Historically, healthcare excellence has been achieved through individual practitioners focusing on being best in their medical discipline. The industry has evolved into a series of independent providers and processes, focusing on intervention. Focusing within each discipline does not provide consideration for the overall patient experience. Today, the healthcare industry is marked by its poor design, high fragmentation, and stunning inefficiency. Care Process Management (CPM) uses best practices for business process management to improve clinical outcomes without changing care processes or displacing the role of health workers.

**Overview**

Care process management (CPM) is the application of business process automation and optimization techniques to clinical care processes in the healthcare environment. CPM uses best practices for BPM to improve clinical outcomes without changing care processes or displacing the role of health workers.

**Healthcare inefficiency and complexity**

According to the 2010 IBM Healthcare and Life Sciences Thought Leadership study, *Redefining Value and Success in Healthcare: Charting the Path to the Future*, healthcare ranked as the least efficient industry in the world, with more than $2.5 trillion wasted annually, as shown in Figure 1.
Care process management: Using BPM tools and methodology in the healthcare environment

Figure 1. Leading the pack in inefficiency

Note: See [1].

Much of this inefficiency can be attributed to the considerable complexity of the business of healthcare with care being delivered through a diminishing number of primary care physicians, and a growing network of specialists, pharmacies, insurers and hospitals exchanging millions of data forms, diagnoses, prescriptions, referrals and medical research every day.

It isn't that healthcare workers don't strive for excellence, but excellence has historically been achieved by each person focusing on what he or she does well. Unfortunately, this approach has not benefited the overall patient experience. In most healthcare systems, a nurse may spend the majority of his or her day coordinating care, services and managing patient information rather than providing care to a patient. Diagnoses are based not on actual evidence but on experiential information. Transaction volumes drive financial incentives, encouraging providers to see as many patients in as little time as possible.

According to IBM Center for Applied Insights' *Capturing Value from Patient-Centered Care*, increasing costs, inconsistent quality and lack of access to timely care are negatively affecting our healthcare systems. Figure 2 shows some facts and statistics that reinforce this observation.
Over the past decade, it has become undeniable that healthcare systems around the world – public and private, local and national – are unsustainable. Spiraling costs and commitments, aging populations, and outdated business models have created a series of unwieldy and uncoordinated healthcare systems that, in some cases, threaten to undermine entire economies and make it challenging to provide access to quality care. Meanwhile, the amount of clinical data already exceeds the cognitive capability of the human brain and available patient data will increase exponentially over the next ten years.

**CPM and the possibility of smarter healthcare**

The pressures on the world’s healthcare systems are real: increasing costs, inconsistent quality, and lack of accessibility to timely care. Healthcare providers are being pressured to transform in order to thrive in these uncertain times. Such a transformation can be enabled by the adoption and integration of a patient-centric approach into business and clinical processes. Healthcare organizations are beginning to look at optimizing the healthcare IT environment to make it more flexible and able to adapt to evolving business requirements.

BPM is the means by which organizations improve their operations by leveraging internal expertise in new and scalable ways. This is achieved by directly engaging business people in the
design, definition and creation of enterprise class process applications. BPM excels at providing comprehensive change management of business processes that results in continuous process improvement.

CPM is the strategic application of the BPM methodology to clinical care processes in the hospital/healthcare environment. The focus is on the patient and how care is delivered.

The traditional application of BPM to the hospital environment has been challenged because many healthcare practitioners do not see healthcare as a "business" but as a "calling." Healthcare practitioners are not "servicing customers" but "caring for patients." However, CPM does not change what a provider does to care for a patient. It focuses on process improvements - on coordination and collaboration between care providers. Still, the benefits of CPM are transformative!

Table 1. The transformative benefits of CPM

<table>
<thead>
<tr>
<th>Healthcare professionals</th>
<th>Benefits</th>
</tr>
</thead>
</table>
| Clinical staff           | • Could perform faster diagnoses and understand different treatment patterns to save and improve more lives.  
                          | • Could collaborate and track recovery with treatment compliance and disease management with quick alerts if patients miss or skip treatment.  
                          | • Could focus on performing higher value tasks (for example, not have doctors or nurses performing administrative or clerical duties). |
| Executive leadership     | • Would have a clear view of how business is performing and be alerted to patient quality issues before they become a problem.  
                          | • Could report, model, and simulate the effects of changes to processes prior to implementation. |
| Administration           | • Could reduce wait times for patients and reduce processing costs without causing bottlenecks further along the patient care path.  
                          | • Could report on all aspects of clinical care both internally and externally. |
| Operations               | • Could speed the claims process, avoid fraudulent payments, and reduce overhead. |
| Finance                  | • Could budget and forecast dynamically, reduce operating costs, and improve overall profitability. |

BPM methodology in a healthcare environment

The standard BPM methodology is described in detail in [3] and quite insightfully in [4]. Figure 3 presents a visual representation of the methodology.
Figure 3. BPM Methodology from discovery to implementation

![BPM Methodology Diagram](image)

Note: See [3].

The state of the art for BPM design involves the use of tools and interactive modeling and design techniques. At IBM, we begin by using Blueworks Live in a set of process discovery workshops that define an organization’s current business processes and variations. Business and technical aspects are captured and these provide the foundation for process implementation. Pain points are documented as inputs to be used later in prioritizing development of solutions.

Iterative BPM development is an important best practice that is applied in two ways:

- An end-to-end BPM process can be developed in iterations or releases. The first release generally focuses on processes where the greatest business value can be derived, though scheduling of development must also take into account technical dependencies. Additional process improvements are made in successive iterations.
- Within a given release, requirements gathering never stops. Rather, requirements are refined through a series of playbacks. Each playback is a planning and implementation iteration. With every user session and every playback, new requirements get added, their business value assigned and scheduled into a release.

A playback is simply a workshop or meeting in which the process is played back end-to-end to process owners to verify correctness, consider alternatives and optimizations. As a project iterates through playbacks, more and more of the solution is delivered. In Playback 0, the process is defined. In Playback 1, process owners review the process and present user interfaces that support business uses. In Playback 2, participants may review the process and user interfaces with some real data derived through integration to back-end systems. Playback 3 is a refinement of 2. As opposed to common waterfall approaches, a playback presents the development progress at a given point in time, but does not commit to a very specific scope. A playback must never be skipped but can be repeated.

We cannot emphasize enough the importance of playbacks in a healthcare context.

- Anytime change is introduced into an organization, it creates concerns and frictions. When healthcare workers are engaged in the design process, they begin to take ownership. It is beneficial organizationally if a playback is performed by one of the process owners. This
strengthens the thought ownership and makes it easier to manage the necessary change in an organization that comes with a new CPM application. Through playbacks, users see that the solution is being designed to benefit them, not to encumber them.

- A common care provider concern is that CPM will change how they deliver care, potentially coming between them and their patients. Playbacks help to assure providers that the way they provide care doesn't change, but that the goal is simply to automate the care administration process. In fact, automation holds the promise of giving them more time with patients.
- In a typical waterfall model of design, the business hands off requirements to IT with the hope that the final solution meets the requirements. In the BPM methodology, IT and business work together to design solutions. Playbacks ensure that requirements are verified and understood during design and are carried through correctly into development.

Once system integration begins, changes to requirements or scope can have very significant impacts to multiple solution components. By Playback 2, scope and requirements should be well-defined. If they are not, additional playbacks are needed and change controls should be reviewed. Ideally, the release scope is mostly fixed by Playback 3. New or changed requirements that arise need to be managed through change management.

**Current and proposed CPM capabilities**

IBM recently developed a Care Process Management solution for hospitals as part of our work to build a Smarter Planet. Through in-depth interviews and workshops with clinicians using Blueworks Live to model "as-is" processes, IBM developed an understanding of a very complex environment and associated processes. From these discussions, IBM identified a number of pain points that were uniform across care providers. These are presented in Table 2.

**Table 2. Common pain points in a hospital environment**

<table>
<thead>
<tr>
<th>Pain point</th>
<th>Business impact</th>
<th>Benefit of CPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited visibility to patient information</td>
<td>Members of the patient’s circle of care frequently do not know what a patient’s current state is. Lack of visibility into the patient's current status, history, diagnostic information, and so on, leads to redundant testing, confusion, and increased chances for adverse effects or reduced efficacy of care.</td>
<td>Increased visibility to all care providers associated with the patient. Information access can be extended beyond the hospital walls to include community care, family physicians, ministry, reporting, and so on.</td>
</tr>
<tr>
<td>Open loop communications, where a page or message is not acknowledged</td>
<td>Clinical practitioners request consults, referrals, labs, diagnostic imaging, and so on, but have no idea if the requested group or individual actually received the request and is taking action.</td>
<td>All members of the patient circle of care know that requests have been made, received, and are being acted on or scheduled.</td>
</tr>
<tr>
<td>Barriers to collaboration</td>
<td>Disconnected people and systems with many possible communications channels operating across multiple locations leads to a breakdown in collaboration not an increase.</td>
<td>All members of a patient’s care team can collaborate with each other more directly and efficiently leading to decreased wait times, confusion, and errors. Ultimately, this will lead to better health outcomes for patients.</td>
</tr>
<tr>
<td>Unmanaged process variability</td>
<td>Many processes remain manual that can be automated or standardized as each person executes processes in their own unique way based on years of trial and error, leading to</td>
<td>Coordinated and streamlined processes provide consistency of care and allow clinicians to focus on higher needs or complex patients.</td>
</tr>
</tbody>
</table>

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lack of standardization and increased potential for adverse effects.

| Unmeasurable performance and unknown results | Lack of accountability across the organization, which leads to management by anecdote where clinicians argue about who did what when without the benefit of actual supporting data. | Operational (real-time) process-related reporting, as well as historical time-series data, allows for complex analytics, performance dashboards, reporting, and simulation. |

IBM consolidated this information and simplified it down to a set of "to-be" processes that coordinate the communication of care delivery. Figure 4 presents a simplified version of those processes.

**Figure 4. Care Process Management discovery using IBM Blueworks Live**

Several core concepts for CPM emerged:

- Each patient has a circle of care that includes all of the service providers who interact with a patient and with each other in the performance of all activities related to that patient's clinical care. Creation, maintenance and access to a patient's circle of care is enabled using BPM.

- Care providers work together to develop a Multi-Disciplinary Activity Plan (MDAP) for each patient. The MDAP provides visibility into activities and progress across the care team from admission to discharge; facilitates communications and collaboration across the care team; reduces time spent searching for people and information, increases time available for patient care; and improves resource budgeting, allocation and scheduling. A critical function of BPM is to help care providers create and update a patient's MDAP.

- Today, requests for clinical staff are typically paged. Paging is a one-way communication mechanism. It limits the information that can be sent and the sender doesn't know whether the page has been received until the staff member calls or shows up somewhere. Often multiple pages need to be sent or multiple people get paged in the hope that someone will respond. This is highly inefficient. A better means of communication involving closed-loop communications is needed to improve care delivery. Closed-loop communications can be implemented using Lotus® Sametime, SMS messaging, email or other mechanisms, but BPM assures that requests are sent, responded to, or escalated as appropriate to the situation.

The set of CPM capabilities defined in Figure 5 were developed after consideration of ambulatory and non-ambulatory requirements.
The CPM reference architecture

IBM has specified a reference architecture, shown in Figure 6, to meet the CPM needs of large clinics, hospitals, and Accountable Care Organizations (ACOs). The CPM architecture could even be deployed across healthcare providers at a state, provincial or governmental level.

The CPM reference architecture has the following key value propositions:

- Has flexibility to provide core and enhanced IT functionality
- Follows architectural best practices for separation of user, business and information concerns
- Is based on established reference architectures that embrace the intersection of SOA, BPM and decision management
- Is secured
  - Integrates with enterprise directory and security infrastructure
• Provides role-based access customizable to enterprise roles

Core IT functionality

While CPM can be implemented using a broad portfolio of IT services, just four functional components are needed to provide the minimum required IT functionality. Additional services (plus security) can be layered into the solution as requirements evolve.

• **BPM engine** – Care processes execute within a BPM engine. The engine implements the following functions that are critical to CPM:
  • Notifies care providers when a patient is admitted, when a consult is requested and when the patient is discharged
  • Creates and maintains an electronic version of the multi-disciplinary activity plan on behalf of the doctors and nurses
  • Manages assignments, reassignments and coverage of care activities on behalf of care providers
  • Can integrate with external systems to schedule medical procedures or equipment

• **Business services** – Implements services for access to CPM functions by the user interface and by external applications.

• **Web or mobile user interface** – Provides a way for care providers to participate in care processes and access patient information. Mobile access from iPads® or tablets can be provided using the IBM BPM Mobile application. However, BPM also supports Safari® mobile browsers and a customized user experience can be implemented using Dojo.

• **HL7 messaging** – Provides standards-based Health Level 7 (HL7) exchange of patient, health information, clinical orders and results, health records, billing and reimbursement. HL7 messages allow the CPM environment to be integrated with other IT systems such that:
  • Creation of a patient MDAP begins with check-in or admission
  • The MDAP is updated as care activities progress
  • The MDAP is suspended or terminated when the patient is discharged or their visit is completed

IBM has implemented the core capabilities of CPM using IBM Business Process Manager and WebSphere Message Broker.

Complementary IT functionality

Beyond the core functionality of CPM, a variety of other IT functionality can contribute to care innovation to help optimize healthcare delivery. Since the functionality is not required for an initial or less complex implementation, it has not been built into the core solution. However, care organizations typically have already implemented at least some of these functions. The preferred approach is to integrate with what health organizations have in place rather than to duplicate existing services.

Collaboration and communications

Enabling collaboration between care providers is a critical CPM capability. Being able to readily see who is caring for a patient – the patient's circle of care – is an important step towards
provider collaboration. However, giving providers the ability to instantaneously collaborate is transformational.

Providers may want to collaborate in a number of ways. Here are two examples from those shown in IBM's CPM reference architecture:

- Click-to-dial can set up a quick call between two providers.
- Instant messaging or conferencing allows sharing of patient information through images and application links; multiple participants can be invited when patient care needs to be coordinated across two or more providers.

Often, however, a provider may be with a patient and is not instantly available. To remedy this problem, it can be very useful to share daily schedules. Presence services – the ability to see whether a person is available, in a meeting, or in do-not-disturb mode – is another valuable capability.

**Rules and decision management**

We have observed that different medical disciplines adhere to the same general process for care delivery, but disciplines have different practices for assigning providers to a patient, for how consult requests are allocated, for how they implement coverage models, and in their handling of communications. As an example of variability, a hospital may ask for acknowledgement of emergency room consult requests within 5 minutes, but allow 30 minutes or an hour before acknowledging other kinds of consult requests.

And of course, individual communication preferences can vary from one provider to the next. One doctor may want to be paged to the emergency room, but to have other consult requests go to his or her iPad. Another doctor may want all requests to go to his or her mobile phone.

Hard-coding of business rules makes care processes rigid and more costly to change. Implementing care process decisions in a business rules engine gives individual medical departments and providers much more flexibility.

While not required for smaller medical facilities, decision management becomes an essential IT capability for medical institutions with more than one or two departments. Rule authoring, as well as execution-time capabilities, are needed. To maximize the usefulness of the decision management IT capabilities, the rule authoring environment must provide interfaces that make it possible for care providers to update rules and preference information.

**Partner management**

Nearly every kind of care facility needs to interface to insurers for pre-approvals and payers for invoicing and payments. In addition, it is desirable to make referrals, and to share and allow scheduling of visits in a regional system. However, communications standards usually lag behind the innovation in healthcare services brought online. Individual communicating partners may implement different communications and different security mechanisms.
To support integration of healthcare participants with a diverse set of systems and practices, partner management can be helpful. Partner management provides a framework for implementing communications with partners while managing functional, protocol and security diversity.

**Device management**

A variety of devices adds value in healthcare. Kiosks can be used by patients to self-register with a care provider or check in for an appointment. Wristband readers can be used to identify patients. RFID can be used to determine where they are at any point in time. Numerous devices monitor vital signs within a hospital and report problems across wired or wireless networks.

An IBM study [5] analyzed how the market for medical devices is likely to change. As healthcare shifts to consumer-directed models, consumers will be encouraged to better manage their health and help contain rising costs. Technological advances are making it possible for smart, connected personal healthcare systems to supply crucial information for health management, and consumers are open to paying for devices that meet their needs.

Communicating with healthcare devices will present challenges for the IT infrastructure. First and foremost, IT must make it easy for care providers and patients to use monitoring devices and share the information they collect. Inside a hospital, healthcare devices represent a new set of endpoints to be inventoried. Whether inside the walls of a hospital or outside, communications must be secured and trusted. IT must plan for an avalanche of data - how to use it, how to store it, how to analyze it for ongoing care improvements. Endpoint security and asset solutions exist today to address these basic management demands. Standard approaches for ease of use still need to be developed, especially in those cases where patients procure their own devices.

**Reporting, analytics and care process data management**

If CPM were only about automation of processes, it would offer considerable value. However, healthcare organizations should look to optimize their processes over time by iteratively collecting delivery information, analyzing the information for inefficiencies, and then by making incremental process improvements.

Out of the box, IBM Business Process Manager provides capabilities for monitoring business processes and collecting information, defining service level agreements (SLAs) and configuring key performance indicators (KPIs), and for creating dashboards that measure current KPIs and performance against SLAs. IBM BPM also provides the ability to simulate how process or staffing changes could increase efficiency and improve care delivery processes.

At some point, care organizations will want to analyze information relationships spanning multiple systems. For example, IBM BPM may show that certain kinds of consult requests take longer to be acknowledged, but detailed call center records may need to determine what is causing delays. In order to perform this kind of analysis, data federation may be used when data resides in multiple systems. As an alternative, data from multiple sources can be brought into a data warehouse or data mart for analysis.
Sample high-level design

Figures 7 and 8 present different views of a sample high-level design for CPM. Figure 7 shows solution components within a typical 3-tier structure. Likely connectivity between solution components is represented.

**Figure 7. Three-tier structuring of CPM**

![Three-tier structuring of CPM](image)

Figure 8 presents a wiring diagram view of the CPM platform that it has implemented. It also describes information flows within the solution.

**Figure 8. Wiring diagram for CPM**

![Wiring diagram for CPM](image)

In this CPM implementation, IBM Worklight® is the recommended platform when implementing a custom web or mobile user interface. WebSphere Enterprise Service Bus hosts business services and the Healthcare Pack enables HL7 messaging with healthcare applications. IBM Business Process Manager is the BPM engine that supports long-running processes and human-centric
workflow. A small number of complementary services have been added to facilitate real-time human collaboration, for real-time notifications and closed-loop communications, and to support evidence-based care administration and process improvement.

At the user interface level, there are alternatives to IBM Worklight, including IBM BPM Mobile or the IBM BPM Process Portal, and these should be considered when developing a proof of concept or during a trial. Ultimately, we expect care providers to demand a more customized user experience. Worklight provides the ability to do this, while supporting a large variety of mobile devices.

While the CPM user interface could make calls to IBM BPM directly, many of functions to be implemented should be treated as business services to be reused across the healthcare enterprise. For this reason, CPM functionality is exposed through an enterprise service bus. These services include:

- **Device** – registration, de-registration, notifications
- **Patient** – access and manage patient information
- **Provider** – access and manage care provider information, including activity lists
- **MDAP** – access and manage the care plan
- **Circle** – access circle of care information

CPM business services that control care processes have been implemented using standard IBM BPM Web 2.0 RESTful services. CPM was developed using a standard interaction pattern. When an update is needed, a business service interacts with the BPM using the following API paradigm:

- **Search API executeQuery** – The search API was used to create dynamic or custom inboxes. When a care provider selects a particular activity to work on, it identifies a task ID used below.
- **Task API startService** – This call assigns the task to the care provider who will then make queries and updates.
- **Service API getData** – This call gets data to be presented to the care provider.
- **Service API setData** – This call updates data in BPM based on modifications made by the care provider.
- **Service API resumeService** – This call is crucial. It allows the task to complete. If it is not called, the task remains assigned to the care provider.

**Conclusion**

Care process management offers a roadmap that will help the healthcare industry to transform delivery. Without changing what healthcare workers do best, it addresses the inherent inefficiencies of the care delivery process. Many aspects of care delivery can be improved using business process management to automate the coordination of care delivery and to enable providers to collaborate more effectively.
Related topics

• Redefining Healthcare with Information Technology: Improving Systems, Patient Care and Clinical Outcomes
• The Ottawa Hospital Smarter Planet Reference

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