

The Role of Clinical Pathways in Improving Patient Outcomes

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Abstract

Clinical pathways have been developed to facilitate the management and delivery of quality clinical care in a time-constrained environment. Having initially been developed for use in hospitals, they are now being used in other clinical areas, such as home care. In this report we review the background, definition, process, benefits, implication, functionality and applicability of clinical pathway. We review them in conjunction with Clinical practice guidelines and demonstrate the usage of TASC for Stroke and Stemi.

Keywords: Clinical Pathways; Integrated care Pathways; GLIF, GEM, PROforma, Clinical Practice Guidelines; Clinical Practice Improvement; Evidence-Based Medicine; Stroke; STEMI (ST-Elevation Myocardial Infarction); Clin-eguide; PEPCID PCP

1. Introduction

Clinical pathways are multidisciplinary plans (or blueprint for a plan of care) of best clinical practice for specified groups of patients with a particular diagnosis that aid in the coordination and delivery of high quality care [7]. They are a documented sequence of clinical interventions that help a patient with a specific condition or diagnosis move, progressively through a clinical experience to a desired outcome. Predominantly, they are management tools and clinical audit tool that are based on clinical information developed in other guidelines or parameters. They are specific to the institution using them. Originally, critical pathways began with admission and ended with discharge from the hospital. Today, they are usually interdisciplinary in focus, merging the medical and nursing plans of care with those of other disciplines, such as physical therapy, nutrition, or mental health. They provide opportunities for collaborative practice and team approaches that can maximize the expertise of multiple disciplines. Clinical pathways have four main components (Hill, 1994, Hill 1998): a timeline, the categories of care or activities and their interventions, intermediate and long term outcome criteria, and the variance record (to allow deviations to be documented and analyzed). They differ from practice guidelines, protocols and algorithms as they are utilized by a multidisciplinary team and have a focus on the quality and co-ordination of care [1].

In essence, a clinical path is not a mandatory treatment plan, a standard of care, a substitute for clinical judgment, or a substitute for physician orders. The intraoperative clinical path serves as an integrated documentation tool to stabilize the intraoperative process of patient care (Patterson, 1997) and effectively manage clinical and financial outcomes. (Windle, 1994). [2]

2. Background

Critical Path & Process Mapping methodology was used in industry, particularly in the field of engineering from as early as the 1950s. In the 1980's, clinicians in the USA began to develop the pathway tool within Managed Care; they were re-defining the delivery of care and attempting to identify measurable outcomes. They were focusing on the patient rather than the system, but needed to demonstrate efficient processes in order to fulfill the requirements of the insurance industry. Developed and used initially for the purpose of cost containment, in the UK in the late 1980s, the emphasis has been to use clinical pathways as a quality tool. They were developed in response to the initial Diagnostic Research Group based prospective reimbursement system of the early 1980's at the New England Medical Center by Karen Zander and Kathleen Bower, among others

In the early 1990's the NHS in the U.K. funded a patient focused initiative to support organizational change. This resulted in the investigation and development of concepts such as pathways. In 1990 a team from the

U.K. visited the USA to investigate the use of these pathways, or 'Anticipated Recovery Pathways' as they were then called. As a result of this visit, 12 pilot sites for Pathways were set up in Northwest London in 1991-2. The West Midlands Pathway Development work also got underway. By 1994, the Anticipated Recovery Pathway had evolved into the Integrated Care Pathway (ICP) in the U.K. ICPs were clinician led and driven, and had patients and locally agreed, best practice at their heart. In response to demand for a coordinated ICP users group, the National Pathways User Group (later re-named the National Pathway Association) was set up in 1994. It finally folded in 2002. The NeLH Pathways Database was launched in 2002 to enable the free sharing of ICPs and ICP Projects across the U.K. The International Web Portal dedicated to ICPs was launched in 2002 to enable the free sharing of ICP information and to provide ICP user and developer forums for discussion and sharing of best practice and development skills. Since, 1992 ICPs have been developed and implemented across all healthcare settings in the U.K. (acute, community, primary, mental health, private, independent, NHS).

Originally used in cold surgery, because the healthcare can be more easily standardized, they are increasingly being developed and used for other patient / treatment categories ICPs are now used all around the world including the U.K., USA, Canada, New Zealand, Australia, Germany, Belgium, and the Netherlands. [6]

3. Definitions

A clinical pathway is a tool used in achieving coordinated care and desired outcomes within an anticipated time frame by utilizing the appropriate resources available. A clinical pathway is a blueprint that guides the clinician in the provision of care. (Australian government Department of Veterans Affairs, [3])

Clinical pathways are pre-conceived patient care algorithms, or paths, that are intended to reduce variability and cost, increase efficiency, and ultimately improve patient care. (PedCCM: Clinical Pathways and Guidelines, [4])

***"Pathways provide patient focused care with benefits to the patient, family and members of the multi-disciplinary team. They allow for the continuous evaluation and improvement of clinical practice and help to stimulate research. Their use represents a new approach to patient care, fulfilling many of the demands of clinical practice".
(Dr Denise Kitchiner, Consultant Cardiologist, Royal Liverpool Children's NHS Trust, [8])***

4. Why Clinical Pathways?

Due to the ongoing changes in medical technology it has become necessary that hospitals begun introducing clinical pathways to cut costs and reduce the variation in care. There are four major reasons for developing clinical pathways [8]:

- To improve patient care by improving the quality of patient care through consistent management by encouraging patient involvement and by identifying and measuring improvements in patient care and outcomes.
- To maximize the efficient use of resources by reducing unnecessary documentation and overlap and reduced length of hospital stay for particular conditions. Patients who do not make expected progress can be easily identified and the appropriate interventions made.
- To help identify and clarify the clinical processes by ensuring continuity of patient care by reducing unnecessary variations. The development and implementation of clinical pathways increases collaboration between the disciplines, professionals and agencies. This ensures continuity of patient care by reducing unnecessary variations in the management of the patient.
- To support clinical effectiveness, clinical audit and risk management. Clinical pathways also provide an appropriate framework to promote and measure the success of the clinical effectiveness cycle, which encompasses: Evidence based practice, clinical audit, patient involvement, multi-disciplinary, multi-professional working, outcome measures and Clinical benchmarking.

Hospital administrators have difficulty understanding why patients with similar illnesses having surgery are treated in different ways [Figure 1]. Different approaches to care, while not affecting clinical outcomes, can result in different economic outcomes.

For example, taking a case where the length of hospital stay for patients having the same surgery may vary significantly depending on the surgeon and the variability in care makes it difficult to ascertain how to improve care. Some of this variability is necessary due to patient conditions (i.e., co-morbidity). Unnecessary variation erodes quality of care, and makes it more difficult to assess interventions designed to improve quality.

Hence, each pathway must be flexible enough to allow for variations that reflect that patient's specific circumstances (to ensure ownership by the individual patient). Unnecessary variations in practice and outcomes among patients with the same diagnosis can be reduced. [8]

A variation is described as being a detour from the patient care activities outlined in the clinical pathway. In general practice there are three distinct types of variation [8]:

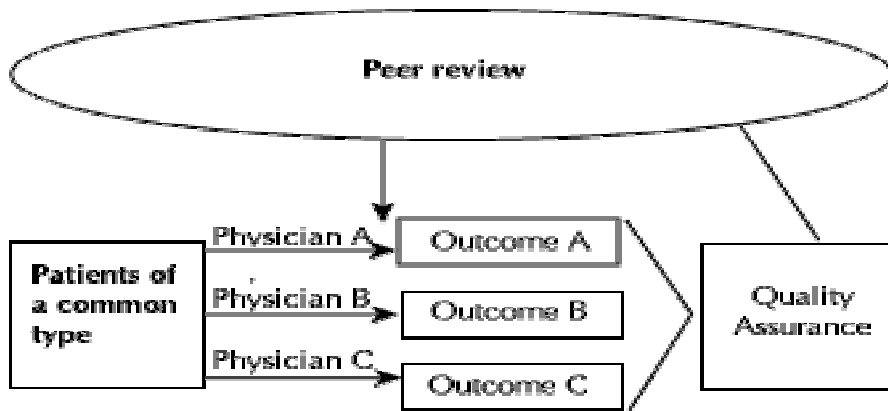
- Systems variations - these include organizational failures such as the unavailability of staff or transport.
- Health and social care professional variations - these include clinical judgments
- Regarding the addition or deletion of specified interventions; and
- Patient variations - these include unexpected illness or complications and patient care.

As active management tools they:

- Eliminate prolonged lengths of stay arising from inefficiencies, allowing better use of
- Resources
- Reduce mistakes, duplication of effort and omissions
- Improve the quality of work for service providers
- Improve communication with patients as to their expected course of treatment
- Identify problems at the earliest opportunity and correct these promptly
- Facilitate quality management and an outcomes focus (Gallagher, 1994)

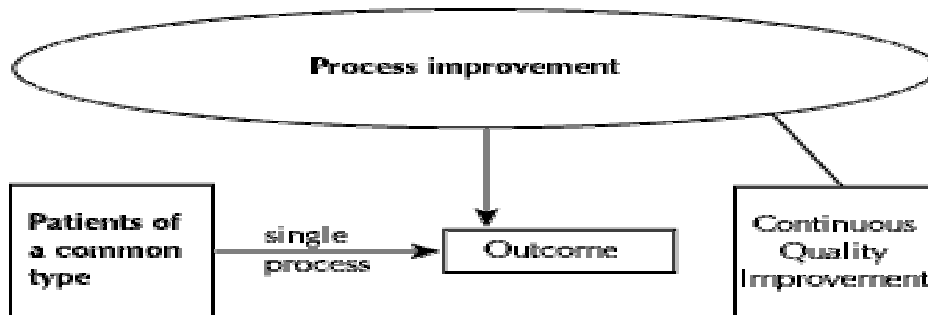
So, if clinical pathways can reduce the portion of financial risk due to provider variability, the risk will be limited to accurately forecasting the numbers of procedures performed for a given number of covered lives. Techniques from industry quality management science are among the newer approaches to managing the delivery of health care. Clinical pathways, also known as care pathways, practice guidelines, or critical pathways, are an application of this industrial quality management science to health care. They standardize practice in the unique culture and environment of individual hospitals and the clinical pathway timeline defines the expected flow of services for a group of patients with a particular diagnosis or undergoing a particular procedure [Figure 2]. In the course of that timeline, a clinical pathway outlines recommended tests and therapies based upon a combination of clinical practice consensus and evidence from the scientific literature.

Figure 1



Medical care that physicians deliver is based upon tradition, their own training and personal anecdotal experience. So, as a result the patients with a common condition; are treated differently by different physicians resulting in differing outcomes. Variation in care often obscures the effect of a particular intervention on that care. Peer review and quality assurance have been the mechanisms for quality improvement.

Figure 2



With a clinical pathway in place, patients of a common type (e.g., knee replacement surgery) are treated under a single process defined by the clinical pathway, potentially eliminating waste and duplication of effort.

Pathways also have a part to play in clinical risk management. When the pathway is developed, current practice is reviewed and the most recent evidence incorporated into the pathway. Potential risks can be identified and procedures established to minimize them. By including these in the pathway, changes in practice can rapidly be communicated to all members of the multidisciplinary team. Analysis of variation from the pathway can be used to monitor areas of potential risk. Poor documentation can fail to indicate whether a guideline has been followed, and this can readily be addressed by the introduction of the pathway. Another aspect of risk management is preventing the recurrence of untoward events. Pathways can include guidelines that ensure all health professionals are aware of potential risks and take appropriate action to prevent them from recurring.

4.1 Are Clinical Pathways and Protocols the same thing?

Clinical Pathways may go by many names, but there is only one-way to be sure that a document is a true clinical pathway - it will contain structured variance tracking.

It is not:

- a protocol
- a flow chart of events
- a care map
- a process map
- a decision tree
- a guideline
- a care plan

They may contain protocols and guidelines and they may start their developmental histories as a process map, flow chart or decision tree, but unless they have a mechanism for recording variations/deviations from planned care/activities when used as the record of patient care, then it is not a true clinical pathway.

Some of the other names used to describe clinical pathways include:

- Anticipated Recovery Pathways (ARPs)
- Multidisciplinary Pathways of Care (MPCs)
- Care Protocols
- Integrated Care Pathways
- Pathways of Care
- Care Packages
- Collaborative Care Pathways
- Care Maps®
- Care Profiles

The genuine clinical pathway is characterized by:

- Patient centered - built into packages of care for identified groupings
- Systematic action for consistent best practice, continuous improvements in patient care, all with attention to the patient experience
- Continuous feedback via variance tracking and analysis
- Multidisciplinary - based on roles, competence & responsibility rather than discipline alone
- Maps and models clinical and non-clinical care processes
- Incorporates order and priorities including guidelines and protocols
- Includes standards and outcomes [6]

5. Clinical Pathway Development

The implementation of a clinical pathway is most likely to succeed when the decision to develop is taken on an organizational basis. Senior management commitment and a strong medical and nursing lead are essential. Pathway documentation is more likely to be used if it is simple, clear and user friendly. The process of pathway development considers why tasks and interventions are performed, and by whom; since it promotes greater awareness of the role of each professional involved in the care cycle.

The development of a clinical pathway to manage patients presenting with chest pain includes:

- Patients, or their representatives;
- General Practitioners;
- Paramedics;
- Accident and Emergency staff;
- ECG Technicians;
- Pharmacists;
- Pathologists;
- Coronary Care staff;

- Cardiac Rehabilitation nurses; and
- Social Services and Community Staff and members of Primary Health Care Teams.
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- Social Services and Community Staff and members of Primary Health Care Teams. [8]

5.1 The Process of Development and Implementation of Clinical Pathways

There are a number of essential steps in the development and implementation of a clinical pathway. Clinical pathways are tools developed by the multidisciplinary team, not by one discipline alone. Starting at step 1 and following the guidelines leads to the successful development and implementation of the pathway.

Guidelines for the Development and Implementation of Clinical Pathways:

The essential steps in the development and implementation of a clinical pathway are summarized as follows:

- Educate and obtain support from physicians and nurse, and establish a multidisciplinary team.
- Identify potential obstacles to implementation.
- Use Quality improvement methods and tools.
- Determine staff interest and select Clinical Pathways to develop.
- Collect Clinical Pathway data and medical record reviews of practice patterns.
- Conduct literature review of clinical practice guidelines.
- Develop variance analysis system and monitor the compliance with documentation on Clinical Pathways.
- Use a pilot Clinical Pathway for 3 to 6 months; revise as needed.

Develop automated data collection if possible. *(By Ignatavicius, D.D. & Hausman, K.A)[7]*

6. Benefits and Issues of Clinical Pathways [1]

Benefits	Issues - potential problems and barriers to the introduction of Critical Pathways [1]
Support the introduction of evidence-based medicine and use of clinical guidelines	The pathway does not have commitment at a senior level [8]
Improve multidisciplinary communication, teamwork and care planning	Insufficient time and resources dedicated to the process [8]
Provide explicit and well-defined standards for care;	Don't respond well to unexpected changes in a patient's condition
Help reduce variations in patient care (by standardizing care);	May take time to be accepted in the workplace
Help improve clinical outcomes;	Cultural factors are also a common barrier to the development and implementation of clinical pathways [8]
Support training;	
To maximize the efficient use of resources without compromising the quality of patient care. Improve management of resources	The existence of a blame culture. Organisational issues including poor communication, internal politics, the lack of commitment and strategic direction [8]
The pathway approach can reduce documentation by forming a single, unified patient record and by recording only variations from the pathway on an exception	The lack of understanding of the pathway approach or the need to adopt a different approach from the one in place [8]

basis.	
Provide a means of continuous quality improvement in healthcare	Rotation of posts, resulting in lack of document ownership [8]
Support the implementation of continuous clinical audit in clinical practice	The poor layout of the pathway document. This problem is compounded when two types of document are in use in one clinical area [8]
Support the use of guidelines in clinical practice	Risk increasing litigation
Help empower patients	Lack of feedback of variances and outcomes [8]
Help manage clinical risk	Lack of direction and guidance from senior clinical staff [8]
Help improve communications between different care sectors	Problems of introduction of new technology
Disseminate accepted standards of care	
Provide a baseline for future initiatives	
Not prescriptive: don't override clinical judgment	
Expected to help reduce risk	
Expected to help reduce costs by shortening hospital stays Patients who do not make expected progress can be easily identified and the appropriate interventions made.	

7. Role of Knowledge Management

7.1 Knowledge Management in Health Care

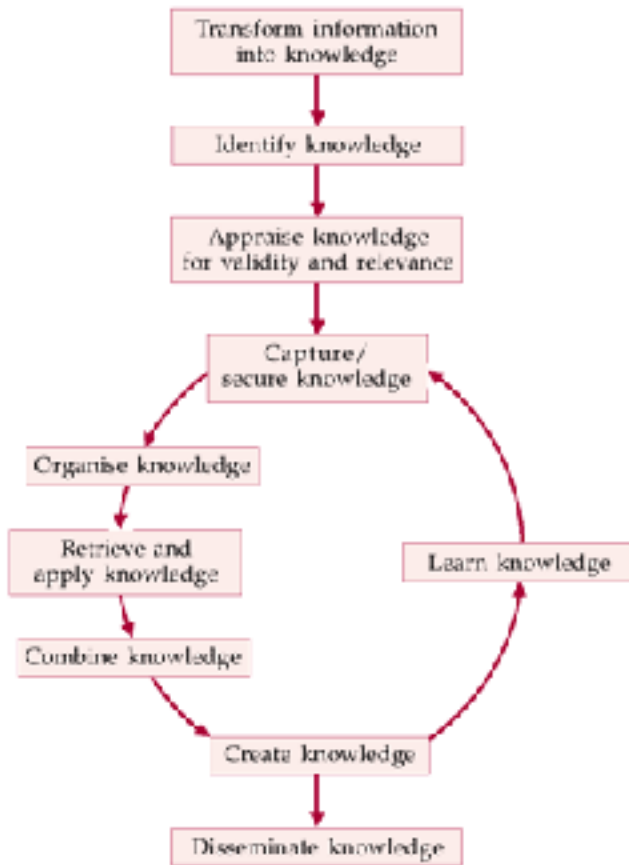
Healthcare organizations have identified that mere utilization of best medical practices and use of information technology is not sufficient to improve healthcare outcomes and to minimize the escalating costs. Medical knowledge is a complex and rapidly expanding field. Practitioners need to access knowledge to improve and evaluate their clinical practice, require prompt and precise patient information to provide better care. It is the effective, efficient and timely utilization of knowledge at the point-of-care that improves the healthcare performance and the success of an organization. [19]

7.2 Definition of Knowledge management

Knowledge management can be defined as "the systematic process of identifying, capturing, and transferring information and knowledge people can use to create, compete, and improve" American Productivity and Quality Center.

Gartner group defines knowledge management as a discipline that promotes a collaborative and integrated approach to the creation, capture, organization, access and use of an enterprise's information assets. This includes databases, documents and, most importantly, the uncaptured, tacit expertise and experience of individual workers.

Knowledge management 'comprises the identification and analysis of available and required knowledge, and the subsequent planning and control of actions to develop knowledge assets so as to fulfill individual and/or organizational objectives' Macintosh (1997). Figure 3.



The various elements of knowledge management are identification, creation, capture, analysis, dissemination and acquisition. [14]

Knowledge management systems assist the healthcare providers to improve decision-making, in creation and utilization of the existing and new knowledge for continuous learning and knowledge sharing within the healthcare organization. An important element of the knowledge management system is the social networks where the success and failures are shared by the group members and thereby provides an environment for future learning.

There are various areas of knowledge management that aims to improve the quality of medical practice. Some examples are: -

- The application of clinical protocols or clinical guidelines and integrated care pathways.
- Various techniques and systems are used that help clinician to improve and support decision-making.
- Techniques and systems are used for assessing costs and quality of treatment so that the healthcare organization can acquire the knowledge to make better decisions.
- Knowledge management system aligned with the institutional goals helps the healthcare providers to target towards attaining the goals.

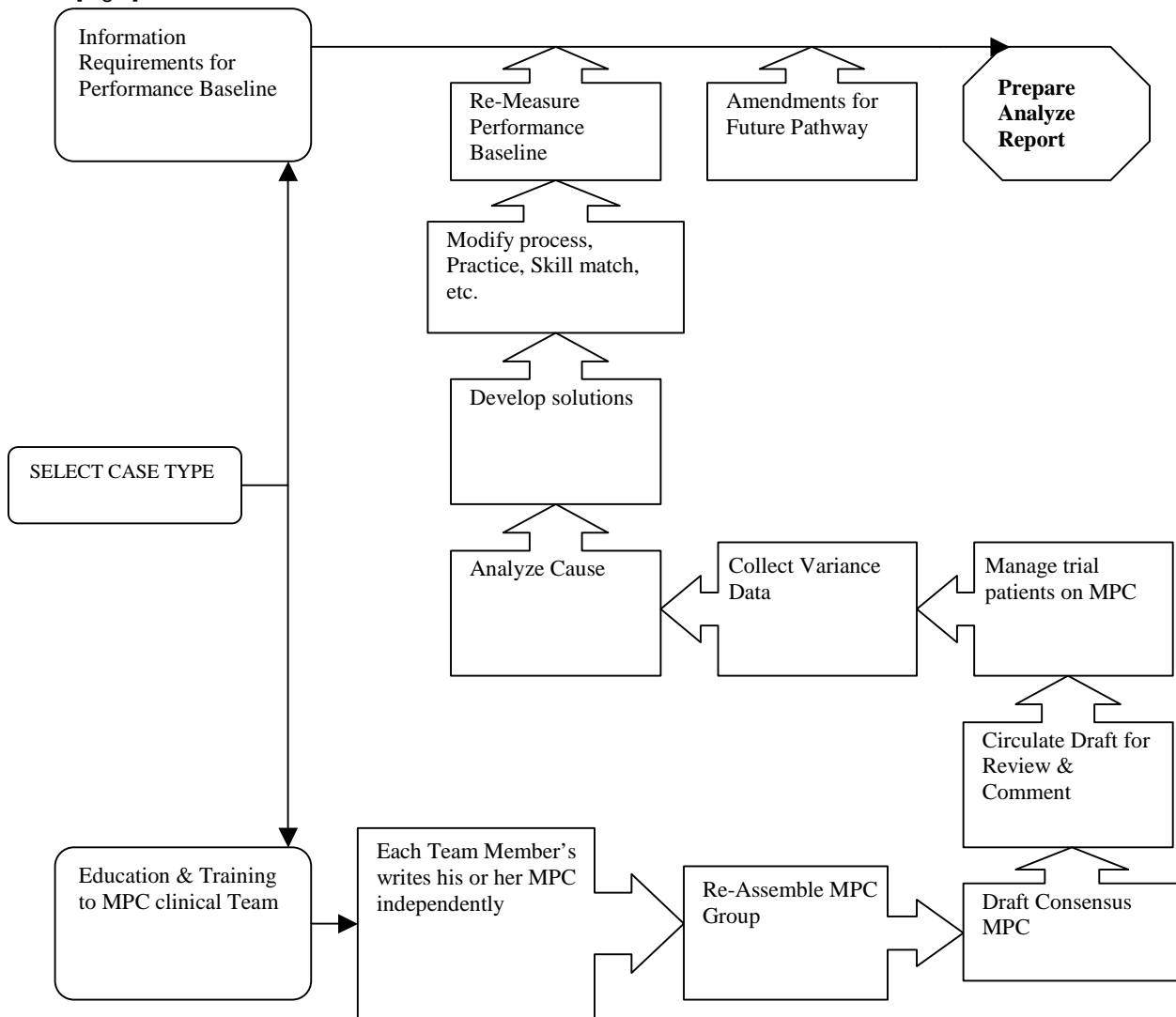
Some of the hindrances faced are:

- If knowledge-based systems were not incorporated in the hospital information system then there would be either deficiency or repetition of knowledge.
- There is a lack of principles and representation for the incorporation of knowledge, related to the financial perspective in the health sector.
- Healthcare practitioners should accept and use technologies to enable them enhance medical practice. [15]

7.3 Knowledge Management in Clinical Pathways [20], [21]

The first step in the development of a Pathway is the case-type example is myocardial infarction. Case-type could base on the diagnosis, treatment stage, patients with a particular condition or procedure done. Education and training is provided to the multi-disciplinary team where each member shares their knowledge and expertise with the other disciplines. Each member prepares a pathway by using their tacit knowledge acquired through empirical evidence and explicit knowledge gathered through various sources like literature reviews, contacts with other hospitals where care maps have been implemented. Then the team reviews and consensus on 'best practice' is achieved. The accepted pathway is implemented and variance data is collected from the trial patients and analyzed. The knowledge acquired through this process helps to identify the area where evidence-based information regarding the best treatment method is lacking. The pathway again review and written. In this manner the integrated care pathway provides continuous quality improvement.

[Fig 4].



8. Guideline modeling methods

8.1 Guideline Interchange Format (GLIF): -

It is the structured representation model of clinical guidelines used for decision support application. It enables sharing of clinical guidelines across institutions and system platforms and is based on object-oriented logical model of concepts. There are various shortcomings of GLF2 like the overuse of text strings

in attributes, no controlled ontology, limited set of low-level constructs and limited decision model. GLF3 is an enhanced model of GLF2, which supports computer-based execution. It is XML based syntax and the model is described using Unified Modeling Language and Object Constrained Language.

GLF3 includes GLF2 specifications with various new constructs. It models guidelines at three levels: -
 Conceptual flow chart: - It helps the users view and understand the guidelines. It's a flow chart of clinical actions and decisions.

Computable level: - It is verifiable for logical uniformity, action and flow of clinical guidelines.

Implementation level: - Guidelines are integrated into the clinical information system.

The GLF3 medical ontology comprises of three layers: -

- The Core GLF
- The Reference Information Model (RIM) – The GLF3 accepts the HL-7 Reference Information Model.
- The Medical Knowledge

8.2 The Conceptual flow chart of a part of Stable Angina guideline

Action steps represented by green squares, decisions are represented as diamonds.

Blue diamonds represents the case step

Purple diamond represents a choice step [22,23]. [Appendix Figure 1]

8.3 GEM (the Guideline Elements Model): -

It is XML – based guideline model that organizes diverse information in clinical practice guidelines. The XML used is clearly expressible, adaptable, enhances knowledge sharing and reutilizing the available knowledge that could be understandable to both man and machine. It translates guideline knowledge into computer-inferred format. It is created with tags and 9 main branches that include identity, purpose, intended audience, development method, target population, testing, review plan, and knowledge. The knowledge element comprises of recommendation, definition and algorithm. Gem cutter is the tool that converts guideline information into GEM format. GEM files could be used for guideline quality evaluation, development, dissemination and execution. [17]

8.4 PROforma: -

It is knowledge representational language used to capture clinical protocols and guidelines in a computer interpretable format. It is been used in various clinical applications like CAPSULE (Computer Aided Prescribing Using Logical Engineering) that guides clinicians with medical prescriptions for various clinical situations, RAGs (Risk Assessment and Genetic screening) a system for assessing risks in cancer genetics, ERA that helps the practitioner with cancer referral guidelines. Arezzo and Tallis are the two PROforma enactment systems. [24].

The four elements of PROforma task are the plan, decision, action and enquiry. Action represents events to be carried out, plan comprises of group of tasks, decisions are the choice points, and enquiries are points where information is acquired from external source.

The method of modeling knowledge used in clinical decision- making is based on the domino model. Based on the signs and symptoms of a particular condition the clinician decides the possible solutions to solve the problem. If there are various treatment options then the system makes judgments based on the effectiveness of the arguments. The decision may result in a new belief or plans which would require a set of actions to be carried out sequentially to accomplish the objective.



DOMINO MODEL

The PROforma software comprises of editor, which creates and edits the guidelines graphically and engine, which implement and allows debugging of the guidelines. [25], [26].

9. Knowledge Management Tools

There are various knowledge management tools like the Clinical Pathway Constructor, Evidence-based Forecaster, Pain manager, Safety Optimizer used in healthcare.

The Clinical Pathway Constructor: It recognizes the “best practices” and provides the clinicians with latest updates on the current clinical knowledge through peer-reviewed literature. It’s cost-effective and easy to use.

The Evidence-based forecaster: It is a web-based application that permits healthcare professionals and healthcare organizations to improve patient outcomes and promote cost effective treatments through knowledge based on evidence.

The Pain Manager: The Pain Manager is a user-friendly Internet based tool that promotes health care professionals to evaluate their actions as per the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) pain standards and allows organizations to track their own performance. It is essentially designed to assist healthcare professionals and managers to study the pain related evidence and track hospital pain management decisions in order to achieve the pain management standards proposed by the JCAHO.

The Safety Optimizer: The Safety Optimizer is a web-based application that uses evidence-based strategies to reduce physician error and improve risk-reduction standards. It is readily accessible and designed for use by healthcare professionals and managers [16]

10. Are clinical practice guidelines and clinical pathways related? [Figure 6]

Clinical practice guidelines which often underlie clinical pathways are primarily the responsibility of professionals, while chain management is that of the managers and therefore the Clinical Pathways can be considered to be a joint effort designed with the motive to improve the patient outcomes and enhance the quality of diagnosis, interventions and management.

Characteristics of Clinical practice guidelines which make them important tools for the clinical practice to improve the patient outcomes: They are initiated with an attempt to define practice questions and explicitly identify all their decision options and outcomes. They explicitly identify, appraise and summarize, in ways that are most relevant to decision-makers, the best evidence about prevention, diagnosis, prognosis, therapy, harm, and cost-effectiveness. They explicitly identify the decision points at which this valid evidence needs to be integrated with individual clinical experience in deciding on a course of action. Thus, they don't inform the clinician which decision to make and take away his legacy for decision-making. But, instead they identify the range of potential decisions and provide the physicians with the evidence which, when added to individual clinical judgment and patient's values and expectations, will help them their own decisions in the best interest of the patient.

Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. This is the source for the clinical practice guidelines.

This shows that clinical pathways, when used in combination with clinical practice guidelines, will assist in reinforcing a clinical workflow, which can eventually help to improve the clinical practice and support the difficult decisions task for the clinicians. *Clinical pathways use the clinical practice guidelines as their base, and then they distill and deploy the knowledge available from the clinical practice guidelines using various deployment driven methodologies (e.g. SAGE - (Standards-Based Sharable Active Guideline Environment).* Clinical Pathways are a translation of the clinical practice guidelines into protocols and the application of these to clinical practice and evidence-based medicine. There is adequate evidence from the studies so far that the clinical pathway is a means of spawning a change in the clinical practice by improving the systematic collection and abstraction of clinical data and using them to enhance the patient care process.

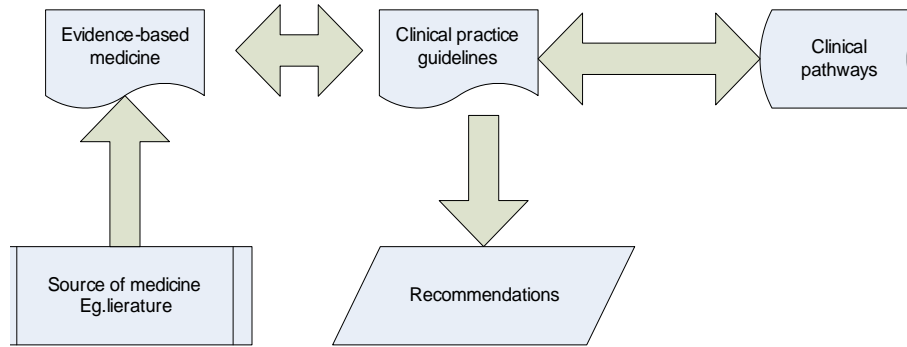


Figure6:

There are studies ongoing that the amalgamation of the tools used for Clinical Practice Improvement and the Evidence-based Medicine, respectively can bring about a dynamic change in clinical practice. It has been demonstrated that evidence-based medicine has significantly contributed to improving the outcomes of the patients, and Clinical Practice Improvement has a large role to play as a process to discuss various clinical issues and in finding the ways to resolve the issues wherein solutions can work out. Clinical Pathways also serve as a source of communication with the patients regarding their specific care plan and progress over time in the form of systematic and clearly sketched out summary of the process of disease management. This is possible because Clinical Pathways form a part of the patient's medical record and summary sheet. Clinical Pathways document the potential steps in the diagnosis and treatment of a condition or a procedure for individual patients to improve the outcomes of the disease or procedure management.

11. Areas implementing the Clinical Pathways [Figure 7]

A care/clinical pathway is an integrated strategy of care for a specific user group based on clinical guidelines and evidence, where available. It determines locally agreed, multi-disciplinary practice and outlines the optimal sequencing and timing of interventions (McQueen and Milloy 2001). The intention of the pathway is to chart a clinical process from start to the end, including the time anticipated to complete key activities in the process.

A prerequisite for clinical pathway is *chain management* which reflects a strategy of managing care pathways, guaranteeing continuity of care, safeguarding best quality of care, ensuring the appropriate use of resources (considering that there are different responsibilities involved) and managing the provision of care.

Out of all the multiple areas listed where we can evaluate the impact of the Clinical Pathways in the outcomes of the patient management, we will look in detail at two areas, which have implemented the use of Clinical Pathways:

1. Stroke
2. Chest pain and STEMI (ST-elevation myocardial infarction)

Since knowledge management means "doing the right things" instead of "doing things right", we will try to focus the insinuation of the Clinical Pathways into clinical practice and their mapping into a strain of knowledge useful for the improvement of the patient management and outcomes in the field of medicine.

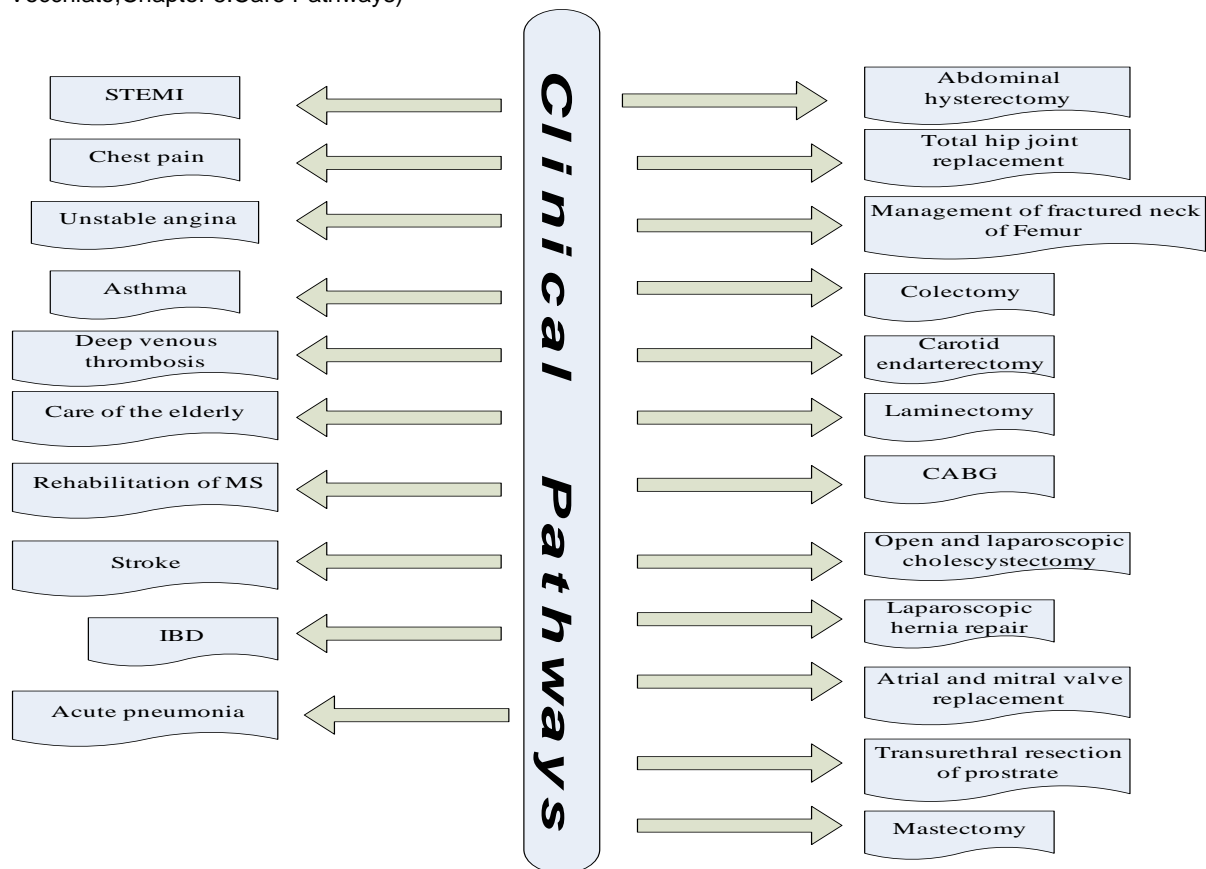
1. **Stroke:** Clinical Pathways are integrated care strategies that offer a means of achieving better integration among practitioners, community-based services, and other health and social care services. (Tiziano Vecchiato)

The main areas of concern for the patients of stroke are the treatment and outcomes and discover the ways for the optimum management of a stroke patient. There is a certainty that if the patients with stroke receive organized care, they will surely have better outcomes and prognosis. In a hospital setting, the well-trained staff and multidisciplinary approach to treatment and care characterize the stroke unit. The core disciplines for such multidisciplinary teams are: medical treatment, nursing, physiotherapy, occupational therapy, speech and language therapy and social work.

The Clinical Pathways ensure a goal-defined, making certain a well-defined efficient diagnosis, organized and time-specified plan of treatment of the patients with stroke, which can ascertain evidence-based practice and an improvement in the quality of outcomes at a lower cost. (Sulch & Kalra, Age and Ageing). They are designed to explicitly define what kind of continuity of care the patients should receive, at what time they should receive this care and what are the roles of the various multidisciplinary teams in the patient care. It has been seen, without much of much evidence to support this, which integrated care

pathways are increasingly being implemented into the care of the patients with acute stroke and rehabilitation of the stroke patients. They have been shown to improve the patient outcomes, the quality of the care, decrease in the interventions ordered for the patients and decrease in the costs and also decrease in the length of the stay.

They should not be seen as a 'cookbook' for healthcare – with prescriptive, step-by-step instructions – but rather as a set of appropriate, evidence-based activities and interventions for a specific user group. Care pathways are instruments that can reduce improper access to hospital emergency services, inappropriate admissions and unplanned discharges. So, to a great extent, they can help avoid unmotivated and undesirable interruptions of care, which can damage people in need and be a waste of resources. Wasted resources are particularly common in situations where different professionals intervene without consulting each other, creating unnecessary and costly overlaps and confusion. (Tiziano Vecchiato, Chapter 5: Care Pathways)



There is an attempt to improve the performance of the Clinical Pathways and minimize the great variances in the application of clinical pathways by physicians, nurses and other staff of the hospital using the data mining technique to discover the time dependency pattern of Clinical Pathways for managing stroke patients. The mining time dependency pattern is to discover patterns of process execution sequences and to identify the dependent relation between activities in a majority of cases. By obtaining the time dependency patterns, we can predict the paths for new patients when he/she is admitted into a hospital; in turn, the health care procedure will be more effective and efficient (Fu-ren Lin a, Shien-chao Chou). Clinical Pathways, being multidisciplinary care plans wherein the various diagnostic and therapeutic interventions done by the physicians and nurses and other hospital staffs are sequenced on a particular timeline for a particular diagnosis or procedure. The application of data mining techniques to design clinical pathways is based on the following rationales, *the design of clinical pathways is knowledge intensive, and the knowledge can be learned from the data collected from the clinical processes*. Moreover, clinical pathways may be embedded with unknown workflow patterns and exception handling. Therefore, it is suitable for using data mining techniques for improving the performance of clinical pathways.

Towards a safer culture (TASC) pathway forms swap the handwritten patient medical record, improve documentation of clinical findings, and enable risk stratification to guide subsequent management. The forms are designed in a software program that enables data acquisition by scanning, optical character

recognition and clinician verification. Each participating hospital modifies the pathways to suit local circumstances, but ensures that a minimum dataset is collected, enabling comparison over time and with other hospitals.

The important considerations for designing the clinical pathways for stroke management aimed to initiate many of the important components of stroke unit care in the emergency department setting. These included:

- Standardized assessment of stroke severity using a simple and reproducible stroke scale and identification of potential high-risk stroke patients using the stroke severity assessment tool;
- Early computed tomography (CT) scanning, with urgency based on risk stratification;
- Early implementation of acute therapies and preventive strategies, particularly for high-risk patients; and
- Attention to detail in stroke care to minimize complications (e.g., early swallowing assessment by medical or nursing staff and interventions for fever and hyperglycemia).

Clinical Protocols implemented by the UVa Emergency Department and Cardiology team up: [Fig8]

Triage system that employs cardiac marker test results and cardiac consultation (same fundamental approach due to the formalized working relationships between the departments and standards of response).

Patients with chest pain are classified according to the five groups, ranging in severity from no cardiac chest pain (lowest risk of mortality) to STEMI (highest risk).

Lower-risk patients may be observed during a 9-hour protocol and then released for follow-up testing (usually within 72 hours). The patient does not have to be admitted or remain in the ED longer than necessary.

Alert System for STEMI to call all players into

When a patient has a STEMI, however, the ED rapidly moves the patient to the Cardiac Catheterization Laboratory for intervention to clear the coronary artery blockage.

Some of the key indicators for the patients with stroke to measure the process of the management (arrival to the emergency department, diagnosis, interventions, treatment, etc), assessment of the risk factors and prognosis and the outcomes of the patients are listed below. These target the various types and causes for stroke and the potential risk groups and the possible indicators for the estimation of their final outcomes.

Key indicators for stroke care

Process indicators

All stroke

- Admission rate by stroke severity
- Time to clinical assessment
- Time to CT scanning
- Time to emergency department separation
- Severity assessment completion rate
- Identification of high-risk categories
- Completion of swallow assessment
- Commencement of interventions for fever and hyperglycemia

Ischaemic stroke

- Commencement of antithrombotic therapy in the emergency department
- Identification of patients potentially eligible for acute therapies

Intracerebral hemorrhage

- Identification of cases requiring possible neurosurgical intervention
- Commencement of blood pressure lowering according to pathway

Transient ischaemic attack

Outcome indicators

- Discharge dependency level
- In-hospital death
- Hospital length of stay
- Pneumonia
- Stroke complications during stay
- Pressure areas
- deep venous thrombosis
- Urinary tract infection

- In-hospital death and dependency rates
- In-hospital complication rates
- Length of stay

- In-hospital death and dependency rates
- In-hospital complication rates
- Length of stay

- | | |
|---|--|
| <ul style="list-style-type: none"> ■ Admission rate by risk category ■ Commencement of antithrombotic therapies in the emergency department | <ul style="list-style-type: none"> ■ Stroke rate in patients admitted with TIA ■ Re-presentation rate in patients discharged after TIA |
|---|--|
- (CT = computed tomography. TIA= transient ischemic attack.)**

Appendix A Fig (II)

2. **Chest Pain and STEMI:** The patients coming with chest pain are generally seen in the emergency departments and admitted to the Coronary Care Units if diagnosed to have acute coronary syndromes and myocardial infarction. It has been shown that two departments concerned with the management of the patients with the conditions, if follow the same set of clinical protocols derived from the clinical practice guidelines and become close partners in the management process, this can improve the patient diagnosis, treatment and outcomes (*UVa Emergency Department and Cardiology Team Up, Mary Jane Gore*). The physicians who evaluate the patient with chest pain in the emergency department have to make rapid, difficult and efficient decision to provide evidence for the admission of the patient in the Coronary Care Unit (CCU). As the diagnosis and admission of a patient with chest pain for acute coronary syndrome is of importance to the organization, government, health insurance companies and health maintenance organizations, it is very crucial and difficult task for the emergency physician to take the appropriate decision.

The focus of the clinical pathways realization in the patients with myocardial infarction is:

- 1) To improve patient outcomes by rapidly opening occluded arteries in patients with Myocardial infarctions.
- 2) To better manage chest pain patients coming to the ED who may or may not be having Myocardial infarction, it is important to properly evaluate all patients for risks but to admit only those who require inpatient care.

Time and off, physicians have felt the need that without appropriate clinical management pathways to triage patients according to risk group and investigate them accordingly, the frequency and timeliness of laboratory testing is irrelevant for the patients with chest pain and myocardial infarctions.

An example of project of applying the evidence for the purpose of realization and putting it into practice is Towards a Safer Culture (TASC) is a joint initiative of the Royal Australasian College of Physicians and the NSW Institute for Clinical Excellence (ICE) in collaboration with the Australasian College of Emergency Medicine. The key tools used to implement TASC in participating hospitals are evidence-based clinical pathways and a measurement system to promote improvement in clinical practice.

An optimal patient outcome requires delivery of multiple forms of care by many clinicians over a care continuum spanning from presentation to emergency department to hospital discharge to general practice. Because of this complexity, several system failures can compromise quality and safety of care. Some of the reasons can be:

- Delayed or incomplete diagnostic evaluation and risk-factor assessment
- Omission, or delayed delivery, of effective treatments
- Insufficient counseling of patients and relevant management
- Imperfect transfer of patient care information between hospital clinicians and general practitioners
- Lack of timely, credible performance data for alerting health professionals to evidence–practice gaps and non-existent or underdeveloped methods for remedying identified deficiencies in care.

12. Challenges faced by the clinical pathways for their implementation:

Acceptance into the clinical practice due to the following aspects:

- Clinicians implement them because they help to classify patients presenting at the emergency department according to their risk and severity and their potential to diagnose complicated cases, and hence guide further investigations and appropriate treatment and support in difficult decision making situations.
- Clinical Pathways make it easy for the appropriate data capture directly from the pathway forms and have the potential enable accessibility to timely data.

Problems for their implementation:

- Difficulties in engaging senior clinicians and persuading them to participate in the procedure of designing and implementation of the clinical pathways (e.g., engaging a cardiologist or neurologist in the process);
- Difficulties in engaging junior medical staff because of their high turn-over, limited free time and heavy clinical loads;
- Problems in finding a common meeting time across disciplines, and

getting the multidisciplinary staff involved in the use of the clinical pathways for the training for their effective use and learning their importance in the clinical practice

13. Functionality of Clinical pathways:

Since the past, paper clinical pathways have been used in defining the road map of patient care and have been used with varying degree of success for providing more cost-effective healthcare and helped to establish quality improvement models for healthcare delivery. However, all paper systems are designed based on **linear sequential model** with little decision support capability. Current electronic versions of the paper systems produce only minimal improvements on the functionality of their paper counterparts.

The Patient Administration System (PAS) module is another example of the user modules, which comprises of Systematic integrated Electronic Patient Record (iEPR) solution. This module has been developed in close co-operation with clinical and clerical staff and is tailored to support the patient administrative processes carried out in a modern hospital. It includes a default set-up that provides full financial and administrative reporting facilities and due to its flexibility and adaptability can be tailored to the individual needs of a hospital, department or ward.

Some of the functions of the PAS module and its benefits to the clinical practice and hospital settings, on implementation are:

I) Patient Details

- The part of the PAS Module that ensures data capture includes functions that:
- Collect data from the Organization and Strategic Tracing Service
- Record and collect data on the patient in the Patient Master Index, including information on relatives, GP etc.

II) Clinical Pathways

- Provides information on clinical pathways, such as electronic referrals, diagnoses, services, outpatient treatment and specification of the ward responsible for the treatment
- Records information about hospital confinements
- Records information related to accident or injury

III) Reporting

The reporting function undertakes government and agency reporting. The reporting function may report to management information systems and clinical databases. Reporting includes routine reporting, error situations and re-reporting.

IV) Disbursement

Disbursement enables the setting up of relationships between Trusts to set in motion OATs (Out of Area Treatments) and include settlements relating to Diagnosis Related Groups (DRGs) and the handling of guarantees and protection agreements. The disbursement function is simplified for the convenience of the users, as a number of tasks are automated.

V) Technologies applied:

- J2EE open standards
- Component-based architecture implemented in Java 2
- Supports the integration of systems using standard protocols such as HL7, Edifact and XML
- Oracle 9i common data storage
- LDAP directory server to support user profiles and security
- Tibco Active Enterprise(PAS module)

A similar example to explain the functionality of the clinical pathways on their implementation is the **eCare assessment module** which is Clinical Assessment module which has given a new ground to the in providing clinicians with the ability to create assessment tools that reflect the most up to date methods and practices as well as tools that suit their own clinical practice. A patient history can be recorded via a very simple user interface, as it is being taken, producing a documented summary that is instantly made available to other clinicians. This functionality reduces clinician time spent documenting patient examinations, reduces the need for patients to be asked the same questions repeatedly by different clinicians and provides greater access to up to the minute clinical data. The e-Care Clinical Pathways and Care Plan function automates the planning of patient care using a flexible approach, which ensures either the pathway, or care plan reflect each individual patients needs. Printed care plans; pathways and activity sheets can be produced. It has functionality to give medical alerts and allergies and these functions link known patient details such as allergies, drug sensitivities and alerts related to medical conditions with the patient plan of care. This provides *real time decision support* for clinicians so that potentially detrimental actions can be avoided. . It provides on line referrals, with the ability to send requests for referrals/consults to clinicians or departments in an organization without the delays of a manual paper process. e-Care Discharge Summaries bring all

relevant patient information together automatically in user defined letter templates providing a unique streamlined approach to creating discharge letters. The function removes the need for clinicians to search through patient records to find all required information to pass on to other health care professionals such as the General Practitioner or community support services. e-Care utilizes its unique care planning methodology to provide up to the minute accurate patient acuity data that also predicts future staffing requirements. (www.healthsolve.com.au/hs_ecare_modules.htm)

There are several modules, which are being designed and implemented into the clinical care with a patient-centered focus, and their benefits to the patient outcomes are being evaluated. These modules function in the more effective way as opposed to the paper based road maps by providing the support for decision-making at the point of care. They function as effort saving for the health care professionals and still do not encroach upon the legacy of the clinicians for decision-making.

If the routine day to day care services to the patients are going to be systematized by the clinical pathways, in the automated form, the outcomes of the patients are going to be improved as also, the physicians will be saved with time to enhance physician-patient relationship by giving more time to the patients.

14. Computing Representation of Clinical Pathways

We will be looking into two computing representations for the Clinical pathways, though there are so many out there. These are:

- Clini-eguide system and
- Pepid primary care plus system

14.1 Clin-eguide System

Clin-eguide, developed by Wolters Kluwer Health Inc. in Chicago, US, is a point-of-care clinical knowledge system. It provides access to evidence based, patient-specific clinical management and treatment recommendations.

The goal of Clin-eguide is to address patients for whom clinically relevant and significantly different management/treatment pathways exist.

The Clin-eguide Clinical Knowledge System

The most crucial component for the Clin-eguide system is **Clinical Knowledge System**, which is a clinical decision support system designed to meet the needs of physicians in the workflow. The *Clinical Knowledge Base* of structured diagnostic, management and treatment recommendations, referenced to the primary literatures, is the core component of the system. A user can access the Knowledge Base on the Internet or integrate it with a clinical application.

Evidence-based answers to clinical questions

Clin-eguide provides speedy access to evidence-based diagnostic, management and treatment suggestions. When integrated with an electronic medical record system, Clin-eguide will offer therapy guidance regarding a disease or medication. When used in the stand-alone version, Clin-eguide's navigation pathways could help physicians find answers quickly.

Extensive research

Clin-eguide system is extensively researched and constantly updated, which scans the contents of over 4,300 medical and scientific journals and proceedings from major medical conferences. The research includes traditional medical databases, evidence-based medicine databases and other websites. By such a research, all relevant guidelines and major studies are located prior to providing information and recommendations.

Prior to releasing any new content, clinical specialists are invited to critique its accuracy. Reviewers consist of physicians and clinical pharmacists from leading US academic and clinical medical centers. In addition, the experts may assist in updating content, especially when the literature is controversial or conflicting evidence emerges

Clin-eguide is updated on a monthly basis. The updating process involves a combination of ongoing literature monitoring and a comprehensive six-monthly review of each disease module.

Clinical recommendations

Clin-eguide helps physicians make reasonable treatment decisions by using relevant information from the electronic medical record (EMR) or, when used stand-alone, through an interactive Q&A process, which centers on patient-specific features and the disease status.

Answers

Clin-eguide prompts a series of action, which confirms diagnosis, appropriate disease management or prescription. There is no impact on the physicians' time spent with patients since the recommendations by Clin-eguide are specific, easily accessible and feasible.

14.2 The rationale

Clin-eguide aims to improve cost and quality outcomes in healthcare settings by reducing inappropriate use of time, medications, lab tests, procedures and finding solutions to the discouraging clinical.

In developing Clin-eguide, Wolters Kluwer Health Inc. conducted a study of the literature on the clinical information needs and the prevention of adverse drug reactions. The 1996 review article by Richard Smith, Editor of the BMJ, cover the following points:

- When doctors see patients they usually generate at least one question.
- Most questions relate to treatment.
- Many questions are highly complex and relate to specific patients and specific areas of medical knowledge.
- Many questions go unanswered even though an answer exists.
- Answering questions is time consuming and expensive.
- Often doctors are seeking not simply information, but support, guidance, affirmation and feedback.
- Texts and journals are inadequate for answering questions; texts are often out of date and journals have too low a "signal to noise ratio" to be of value in daily practice.
- Literature searches are rarely performed at the point of care.

An internal review process involving Clin-eguide's editorial team acts as a precursor to full external review by named domain experts.

Clin-eguide is regularly updated through:

- An ongoing systematic review of published clinical trials, which immediately identifies items that should be incorporated into the data.
- Formal literature searches, which are repeated at 1-2 monthly intervals to ensure that all relevant material is considered for inclusion.

The ultimate goal of clinical information is to be specific to individual patients.

Existing drug information publications are largely based on manufacturers' product data sheets and faithfully reflect FDA-approved labeling for individual drugs.

Clin-eguide addresses these issues by providing evidence-based drug therapy information that is clinically appropriate for the use of a specific drug in a specific indication. Patient specific characteristics that may affect clinical use of the drug are also reflected.

Software development

Formal software engineering approaches were employed during the development of Clineguide. An **object orientated modeling process** was applied to the combined information domains of disease, drug and patient characteristics. Clin-eguide has been subject to extensive testing from initial concepts, through a variety of prototypes and user interface tests prior to full beta field-testing.

Customization Tools

Cline-guide has a suite of Customization Tools - the Formulary Integration Tool, the Alerts Integration Tool and the Content Linking Tool. The Formulary Integration tool allows the user to bring his institution's formulary information to point-of-care decision-making by incorporating it into Clin-eguide. The Alerts Integration Tool provides a means of prompting physicians to consider specific issues for the patient. The Content Linking Tool allows the user to create his own context-specific links to clinical practice guidelines and other information from Clin-eguide.

14.3 Operational Requirements for Clin-eguide System

Clin-eguide Demo version has following system requirements:

- Computer Processor: Pentium II or better.
- Memory: 32MB RAM, 64MB for Windows NT/2000/CP
- Operating System: Windows 95, 98, Me, Windows NT 4.0 SP3, Windows 2000 SP2 or Windows XP
- Display/Video Card: Supports 800 x 600 x 16 bit (high color)

Strengths: The Clin-eguide System is applicable to various Windows users.

Weakness: The system does not support Linux or UNIX OS.

Clin-eguide Demo

<http://www.clineguide.com/products/frameset.aspx?bodycopy=/products/downloads/body.html>

Register for a free Clin-eguide TRIAL

<http://www.clineguide.com/registration/regTrialIndex.aspx>

Case studies for Clin-eguide System

Case 1

LDS Hospital, Salt Lake City, Utah

A family practitioner phoned to say he was sending an adult patient to the clinic with suspected community acquired pneumonia. Before the patient arrived Dr Lahey used Clin-eguide to review diagnosis and management recommendations for adult patients with community acquired pneumonia. The result: "Never have I treated a patient with CAP so well," said Dr Lahey.

Comment by Chunyang Qing: The description of Clin-eguide by Dr. Lahey is too simple. Are the diagnosis and management recommendations really necessary for physicians? Do such recommendations follow clinical guidelines? Does Clin-eguide enhance the work efficiency?

Case 2

LDS Hospital, Salt Lake City, Utah

The patient had been stabilized and was progressing well. Prior to rounds that day, Dr Mansfield used Clin-eguide to update himself on the latest management guidelines for a patient with MI. These guidelines are based on the September 1999 update of the ACC/AHA guidelines for the management of patients with acute myocardial infarction first published in 1996. As a consequence, Dr Mansfield was able to discuss this patient's treatment with more information and greater confidence. "This product makes me look like a genius in front of my Attending," he stated later.

Comment by Chunyang Qing: Does Clin-eguide enhance the work efficiency? How does Dr Mansfield's patient benefit from indirect use of the Clin-eguide system? Does the patient have more time to contact with Dr Mansfield? Does Clin-eguide improve the treatment?

Case 3

LDS Hospital, Salt Lake City, Utah

While on night duty, Dr Beeson admitted a patient with progressing unstable angina. Using Clin-eguide Dr Beeson was able to rapidly access the latest evidence-based treatment recommendations for unstable angina. Dr Beeson was prompted by Clin-eguide to consider the risk of death or nonfatal MI, and consequently treated the patient with SC noxaparin and IV eptifibatide due to the high-risk nature of the patient's condition.

Clin-eguide enabled Dr Beeson to make a quick decision that took into account the potential risk factors facing this patient. "My problem is that when I finish my residency, I am concerned that I will move to a hospital that does not have Clin-eguide," she stated.

Comment by Chunyang Qing: The prompt of vital information is one of most important functions offered by any clinical decision-making support systems. In this case, Clin-eguide system demonstrates this feature. But the patient history, physical examination and lab test results are unavailable. Therefore, it is impossible for the reviewer to evaluate the system effectively. In addition, some descriptions are extremely subjective and lack of reasoning, e.g., one of Dr Beeson's commentaries is: "My problem is that when I finish my residency, I am concerned that I will move to a hospital that does not have Clin-eguide."

Case 4

LDS Hospital, Salt Lake City, Utah

During a teaching session with a class of interns, Dr Edwards was discussing the management of patients with severe acute pancreatitis. The question was posed: what is the use of prophylactic antibiotics in the

prevention of local and other septic complications in severe acute pancreatitis? There was no clear consensus in the group so Clin-eguide was referred to for guidance. Within seconds a clear point of reference for treating such cases was established, and the discussion that ensued was focused and productive. "Not only is Clin-eguide a valuable point of care clinical decision support tool, we are finding significant additional uses for the product such as in the teaching environment," says Dr Edwards. *Comment:* Generally, the use of antibiotics is a must for the therapy of severe acute pancreatitis, from the perspective of physician. Hence, the question, what is the use of prophylactic antibiotics in the prevention of local and other septic complications in severe acute pancreatitis, is misleading. In this circumstance, physicians do not necessarily use Clin-eguide to make a clinical intervention.

Case 5

LDS Hospital, Salt Lake City, Utah

Dr Besch was treating a patient in the CCU who had presented to the ER that morning with an acute MI (myocardial infarction). The patient was commenced on alteplase and unfractionated heparin as well as atenolol, IV nitroglycerin and an ACE inhibitor, but was not stabilizing. Reference to Clin-eguide showed that nitroglycerin has the potential to decrease alteplase blood levels. Discontinuation of the nitroglycerin resulted in rapid stabilization of the patient. Dr Besch was enthusiastic about the effectiveness of Clin-eguide. "There is no other product around that provides me with such rapid access to quality clinical decision support," he commented.

Comment by Chunyang Qing: In this case, it is possible for Dr Besch to make a right discontinuation of the nitroglycerin use by accessing the Clin-eguide system. But it is not necessarily true since the detailed patient history, physical examination and lab test results are unavailable.

14.4 Evaluation of Clin-eguide System

Technically, Clin-eguide is helpful for clinical decision support and other applications. Nevertheless, more case studies regarding the system are required for the purpose of research. Some statements from the cases are misleading.

14.5 PEPID Primary Care Plus System

Profile of PEPID PCP

Portable Emergency Physician Information Database (PEPID) Primary Care Plus (PCP) system, developed by PEPID LLC Headquartered in Skokie, Illinois, USA, is a unique collaborative effort from leading academic and clinical physicians in all specialties, reviewed and coordinated in partnership with the prestigious FPIN (Family Practice Inquiries Network), under the direction of Editor-in-Chief, Dr Bernard Ewigman, Department Chair at the University of Chicago.

PEPID medical professional programs were initiated in 1994. PEPID's six current professional products provide access to the most comprehensive, accurate, and current pharmacological and clinical information at the point-of-care via personal digital assistants (PDAs).

Features

PEPID PCP system includes 1800 Medical Topics such as comprehensive Pathophysiology, Epidemiology, Diagnostics, Therapeutics, Follow-Up, Prognosis and Preventive information accessible by medical specialty or organ system. In addition, the system covers Preventive Medicine, Complementary and Alternative Medicine, Geriatrics and Acute Care Reference, Comprehensive Toxicology and Weapons of Mass Destruction information.

All PEPID Suites include the following features:

- A complete Drug Database - includes over 5000 drug, herbal and OTC generic and trade names.
- Virtually every Medical Calculator is included with direct links from relevant topics.
- Cross reference up to 40 drugs, herbal remedies and OTC medications simultaneously in the Drug Interactions module.
- Internationally Comprehensive with SI (The International System of Units) Lab Units presented along with American units, an SI calculator, complete metric conversion calculators, and even includes 1200 Canadian drug trade names
- Comprehensive Dynamic Index lets users search for almost 10,000 entries - medical topics, procedures, drugs, herbals, common abbreviations, eponyms, equations, etc. - all in one place.
- Embedded Illustrations such as Dermatomes, Rule of 9's and rhythm strips add even more value to PEPID.

- Plus: Personal Notes that allow users to add their own content to each PEPID topic and drug. Notes are saved whenever users update their PEPID.

Applications of PEPID PCP System

PEPID LLC has signed a licensing agreement with Harvard Medical School and the Care Group Healthcare System. The agreement allows all medical students, faculty and staff at Harvard and its affiliated hospitals to use PEPID ED (Emergency Doctor), PEPID MD (Medical Doctor), PEPID RN (Registered Nurse), PEPID MSC (Medical Student Companion), and PEPID PDC (Portable Drug Companion) products for a period of one year.

Operational Requirements for PEPID PCP

Operating System

Windows 95, 98, 2000, NT, or XP running either Internet Explorer 4.0 and greater or Netscape Navigator 5.0 and greater. Mac Compatible. Compatible platforms for PDA include Palm OS 5.X & 4.X, Pocket PC 2002 & 2003.

Strengths: PEPID is compatible with various Windows versions. Hence it is easily applicable to the market since Windows is still the most popular OS, from the perspective of market researcher.

Weakness: It does not support Linux or UNIX OS.

PEPID PRIMARY CARE PLUS: Ambulatory and Hospital Care (demo & free trial) are available online.

<http://www.pepid.com/products/default.asp#>

PEPID PCP V5.22

Date of Release: Dec. 2004.

Medical Content

- Updated antibiotic protocols for cavernous thrombosis, cholangitis, encephalitis, endocarditis, epiglottitis, haemophilus, klebsiella, legionella, meningitis, orbital cellulitis, otitis externa and media, pericarditis, pertussis, pharyngitis, pneumonia (aspiration and general), SARS, sinusitis, UTI, and toxic shock syndrome.
- Two new monographs added to the Infectious Disease section.

Medications

- Fifty-eight new drug monographs added.
- New FDA Black-Box Warning: (Nov. 17, 2004) Long-term use of Depo-Provera contraceptive injection may result in significantly reduced bone density.

Drug Interactions Generator

- Interactions for 22 new drugs added.
- Information on interactions with Canadian drugs expanded.

Medical Calculators

Two new equations and calculators added: ABGs, Peak Flows.

System Improvements

Pocket PC performance enhancements allow quicker access to information.

Evaluation of PEPID PCP system

PEPID PCP system holds the promise for further application in healthcare settings. Since the system focuses on mobile medical computing, PEPID PCP will be handier for the physicians in remote areas. Detailed case studies are still required for further applications of the system in healthcare settings.

15. Conclusion:

A Clinical Pathway is thus a road map for a patient as well as for the treatment team, which supports an efficient and effective in-patient care. Clinical Pathways are disease-specific and individually tailored to account for the specific atmosphere, reputation and experience in the implementing hospital. They are care plans that detail the essential steps in the care of patients with a specific clinical problem and describe the expected progress of the patient; They aim to facilitate the introduction into clinical practice of clinical guidelines and systematic, continuing audit into clinical practice: they can provide a link between the establishment of clinical guidelines and their use; They help in communication with patients by giving them access to a clearly written summary of their expected care plan and progress over time.

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APPENDIX: Figure (I):

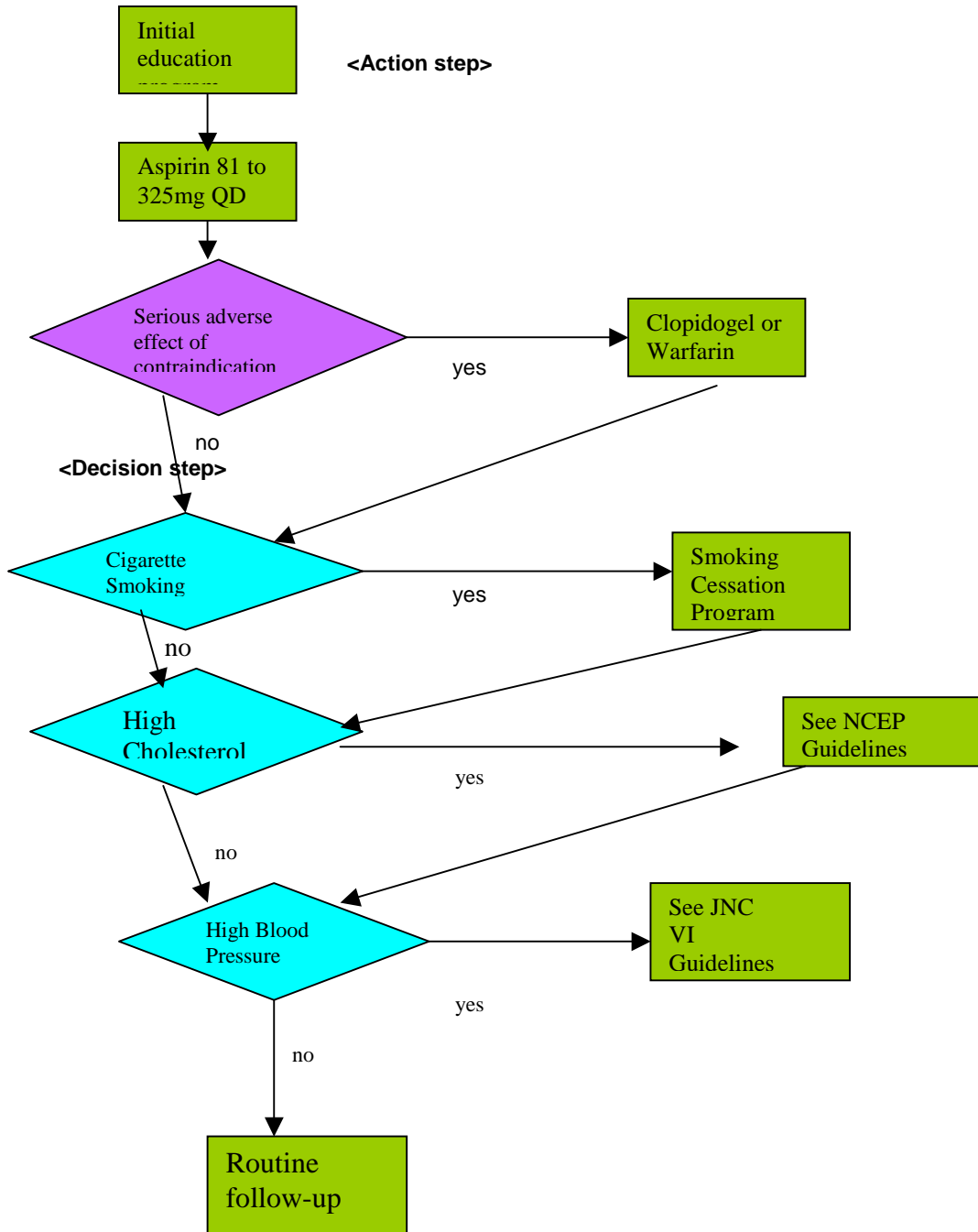


Figure II: An example of the clinical pathways implemented in the emergency department for Blood pressure management for Acute Stroke Thrombolysis:

