis Module for PM.** Visualizes patients on the Sepsis pathway to support compliance and timely intervention. Spots and alerts on screening and potential diagnosis delays. Tracks treatment progress and brings visibility to delays for patients diagnosed as septic.
    - **ICU Downgrades Module for PM**. Continuously visualizes patients in the ICU for readiness to step down based on hospital-defined criteria. Surfaces unmet criteria so caregivers can see opportunities to expedite certain activities, reduce ICU LOS, and create ICU capacity.
2. **Capacity Expediter Tile.** Provides automated, real-time, at-a-glance visibility to the current and near-term status of beds, capturing the true status of all beds by considering patients in beds, patients assigned a bed and waiting for it, patients unassigned and needing a bed, and blocked beds.
    - **Pressure Indicator Module for CET.** Pressure Module can be added to Capacity Expediter Tile to provide a real-time, hospital-wide view of where capacity pressure is building. Used to trigger surge protocols and other actions to decongest the house.
3. **Patient Placement Prioritizer Tile.** Used by Bed Managers to prioritize in real time, using a Machine Learning algorithm, the queue of patients with bed requests for different units/services by identifying the highest priority patients who could get "the next bed." Saves the Bed Manager from manually researching all the factors about each patient who needs a bed assigned – information which is likely out of date by the time the decision is made, and/or may not be relevant for the decision.
4. **Boarders & Transfers Expediter Tile.** Provides a clear view of all patients boarding or holding in ICU, ED, PACU, OR, labor and delivery, etc. as well as the inbound transfer queue and the status of the beds they are waiting for. Uses a bed matching algorithm to find matching beds and flags workflow delays.

5. **ED Expediter Tile.** Provides real-time situational awareness of ED capacity pressures and patient flow, prompting action to decrease ED LOS, better sequence consults/labs/imaging, avoid ED admissions, and determine when surge resources are needed.
6. **Imaging Growth Tile.** Provides a real-time 15-day forward-looking view of available imaging capacity, scheduled patients at risk of canceling or postponing, and opportunities to reduce inpatient days.
7. **Surgical Growth Tile.** Forecasts add-on cases for next 15 days as part of providing a real-time forward-looking view of OR capacity utilization, and patients with risk of cancellation, delay, or excess inpatient days. Alerts on downstream bed availability risk. Used by OR schedulers, flow coordinators, and care teams to fill un-booked OR time and increase patient readiness for surgery.
8. **Census Forecast Tile.** Predicts the census, available beds, and occupancy by hour for each of the next 48 hours (and up to 5 days after that) at the service and unit level. Typical accuracy is >95% at the hospital level and >90% at unit level. Uses Machine Learning to tune itself every night.
    - **Staffing Module for CFT.** Staffing Module can be added to Census Forecast Tile to help plan staff and anticipate bottlenecks. Updates hourly. Predicts imbalance in RN staffing over next 24-48 hours (in 4-hour increments) and up to 5 days, using the Census Forecast and scheduled staff. Reduces inefficiencies and risks caused by sub-optimal staffing.
9. **Treatment Team Workload Tile.** Tracks treatment team workload per shift, and available productivity for the treatment team based. Uses machine learning to forecast treatment team workload for the next several shifts.