

## ORIGINAL ARTICLE

# Clinical Pathway as a Strategy in Improving Healthcare Quality and Cost Containment

Aniza I<sup>1</sup>, Saperi S<sup>2</sup>, Aljunid SM<sup>3</sup>

<sup>1</sup> Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre

<sup>2</sup> Case-Mix Centre, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre,

<sup>3</sup> United Nation University-International Institute of Global Health (UNU-IIGH), Kuala Lumpur

## ABSTRAK

Peningkatan kos dan kesedaran masyarakat mengenai penyampaian kualiti perkhidmatan yang tinggi telah memaksa pembekal dan pengurus jagaan kesihatan untuk menyiasat sistem pemberian jagaan kesihatan. Carta-alir klinikal (CK) telah diperkenalkan di banyak hospital dan telah diterima sebagai satu alat yang berfaedah dalam membantu organisasi jagaan kesihatan di seluruh dunia. Tambahan, CK juga dapat membekalkan perkhidmatan yang berkualiti tinggi secara berterusan dan dapat mengkoordinasikan perkhidmatan kesihatan dengan penggunaan sumber-sumber yang rendah. Telah dibuktikan sebagai alat yang berfaedah di negara-negara lain, CK sedang diperkenalkan dalam sistem jagaan kesihatan di Malaysia. Tujuan artikel ini adalah untuk mengenengahkan faedah-faedah CK dalam meningkatkan kualiti jagaan kesihatan dan mengawal kos perubatan. Artikel-artikel yang berkaitan telah disemak. Kesimpulannya, sebahagian besar artikel-artikel yang disemak menyimpulkan terdapat kesan-kesan positif dalam mengimplementasikan CK. CK telah didapati dapat menurunkan dengan signifikannya jangka masa tinggal di hospital dan kos perubatan. Pengenalan *evidence based medicine*, hasil klinikal, audit klinikal, komunikasi jabatan-jabatan, kerjasama dan perancangan penjagaan juga dipertingkatkan oleh CK. Cabaran kepada pembekal dan pengurus jagaan kesihatan adalah penglibatan dan komitmen sepenuhnya dalam pembentukan dan implementasi CK untuk meningkatkan kualiti jagaan kesihatan dan kawalan kos.

**Kata kunci:** sistem pemberian jagaan kesihatan, carta-alir klinikal, kualiti, kos perubatan, pembekal dan pengurus jagaan kesihatan

## ABSTRACT

The increasing health care cost and public awareness on the delivery of high quality services has forced healthcare service providers to look into the healthcare delivery system. Clinical Pathway (CP) has been introduced in many hospitals and has been

**Address for correspondence and reprint requests:** Dr. Aniza Ismail, Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur. Email: [aniza.ismail@gmail.com](mailto:aniza.ismail@gmail.com)

accepted as a beneficial tool in assisting healthcare organizations worldwide. Further, the CP also provides consistently high quality and coordinates services with minimum resources. It is proven to be a beneficial tool in other countries. CP is recently being introduced into the Malaysian healthcare system. The aim of this article was to highlight the benefits of CP in improving healthcare quality and controlling the medical cost. The relevant articles have been reviewed. The majority of literature reviewed concluded that there were positive effects in implementing CP. The CP was found to be significant in reducing length of stay and medical cost. The introduction of evidence based medicine, clinical outcomes, clinical audit, multidisciplinary communication, teamwork and care planning were also improved by CP. The challenges for healthcare providers and healthcare managers are to participate and be fully committed in pathway development and implementation in order to improve healthcare quality and cost control.

**Key words:** healthcare system, clinical pathway, quality, medical cost, healthcare providers and managers

---

## INTRODUCTION

The demand for the healthcare system to deliver high quality services whilst containing expenditure, has forced health service providers to examine and re-structure the clinical management systems. There is a need for healthcare organizations to persistently examine patient care processes, deliver superior quality care, achieve positive clinical and better financial outcomes (Coffey et al. 1992, Pearson et al. 1995, Jones et al. 1999).

The focus of health services has shifted towards controlled clinical management strategies to make healthcare organizations more efficient without compromising the quality of care delivered. There are increasing demands for more appropriate use of technologies, more coordinated care and more enhanced care given to the patient. Qualities of care and cost containment are debatable and are the foremost and principal agenda on the policy in many countries today (Cheah 2000).

The Ministry of Health, Malaysia has implemented several quality assurance pro-

grams in government hospitals such as peri-operative morbidity review (POMR), clinical audit, risk management and incident reporting (Ministry of Health Malaysia 1998). All these programs are very important to maintain the quality of healthcare in government hospitals.

Clinical pathway has been introduced in many hospitals and has been accepted as a beneficial tool. The CP assists the healthcare organization in providing better quality and coordinating services within scarce resources (Dowsey et al. 1999, Hoffart & Kuckelman 2000, Kohn et al. 2000, Every et al. 2000). Clinical pathway differs from clinical guidelines, protocol and algorithms. Clinical guidelines are consensus statements that are systematically developed to assist practitioners in making patient management decisions related to specific clinical circumstances (Field & Lohr 1990, Dwyer 1998, Gaddis et al. 2007). Protocols are treatments that were recommended based on guidelines.

What is clinical pathway? Clinical pathway is a methodology for mutual decision making, and is an organization of care for a well-defined group of patients during a

well-defined period. (European Pathway Association, Slovenia Board Meeting, Dec 2005). The pathway can also be defined as a multidisciplinary plan of care based on best clinical practice for specific groups of patients with a particular diagnosis designed to minimize delays, optimise resource utilization and to maximize the quality of care (Pearson et al. 1995, Campbell et al. 1998, Panella et al. 2003). The aim of a care pathway is to enhance the quality of care and cost control by improving patient outcomes, promoting patient safety, increasing patient satisfaction, and optimising the use of resources (European Pathway Association, Slovenia Board Meeting, Dec 2005).

Clinical pathway is also known as critical pathway, care map or integrated care pathway. It forms all or part of the clinical record, document the care given and facilitates the evaluation of outcomes for continuous quality improvement. The CP was developed by multi-professional teams, consist of physicians (family practitioners to specialist), nurses, physiotherapist, pharmacist, social workers and managers (Pearson et al. 1995, Gregor et al. 1996, Mabrey et al. 1997, Campbell et al. 1998, Healy et al. 1998, Hill 1998, Pritts et al. 1999, Cheah 2000, Huerta et al. 2001, Pearson et al. 2001, Uchiyama et al. 2002, Panella et al. 2003, Lee & Anderson 2006). The pathway was able to facilitate the use of clinical practice guidelines by the multidisciplinary team, as pathway was locally agreed and available in the patients' record (Kitcher & Bundred 1998).

The CP was first developed in the 1950s to coordinate multiple contractors or persons in a project by identifying the key sequence of events or critical point which would drive the timeline of the overall project (Pearson et al. 1995). In healthcare system the CP was first developed and applied in the 1980s at the New England Medical center by Karen

Zander and Kathleen Bower (Pearson et al. 1995). The development of CP was in response to the initial Diagnostic Related Group (DRG) based reimbursement system (Pearson et al. 1995, Luttmann 2000). The CPs were introduced in the early 1990s in the United Kingdom and the United State of America (Kitcher & Bundred 1998, Lutman 2000)

The implementation of CP is highlighted in the current health care sector because of its similarity to the descriptions of case-mix system which addresses the same clinical characteristics and resources involved (Cheah 2000). The development and implementation of CP can be applied in homogenous population, high volume cases, high risk cases and common cases. The CP can also be applied in clinical protocols and guidelines, by committed and accountable healthcare providers, health managers and government. The aim of this article was to highlight the benefits of CP in improving healthcare quality and cost control.

## MATERIALS AND METHODS

For selection of relevant articles, the search was focused on the terms 'clinical pathway', 'care path' and integrated care pathway. Most studies were conducted in the United States, Canada, Australia and United Kingdom. Only few studies were conducted in Asia.

## RESULTS

*What can be measured from clinical pathway?*

Continuous evaluation and follow up are essential to establish a good CP. The effect of clinical pathway can be measured in five domains; clinical outcome, service, team, process and finance (Herck et al. 2004). The indicators for clinical outcome domain are number of readmissions, complications, mortality, number of re-

lapses without admission, time until extubation, time until normal food intake, quality of life, number of infections, level of pain and length of stay (Kucenic & Meyers 2000, Johnson et al. 2000, Huerta 2001, Benson et al. 2001, Darer et al. 2002, Hoffart & Kuckelman 2002, Kinsman 2004).

For process domain, the indicators are analysis of variance, number of clinical examinations (laboratories, radiology), completeness and quality of documentation, time schedules, planning and analysis of process flow (Johnson et al. 2000, Kucenic & Meyers 2000, Huerta 2001, Benson et al. 2001, Hoffart & Kuckelman 2002, Darer et al. 2002, Kinsman 2004).

The indicators for team domain are team communication, team satisfaction, knowledge and competence, recognition and appreciation of roles, autonomy of physician, self confidence and influence on understanding (Johnson et al. 2000, Hoffart & Kuckelman 2002, Kinsman 2004).

For financial domain the indicators are length of stay, medical, consumption of resources and number of staff. (Kucenic & Meyers 2000, Kelly 2000, Johnson et al. 2000, Benson et al. 2001, Huerta 2001, Hoffart & Kuckelman 2002, Darer et al. 2002, Kinsman 2004). Finally, the service indicators are patient and family satisfaction (Hoffart & Kuckelman 2002, Darer et al. 2002).

Herck et al. (2004) evaluated the effect of the implementation of the clinical pathways and found that the majority of the articles reviewed between years 2000 to 2002 had positive effects on three domains namely process, team and financial domain (Table 1).

### *Benefits of clinical pathway*

The majority of literature reviewed concluded that there were positive effects in implementing CP. According to more

Table 1: Global effect of the implementation of clinical pathways, described in literature between 2000-2002 (Herck et al. 2004)

Domain	Positive effect (%)	No effect (%)	Negative effect (%)
Clinical outcome	65.6	32	2.4
Service	62.2	29.7	8.1
Process	86.0	7.0	7.0
Team	83.3	6.3	10.4
Financial	82.5	13.5	4.0

than 80% of the authors, the CP is found to be significant in reducing length of stay and medical cost. The articles include management in patient asthma in paediatric cases (Banasiak & Oliver 2004, Cheney et al. 2005), management on uncomplicated acute myocardial infarction (Nichol 1997, Cheah 2000, Kucenic & Meyers 2000, Bahit et al. 2002, Zevola et al. 2002, Lee & Anderson 2006), management of congestive cardiac failure (Hogkin 2001, Ranjan et al. 2003), management of pneumonia (Estrada et al. 2000, Loeb et al. 2006) and management of nephrology cases (Benson et al. 2001). The CP is also useful in managing surgical cases such as knee joint management (Gregor et al. 1996, Macario et al. 1998, Dowsey et al. 1999, Pearson et al. 2001, Panella et al. 2003, Pennington et al. 2003, Brunenberg et al. 2005, Walter 2005, Xu et al. (2008), management fracture neck of femur (Choong et al. 2000), management of bowel resection (Pritts et al. 1997), laparoscopic surgery (Huerta et al. 2001, Uchiyama 2002) fluid management in femoral neck fracture (Davidson 2007) and patients who had undergone total laryngectomy (Hanna et al. 1999).

Standardized processes and better coordination in CP have improved patient care among clinicians and managers (Pearson et al. 1995, Gregor et al. 1996, Mabrey et al. 1997, Healy et al. 1998, Pritts et al. 1999, Cheah 2000, Huerta et

al. 2001, Pearson et al. 2001, Uchiyama et al. 2002, Panella et al. 2003, Lee & Anderson 2006). The CP also improved clinical outcomes through the variance management system (Luttman 2000, Santoso et al. 2002).

The CP was able to maximize the efficient use of resources in reducing unnecessary documentation (Pearson et al. 1995, Kucenic & Meyers 2000, Kelly 2000, Johnson et al. 2000, Benson et al. 2001, Huerta 2001, Hoffart & Kuckelman 2002, Darer et al. 2002, Kinsman 2004). Most of the articles concluded that one of the measures to control costs and to assure quality is the use of a case-managed CP model. The authors also revealed CP is useful for costing services (pricing and contracting) (Field & Lohr 1990, Gregor et al. 1996, Healy 1998, Luttman 2000, Huerta et al. 2001)

According to Zander et al. (1988), the major reasons for developing CP are to improve patient care by improving the quality of patient care through consistent management, identifying and measuring improvements in patient care, and measuring outcome. The CP has also improved communication and collaboration among all disciplines, enhanced the discharge coordination process and established protocols to all members of the health care team. CP also can be used to support clinical audit and risk management (Zander et al. 1988, Dowsey et al. 1999, Cheah 2000, Benson et al. 2001, Darer et al. 2002, Panella et al. 2003, Xu et al. 2008)

In the articles reviewed, only a few studies were conducted in an Asia health care setting. In Singapore, a study conducted by Cheah (2000) at a General Hospital discovered the average length of stay for uncomplicated acute myocardial infarction using CP was significantly reduced. There was no significant increase in hospital mortality, complication rate and no readmission rate at six months after discharge. He concluded that CP

was able to improve care processes through better collaboration among healthcare professionals and improved work systems (Cheah 2000). Santoso et al. (2002) had developed a mastectomy clinical pathway for breast cancer patients at the National University Hospital of Singapore and the results showed that the implementation of the CP had improved patients' treatment and outcome. The medical cost and length of hospital stay also was reduced. Similar finding by Xu et al. (2008) shown that the use of knee pathway had led to a significant decrease in the length of stay, complication rates and early mobilization among 1663 patients who underwent total knee replacement (tkr) in a tertiary institution in Singapore.

In Taiwan, a study carried out by Liao et al. (1998) at Tsu Chi General Hospital found that CP was able to decrease resource consumption, control medical expenditure and decrease the number of procedures performed. They also demonstrated no changes in clinical outcomes and complication rates in patients who underwent transurethral resection of the prostate. In another study conducted by Chang & Lin (2003) they also found the implementation of the CP for patients who underwent vaginal hysterectomy had improved health care outcomes, decreased length of hospital stay and admission fees. The authors concluded that CP is a good policy for cost management and in enhancing the quality of care.

Paiboon (2006) in his study conducted at Taksin Hospital in Thailand also found the implementation of clinical pathway among type 2 diabetic patients had reduced the length of hospital stay and decreased readmission rate of recurrent hypoglycaemia.

Many studies on CP have been carried out in United States (US) and United Kingdom (UK) (Wigfield & Boon 1996, Chang et al. 2006). The implementation of CP was reported to be high in US and

UK with the apparent outcomes such as reduction in the incidence of complications, medical cost and improved patient satisfaction (Chang et al. 2006 and Wigfield & Boon 1996).

Ranjan et al. (2003) had carried out a study among congestive heart failure (CHF) patients at hospitals in United States and the result showed that the patients assigned to the CHF CP had a shorter length of stay and reduced hospital charges compared with those who were on the usual care. The quality of care delivered (as measured by administration of ACE inhibitors) was not compromised by the reduction in length of hospital stay in patients on the clinical pathway. Further there was a significant saving of US\$2,500 per patient and US\$750,000 per year in CHF treatment (Ranjan et al. 2003)

A study conducted by Pearson et al. (2001) also found with the implementation of the CP, the length of stay decreased 21% for total knee replacement, 9 % for CABG surgery, 7% for thoracic surgery, 5% for hysterectomy and 3% for colectomy. In 1999, Pritts et al. conducted a study at University of Cincinnati Medical Center, Ohio and showed a significant decrease in length of stay and medical cost in the pathway groups who underwent bowel resection.

Several studies also found improvement of interdisciplinary cooperation, staff satisfaction (Mabrey et al. 1997, Maxey 1997, Hanna et al. 1999, Jacavone et al. 1999) and also patient satisfaction (Jacavone et al. 1999, Walter 2005).

About 40.0% of the authors discovered the clinical outcomes such as readmission, mortality and complication rates showed no significant difference between patients on clinical pathway and patients on usual care (Nichol et al. 1997, Macario et al. 1998, Jones et al. 1999, Choong et al. 2000, Farquhar 2000, Johnson et al. 2000, Kucenic & Meyer

2000, Hogkin et al. 2001, Huerta et al. 2001, Uchiyama et al. 2002, Ranjan et al. 2003, Banasik & Oliver 2004, Brunenberg et al. 2005, Lee & Anderson 2006). Nevertheless, one third of the authors found the readmission and complication rates were reduced in the clinical pathway group and there was significant difference compared to the non clinical pathway group (Dowsey et al. 1999, Estrada et al. 2000, Cheah 2000, Benson et al. 2001, Bahit et al. 2002, Darer et al. 2002, Ransom et al. 2002, Panella et al. 2003, Bestul et al. 2004, Cheney et al. 2005, Walter et al. 2005, Loeb et al. 2006, Paiboon 2006, Xu et al. 2008).

Even though CP has been approved as beneficial tools in improving quality and controlling healthcare cost, there are a few aspects and factors which require attention as revealed by nearly one third of the articles reviewed (Gregor et al. 1996, Pritts et al. 1997, Macario et al. 1998, Dowsey et al. 1999, Choong et al. 2000, Cheah 2000, Pearson et al. 2001, Hogkin 2001, Uchiyama 2002, Panella et al. 2003, Ranjan et al. 2003, Brunenberg et al. 2005, Walter 2005, Lee & Anderson 2006). The aspects that require attention are the understanding, implementation, accountability, the system and the administrative support of the CP.

## CONCLUSION

As a conclusion, the majority of literature reviewed concluded that there were positive effects in implementing CP. The CP was not only found to be significant in reducing length of stay and medical cost but is also found to support the introduction of evidence based medicine, clinical audit, multi disciplinary communication, teamwork and care planning. In addition, the CP is able to support the continuity and coordination of care across different clinical disciplines, reduce variances in patient care (by promoting standardization), help improve patient documentation

and optimize the management of resources. Even though CP had been shown to improve quality and control of healthcare costs, its successful implementation would require full commitment and participation from all health care providers and healthcare managers.

## REFERENCES

- Bahit, M.C., Murphy, S.A., Gibson, C.M., Cannon, C.P. 2002. Critical pathway for acute ST-segment elevation myocardial infarction: Estimating its potential impact in the TIMI 9 registry. *A Journal of Evidence Based Medicine*. **1**(2):107-112.
- Banasiak, N.C., Oliver, M.M. 2004. Inpatient asthma clinical pathways for the pediatric patient: An integrative review of the literature. *Pediatric Nursing*. **30**(6):447-450.
- Bestul, M.B., McCollum, M., Stringer, K.A., Burchenal, J. 2004. Impact of a critical pathway on acute myocardial quality indicators. *Pharmacotherapy*. **24**(2):173-178.
- Benson, L., Bowes, J., Cheesebro, K., Stasa, C., Horst, T., Blyskal, S., Hoenig, N., Wolf, M., Hanson, C., Bangel, L., Bergman, K., Cyphers, N., Duncan, P. 2001. Variance tracking to improve outcomes and reduce costs. *Lippincott Williams & Wilkins, Inc.* **20**(2):34-42.
- Brunenberg, D.E., VanSteyn, M.J., Sluimer, J.C., Bekebrede, L.L., Bulstra, S.K., Joore, M.A. 2005. Joint recovery programme versus usual care: An economic evaluation of a clinical pathway for joint replacement surgery. *Med Care* **43**(10):1018-1026.
- Campbell, H., Hotchkiss, R., Bradshaw, N., Proteus, M. 1998. Integrated clinical pathway. *British Medical Journal*. **316**(1):133-137.
- Chang, C.L., Cheng, B.W., Ho, C.M. 2006. Knowledge-based Quality Management and clinical pathways. *Quality Management in Health Care*. **15**(1):46-57.
- Chang, W.C., Lin, C.C. 2003. Clinical pathway for laparoscopically assisted vaginal hysterectomy. Impact on costs and clinical outcome. *J Repro Med*. **48**(4):247-251.
- Cheah, J. 2000. Clinical pathway - An evaluation of its impact on the quality of care in an acute care general hospital in Singapore. *Singapore Medical Journal*. **41**(7):335-346.
- Cheney, J., Barber, S., Altamirano, L., Medico, C., Cheney, M., Williams, C., Jackson, M. 2005. A clinical pathway for bronchiolitis is effective in reducing readmission rates. *J Pediatr* **147**(5):568-570.
- Choong, P.F.M., Langford, A.K., Dowsey, M.M., Santamaria, N.M. 2000. Clinical pathway for fractured neck of femur: a prospective, controlled study. *The Medical Journal of Australia*. **172**(5):423-426.
- Coffey, R.J., Richards, J.S., Rimmert, C., LeRoy, S.S., Schoville, R.R., Baldwin, P.J. 1992. An introduction to critical paths. *Quality Management Health Care*. **1**(1):45-54.
- Darer, J., Pronovost, P., Bass, E.B. 2002. Use and evaluation of critical pathways in hospitals. *Effective Clinical Practice Journal* **5**(2):114-119.
- Davidson, J., Griffin R., Higgs, S. 2007. Introducing a clinical pathway in fluid management. *Journal of Perioperative Practice*. **17**(6):248-250.
- Dwyer, P. 1998. Legal implications of clinical practice guidelines. *The Medical Journal of Australia*. **169**:292-293.
- Dowsey, M.M., Kilgour, M.L., Santamaria, N.M., Peter, F.M. 1999. Clinical pathways in hip and knee arthroplasty: a prospective randomised controlled study. *The Medical Journal Of Australia*. **170**:5-20.
- Estrada, C.A., Unterborn, J.H., Price, J., Thompson, D., Gibson, L. 2000. Judging the effectiveness of clinical pathways for pneumonia: The role of risk adjustment. *Effective Clinical Practise*. **4**:221-228.
- European pathway Association, Slovenia Board Meeting, 2005.
- Every, N.R., Hochman, J., Becker, R., Kopecky, S., Cannon, C.P. 2000. Critical pathways: A review. *American Heart Association*. **101**(4):461-472.
- Farquhar D. 2000. Use of a critical pathway for the management of community-acquired pneumonia: The capital study. *Can. Med. Assoc. Journal*. **163**(6):755-760.
- Field, M.J., Lohr, K.N. 1990. Clinical practice guidelines: directions for a new program. Washington, DC: Institute of Medicine. National Academy Press.
- Gaddis, G.M., Huckson, S. 2007. Toward improved implementation of evidence based clinical algorithms: Clinical practice guidelines, clinical decision rules and clinical pathways. *Acad Emerg Med*. **14**(11):1015-1022.
- Gregor, C., Pope, S., Werry, D., Dodek P. 1996. Reduced length of stay and reduced appropriateness of care with a clinical path for total knee or hip arthroplasty. *Joint comm. Journal Quality Improvement*. **22**(2):617-628.
- Hanna, E., Schultz, S.D., Vural, E., Stern, S., Suen, J. 1999. Development and implementation of a clinical pathway for patients undergoing total laryngectomy: Impact on cost and quality of care. *Archives of Otolaryngology-Head and Neck Surgery*. **125**(11):1247-1251.
- Healy, W.L., Ayers, M.E., Ioris, R. 1998. Impact of a clinical pathway and implant standardization on total hip arthroplasty: a clinical and economic study of short term patient outcome. *Journal of Arthroplasty*. **13**(1):266-276.
- Herck, P.V., Vanhaechi, K., Sermeus, W. 2004. Effects of clinical pathway: Do they work? *Journal of Integrated Care Pathway*. **8**(3):95-105.
- Hill, M. 1998. The development of care management systems to achieve clinical integration. *Adv Pract Nurs Q*. **4**(1):33-39.
- Hoffart, N., Kuckelman, A. 2002. Assessing clinical pathways use in a community hospital: It depends on what use means. *Journal of Quality Improvement*. **12**(1):167-179.
- Hogkin, L.M., Thiel, S.L., Walton, M., Clark, H.M., Schroeder, M.A. 2001. Clinical pathway versus usual plan of care for patients with Congestive Heart Failure: What's the difference? *Medical Journal Australia*. **19**(3):142-150.
- Huerta, S., Heber, D., Sawicki, M.P., Liu, C.D., Arthur, D., Alexander, P., Yip, I., Li, Z.P. 2001. Reduced length of stay by implementation of a

- clinical pathway for bariatric surgery in an academic health care center. *Am Surg.* **67**(12):1128-1135.
- Jacavone, J.B., Daniels, R.D., Tyner, I. 1999. CNS facilitation of a cardiac surgery clinical pathway program. *Clinical Nursing Specialist.* **13**(3):126-132.
- Johnson, K., Blaisdell, C., Walker, A., Eggleston, P. 2000. Effective of a clinical pathway for inpatient asthma management. *American Academy of Pediatrics.* **106**(5):1006-1012.
- Jones, M.L.H., Day, S.B., Creely, J.R., Woodland, M.B., Gerdes, J.B. 1999. Implementation of a clinical pathway system in maternal newborn Care. A comprehensive documentation system for outcomes management. *The Journal of Perinatal Neonatal Nursing.* **13**(3):1-20.
- Kelly, C.S., Anderson, C.L., Pestian, J.P., Wenger, A.D., Finch, A.B., Strobe, G.L. 2000. Improved outcomes for hospitalized asthmatic children using a clinical pathway. *Annals of Allergy Asthma Immunology.* **84**(3):509-516.
- Kinsman, L. 2004. Clinical pathway compliance and quality improvement. *Journal of Nursing.* **18**(18):33-35.
- Kitcher, D.J., Bundred, P.E. 1998. A practical tool for specifying, evaluating and improving the quality of clinical practice. *Medical Journal of Australia.* **170**:54-55.
- Kohn, L.T., Corrigan, J.M., Donaldson, M.S. 2000. To err is human. Building a safer health system. Washington, DC: Institute of medicine.
- Kucenic, M., Meyers, D. 2000. Impact of clinical pathway on the care and cost s of Myocardial Infarction. *The Journal of Vascular Diseases.* **51**(5):393-404.
- Lee, H.K., Anderson, Y.M. 2006. The association between clinical pathway and hospital length of stay. A case study. *Journal of Medical Systems.* **31**(1):79-83.
- Liao, S.L., Chu, S.H., Chen, Y.T., Chung, K.P., Lai, M.K. 1998. The impact of a clinical pathway for transurethral resection of the prostate on cost and clinical outcomes. *J Formos Med Assoc.* **97**(5):345-350.
- Loeb, M., Carusone, S.C., Goeree, R., Walter, S.D., Brazil, K., Krueger, P., Simor, A., Moss, L., Marrie, T. 2006. Effect of a clinical pathway to reduce hospitalizations in Nursing Home Residents with Pneumonia. *Journal of American Medicine.* **295**(21):2005-2010.
- Luttman, R. 2000. How to design clinical pathways variance systems for continuous improvements. Brown- Spath Associates.
- Mabrey, J.D., Toohey, J.S, Armstrong, D.A., Lavery, L., Wammack, L.A. 1997. Clinical pathway management of total knee arthroplasty. *Clinical Orthopaedics and Related Surgery.* **345**(2):125-133.
- Macario, A., Horne, M., Goodman, S., Vitez, T., Franklin, Heinen, R., Brown, B. 1998. The Effect of a Perioperative Clinical Pathway for Knee Replacement Surgery on Hospital Costs. *International Anesthesia Research Society.* **86**(5):978-984.
- Maxey, C. 1997. A case map reduces time to administration of thrombolytic therapy in patients experiencing and acute myocardial infarction. *Nursing Case Management.* **2**(5):229-237.
- Ministry of Health Malaysia. 1998. The strategic plan for quality in health, Ministry of health Malaysia, Kuala Lumpur.
- Nichol, G., Walls, R., Goldman, L., Pearson, S., Hartley, L.H., Antman, E., Stockman, M., Teich, J.M., Cannon, C.P., Johnson, P.A., Kuntz, K.M., Lee, T.H. 1997. A critical pathway for management of patients with acute chest pain who are at low risk for Myocardial Ishaemia : *Recommendations and potential impact.* **127**(1):996-1005.
- Panella, M., Marchisio, S., Stanislaio, F.D. 2003. Reducing clinical variations with clinical pathways: do pathways work 2003. *Internal Journal Quality Health Care.* **15**(6):509-521.
- Paiboon, K. 2006. Effects of counseling and implementing of clinical pathway on diabetic patients hospitalizes with hypoglycemia. *Journal of Medical Assoc Thai.* **89**(5):619-625.
- Pearson S.D., Kleeffeld, S.F., Soukop, J.R., Cook, E.F., Lee, T.H. 2001. Critical pathway s intervention to reduce length of hospital stay. *American Journal Medicine.* **110**(3):224-225.
- Pearson, S.D., Fisher, D., Lee, T.H. 1995. Critical pathways as a strategy for improving care: problems and potential. *Annal Journal Medicine* **123**(12):941-948.
- Pennington, J.M., Jones, D.P.G., McIntyre, S. 2003. Clinical pathways in total knee arthroplasty : A New Zealand experience. *Journal of Orthopaedic Surgery.* **11**(2):166-173.
- Pritts, T.A., Nussbaum, M.S., Fleisch, L.V., Fegelman, E.J., Parikh, A.A., Fisher, J.E. 1999. Implementation of a clinical pathway decreases length of stay and cost for bowel resection. *Annals of surgery.* **230**(5):728-733.
- Ranjan, A., Tarigopula, L., Srivastava, R., Obasanjo, O., Obah, E. 2003. Effectiveness of the Clinical pathway in the management of Congestive Cardiac Failure. *South Medical Journal.* **96**(7):661-670.
- Santoso, U., Lau, P.T., Lim, J., Koh, C.S., Pang, Y.T. 2002. The mastectomy clinical pathway. What has it achieved? *Ann Acad Med Singapore.* **31**(4):440-445.
- Uchiyama, K., Takifuji, K., Tani, M., Onishi, H., Yamaue, H. 2002. Effectiveness of the clinical pathway to decrease length of stay and cost for laparoscopic surgery. *Journal Surgical Endoscopy.* **16**(11):1594-1597.
- Walter, F.L., Bass, N., Bock, G., Markel, D.C. 2005. Success of clinical pathway for total joint arthroplasty in a Community Hospital. *Clinical Orthopaedic and Related Research.* **457**:133-137.
- Wigfield, A., Boon, E. 1996. Critical care pathway development: the way forward. *Br J Nurs.* **10**:5(12):732-735.
- Xu, G.G., Sathapan, S.S., Jaipaul, J., Chan, S.P., Lai, C.H. 2008. A review of clinical pathway data of 1663 total knee arthroplasties in Tertiary Institution in Singapore. *Ann Acad Med Singapore.* **37**:924-928.
- Zander, M.N., Boyages J., Gupta, L. 1988. Local impact of the NHMRC early myocardial infarction guidelines: where to go from here? *Nurs Clin North Am.* **166**(3):592-595.
- Zevola, D.R., Raffa, M., Brown, K., Hourihan, E., Maier, C.B. 2002. Clinical Pathways and Coronary Artery Bypass Surgery. *CC Nurse Journal* **22**:31-39.