



<b>Title</b>	<b>The Effectiveness of a Geriatric Hip Fracture Clinical Pathway in Reducing Hospital and Rehabilitation Length of Stay and Improving Short-Term Mortality Rates</b>
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**The Effectiveness of Geriatric Hip Fracture Clinical Pathway  
in Reducing Acute and Rehabilitation Hospital Stay with  
Improved Short Term Mortality Rates**

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Keywords:	Geriatric Trauma, Systems of Care, Trauma surgery, Fragility Fractures, Geriatric medicine
Abstract:	<p><b>Background:</b> A geriatric hip fracture clinical pathway, led by an orthopedic surgeon, was developed in 2007. This clinical pathway team is a multidisciplinary team consists of surgeons, physicians, anesthetists, nurses, physiotherapists, occupational therapists, medical social workers, dieticians as well as voluntary support groups.</p> <p><b>Methods:</b> From early 2007 onwards, all isolated acute geriatric hip fractures, age over 65, were included. During the whole in-patient treatment, all relevant data were captured prospectively. The data in 2006, before the implementation of the clinical pathway, were collected retrospectively through computer record system. A study of the length of stay in acute and rehabilitation hospital and also the short term mortality rate is carried out to compare the difference before and after the implementation of the pathway.</p> <p><b>Results:</b> From 2007 onwards, we treated more than 1300 hip fracture patients. After the implementation of the pathway, the pre-operative length of stay was markedly shortened by 4 days, from an average of 6.1 days in 2006 to 1.5 days in 2011, which is statistically significant (<math>p &lt; 0.05</math>). The post-op length of stay and the overall acute hospital length of stay also showed improvement with statistical significance. The length of stay in rehabilitation hospital is also significantly shorter in the last four years. Despite we operated more and more hip fractures with increasing age and increasing number of co-morbidities each year, the in-patient mortality rate showed a gradual decrease from 2.7% in 2006 to 1.25% in 2010. The 30 days mortality rate also showed a decrease from 3.65% in 2006 to 2.75% in 2010.</p> <p><b>Conclusion:</b> Geriatric hip fracture clinical pathway is an excellent approach to the geriatric hip fracture service. The most significant improvement is the dramatic shortening of hospital stay. Our success in the last 5 years has</p>

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	proven its value and sustainability.

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## The Effectiveness of Geriatric Hip Fracture Clinical Pathway in Reducing Acute and Rehabilitation Hospital Stay with Improved Short Term Mortality Rates

### Abstract:

#### Background:

A geriatric hip fracture clinical pathway, led by an orthopedic surgeon, was developed in 2007.

This clinical pathway team is a multidisciplinary team consists of surgeons, physicians, anesthetists, nurses, physiotherapists, occupational therapists, medical social workers, dieticians as well as voluntary support groups.

#### Methods:

From early 2007 onwards, all isolated acute geriatric hip fractures, age over 65, were included.

During the whole in-patient treatment, all relevant data were captured prospectively. The data in 2006, before the implementation of the clinical pathway, were collected retrospectively through computer record system. A study of the length of stay in acute and rehabilitation hospital and also the short term mortality rate is carried out to compare the difference before and after the implementation of the pathway.

#### Results:

From 2007 onwards, we treated more than 1300 hip fracture patients. After the implementation of the pathway, the pre-operative length of stay was markedly shortened by 4 days, from an average of 6.1 days in 2006 to 1.5 days in 2011, which is statistically significant ( $p < 0.05$ ). The post-op length of stay and the overall acute hospital length of stay also showed

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3 improvement with statistical significance. The length of stay in rehabilitation hospital is also  
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5 significantly shorter in the last four years. Despite we operated more and more hip fractures  
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7 with increasing age and increasing number of co-morbidities each year, the in-patient mortality  
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9 rate showed a gradual decrease from 2.7% in 2006 to 1.25% in 2010. The 30 days mortality rate  
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11 also showed a decrease from 3.65% in 2006 to 2.75% in 2010.  
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18 Conclusion:

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20 Geriatric hip fracture clinical pathway is an excellent approach to the geriatric hip fracture  
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22 service. The most significant improvement is the dramatic shortening of hospital stay. Our  
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24 success in the last 5 years has proven its value and sustainability.  
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3 **Keywords:** Geriatric hip fractures; Clinical pathway; Multidisciplinary; Length of hospital stay;  
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**Introduction:**

Geriatric hip fracture is probably one of the most common orthopedic problems. As the number of elderly population increases, the annual number of hip fractures globally is expected to exceed 7 million in the next 40-50 years<sup>1</sup>. In United Kingdom, the bed occupancy rate was more than 1.5 million days, which represent 20% of total orthopedic beds<sup>2</sup>. Last year, in Hong Kong, in a population of 7 million people, over 4500 hip fractures were operated. The trend is increasing in the last 5 years, which is also reflected in other parts of the world<sup>3,4</sup>. Furthermore, these geriatric hip fractures are associated with many co-morbidities. Despite the fact that aggressive treatment is commenced during the pre-operative, peri-operative and post-operative period, morbidities and complications rate are still high comparing to other common surgeries<sup>5</sup>. Most important of all, the mortality rate is relatively high. The 30 days mortality is around 10% and the 1 year mortality rate can be up to 30%<sup>6</sup>.

Geriatric hip fracture is an increasing burden to our medical system which requires increasing health utilization in the first year of fracture<sup>7,8</sup>. In our medical care system, our patients are operated in acute hospital and then transferred to rehabilitation hospital before they are discharged home. There were literatures supporting the use of clinical pathway to shorten the hospital stay and thus improve the clinical outcomes<sup>9-11</sup>. However, many of these clinical pathways only focused on the acute hospital stay and ignore the rehabilitation hospitals. These clinical pathways may not be able to apply to our medical system where the patients need to stay in the rehabilitation hospital before discharging back to home. Therefore, we feel that there is a need to develop a unique pathway tailor-made for the local medical system needs.

**Model of Care:**

Since early 2007, we have started our geriatric hip fracture critical clinical pathway<sup>12</sup>. Generally for hip fracture patients coming into our hospital, they will be admitted to the orthopedic ward in our hospital, which is a level I trauma centre having over one thousand acute beds. During the stay in admission ward, pre-operative work up and anesthetist assessment will be done. After the operation, they will be transferred back to the ward for post-operative care. When the patients are stable, usually in 4 to 5 days time, they will be transferred to a rehabilitation hospital.

The Geriatric hip fracture clinical pathway team was first developed by a team of medical staff in the acute hospital, led by an orthopedic surgeon, named as the clinical champion. He/she is the one who develops and coordinates the running of the pathway. A case manager, who is a nurse, will be responsible for the monitoring of the whole pathway running on a day to day basis.

In order to achieve a smoother and shorter pre-operative stay, the whole process of pre-operative assessment is re-defined. It started with the communication with the emergency department. When a geriatric hip fracture patient is admitted, apart from the hip x-ray, a chest x-ray and a pelvic x-ray should be available before he/she is transferred to the orthopedic admission ward. Once the patient is in the ward, a general pre-operative work-up will be done immediately in a 24-hour basis so that the patient can be ready to be seen by anesthetist the next day morning. The pre-operative work-up includes complete blood count, liver and renal



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3 function test, clotting profile, cross-matching of blood group and 12-leads electrocardiogram as  
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5 well.  
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9 Our pathway team, led by the clinical champion and the case manager, also includes surgeons  
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11 and nurses that are responsible for the daily routine in the acute and rehabilitation ward. The  
12  
13 other team members include a cardiologist, a respiratory physician and a senior anesthetist  
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15 who are responsible for the guidelines of the indications of pre-operative cardiac, respiratory  
16  
17 and other medical consultations.  
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22 Close collaboration with cardiologist is a crucial step in eliminating last minute operation  
23  
24 cancellation. After several meetings and discussions with several dedicated cardiologists and  
25  
26 anesthetists, a consensus was made. Whenever there is any active cardiac problems, for  
27  
28 example, active heart failure, uncontrolled arrhythmias, recent myocardial infarction, and/or  
29  
30 previously undiagnosed severe ejection systolic murmur, a consultation will be arranged with  
31  
32 the cardiologist the next day morning together with a 12-leads electrocardiogram faxed prior to  
33  
34 the consultation. A proper pre-operative cardiac assessment, usually including an  
35  
36 echocardiogram, will be performed.  
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43 Senior representatives from allied health worker group include physiotherapists, occupational  
44  
45 therapists, medical social workers, community nurse units and voluntary support groups are  
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47 also involved in the development and running of the pathway. Besides the usual daily routine of  
48  
49 the therapist in taking care of the patients, they also define which assessment scores, Mini-  
50  
51 Mental State Examination (MMSE) and Modified Barthel Index (MBI), are used for the  
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53 monitoring of the rehabilitation potential and the progress during the hospital stay. Social  
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3 problem is also one of the difficult aspects in patient discharge. The medical social workers re-  
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5 define their duty in geriatric hip fracture care by assessing all admitted patients and make a  
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7 discharge plan with the patients and their family in the early phase of management. Out-  
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9 patient therapists and community nurse units also extend their services to the post-discharge  
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11 period in order to provide a better and comprehensive rehabilitation.  
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17 During the stay in rehabilitation hospital, standard protocol of post-operative management  
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19 helps to speed-up the rehabilitation process. During the first week, the patients are encouraged  
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21 to mobilize in the ward with the help from the therapists. The wounds are inspected once they  
22  
23 are transferred to the rehabilitation ward. Stitches are removed on day fourteen after  
24  
25 operation. Pain control is very important and regular analgesics are usually prescribed.  
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30 In the second week, x-ray will be taken to check for early problem. The physiotherapists will  
31  
32 focus on strengthening of muscles and walking stability. The occupational therapists will look  
33  
34 for potential home modifications and start planning early.  
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38 During the third week, the patients should be ready to be discharged home or nursing home.  
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40 The care providers or families are educated for home exercise. Any medication that has been  
41  
42 changed during the hospital stay will be finalized. (Fig. 1).  
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#### 46 47 **Methodology:**

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50 The clinical pathway first started running in February 2007. All isolated hip fractures with age  
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52 greater than 65 were recruited into the clinical pathway. Prospective collection of  
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54 demographics, including age, sex, original placement where the patients live before admission,  
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3 history of previous fractures, pre-morbid mobility and walking aids. Other data including  
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5 number of co-morbidities, laterality of fractures, classification of fractures, surgery types,  
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7 American Society of Anesthesiology (ASA) score, surgeons' rank, pre-operative hemoglobin  
8  
9 level, post-operative requirement of blood transfusion, number of days before patients start  
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11 walking, number of days when drains are removed, financial assistance requirements and also  
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13 re-arrangement of placement are all collected from 2007 till the end of 2010.  
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19 The co-morbidities are defined by the previously diagnosed problems when the patient is  
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21 admitted. These co-morbidities include six main categories, cardiovascular, respiratory,  
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23 neurological, endocrine, psychiatric problems and neoplasm. Common cardiovascular problems  
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25 include ischemic heart disease, history of myocardial infarction, congestive heart failure and  
26  
27 arrhythmias. Respiratory problems include chronic obstructive airway disease, pulmonary  
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29 tuberculosis and asthma. Neurological problems include history of cerebral vascular accident,  
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31 transient ischemic attack, and Parkinsonism. The most common endocrine problems include  
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33 diabetes and thyroid disease. Psychiatric problems include dementia, schizophrenia and other  
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35 forms of psychosis. There are some other problems like renal impairment, chronic renal failure  
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37 and liver problems which are also considered as co-morbidities.  
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45 Pathological fractures, multiple fractures, and hip fractures that were transferred from other  
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47 specialty were excluded from this pathway. The pre-operative, post-operative length of acute  
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49 hospital stay and also the rehabilitation hospital stay were also recorded. Wound complications  
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51 and medical complications are recorded. The in-patient mortality rate and the 30-days  
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53 mortality rate were used as the clinical outcomes to evaluate the effectiveness of this pathway.  
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3 The in-patient mortality is defined as the patient's death occurs either in the acute or the  
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5 rehabilitation hospital stay. The 30-days mortality is defined as the patient's death occurs  
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7 within 30 days after his/her admission to the acute hospital, regardless of the fact that whether  
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9 he/she is staying in or discharged from the hospital system. The data from 2006 were then  
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11 collected retrospectively through the computer medical system. These two sets of data were  
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13 then compared and analyzed.  
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## 18 19 **Results:**

### 20 21 **Demographics:**

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23 From 2007 till 2010, we treated 1342 hip fracture patients. The female to male ratio was kept  
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25 relatively constant at around 2.5:1 each year. The average age was from 82 in 2007 increasing  
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27 to 84 in 2010. The youngest age of the hip fracture was 65 which corresponded to the lowest  
28  
29 limit of our hip fracture clinical pathway. The oldest patient operated was a female patient age  
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31 102. Regarding the number of hip fractures operated each year, there was a steady increase  
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33 annually, reaching more than 400 cases a year in 2010. Among all these fractures, 672 (50%)  
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35 were neck of femur fractures, 736 (47%) were intertrochanteric fractures and 37 (3%) were  
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37 subtrochanteric fractures. 231 (17%) patients received cannulated screws fixation. 362 (27%)  
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39 patients received hemiarthroplasty replacement. 524 (39%) patients had dynamic hip screws  
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41 done and 218 (16%) patients received cephalomedullary nail fixation.  
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51 Among these 1342 patients, majority of them has ASA score 2 and 3, comprising 41% and 56%  
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53 respectively (Table 1). The number of co-morbidities also increased gradually in last 4 years (Fig.  
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3 2). Moreover, 52% of them had more than 3 co-morbidities when they were admitted. The  
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5 three most common problems were hypertension, diabetes and dementia. Regarding the  
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7 community we serve, about 70% of these hip fractures lived in their home and the remaining  
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9 30% were already institutionalized before admission.  
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14 In 2006, when we did not have this clinical pathway, we have treated 411 hip fracture patients.  
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16 The average age was 82. All other parameters including male to female ratio, hip fracture types,  
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18 number of co-morbidities and ASA score were comparable to those of the following 4 years.  
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20 However, one point worth noticing is that there was a three times increase in the use of  
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22 cephalomedullary device for fixing the intertrochanteric fractures from 2006 to 2010 despite  
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24 the fracture patterns were comparable in these 2 periods.  
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30 Length of hospital stay:  
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33 After the implementation of the clinical pathway since 2007, there was a mark decrease in the  
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35 pre-operative length of stay as well as the total length of stay in acute hospital. Besides, the  
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37 length of stay in rehabilitation hospital also markedly decreased. In year 2006, the average pre-  
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39 operative length of stay was 6.1 days. It was dramatically decreased to an average of 2.53 days  
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41 in 2007. Upon the subsequent years with the clinical pathway fully operational, there was a  
42  
43 steady and gradual improvement of the pre-operative length of stay. Our most recent data  
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45 showed that the average pre-operative length of stay was 1.5 days in 2010. This improvement  
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47 was significant when compared with that of the year 2006 ( $p < 0.05$ ). The post-op length of stay  
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49 also showed a decrease from 6.78 days in 2006 to 5.13 days in 2010. This improvement was  
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51 also statistically significant ( $p < 0.05$ ). Since both pre-operative and post-operative stay were  
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3 significantly shorter, the total length of stay also showed a significant improvement from 12.07  
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5 days in 2006 to 6.38 days in 2010 (Fig. 3). Although there was a gradual increase in the number  
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8 of geriatric hip fractures each year, a total of 50% reduction in the total acute hospital stay  
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10 demonstrated the tremendous effectiveness of the clinical pathway.  
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14 One of the uniqueness of our clinical pathway when comparing with the other pathways in the  
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16 world<sup>9-11 13 14</sup> is that ours starts from the emergency department of the acute hospital when the  
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18 patient is admitted, and continues all the way to another rehabilitation hospital until the  
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20 patient is discharged home. This ensures a smooth running of the whole chain of care. Our  
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22 statistics showed that in 2006, the average length of stay in rehabilitation hospital was 40 days.  
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24 This was greatly reduced to 17.6 days in 2010 (Fig. 4). The decrease was statistically significant  
25  
26 as well ( $p < 0.05$ ). The reduction was more than 50%. Despite this dramatic improvement, over  
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28 80% of the patients were still able to be discharged back to their original placements during the  
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30 study period.  
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38 Complication rates:

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41 Wound infection rate is one of the parameters we monitor after the implementation of the  
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43 clinical pathway. There is no obvious improvement in the infection rate in both fixation group  
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45 and hemiarthroplasty group. The fixation group includes cannulated screws fixation, dynamic  
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47 hip screws and cephalomedullary devices. The hemiarthroplasty group includes bipolar  
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49 hemiarthroplasty, cemented and non-cemented ones and also Austin Moore hemiarthroplasty.  
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51 In fact, there is a slight increase in the infection rate in the data of 2010 (Table 2). Post-  
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53 operative pneumonia was another parameter we monitored. Post-operative pneumonia is  
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3 defined as the patients with clinical signs of chest infection together with positive sputum  
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5 culture. There is a slight decrease in the rate of pneumonia (Table 3).  
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9 **Mortality rates:**  
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12 Our results showed that despite we operated more and more hip fractures with advancing age  
13 and increasing number of co-morbidities every year, the inpatient mortality rate showed a  
14 decrease from 2.7% in 2006 to 1.25% in 2010 (Fig.5). The 30-day-mortality rate also showed a  
15 decrease from 3.65% in 2006 to 2.75% in 2010 (Fig. 6). However, the decrease in both mortality  
16 rates showed no statistical significance which is likely due to the relative small number of  
17 deceased patients.  
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28 **Discussion:**  
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31 Geriatric hip fractures used to be less attended in the old days because these patients were  
32 considered as less urgent when compared to the younger patients. These fractures are also  
33 traditionally considered "simple" fracture to treat. Therefore they were considered to be  
34 fractures that were suitable for beginners to learn. However, this "traditional" approach was  
35 changing rapidly in the last decade. More and more evidence showed that these osteoporotic  
36 fractures should be managed with aggressive medical and surgical support which achieved  
37 excellent results with good clinical outcomes<sup>15</sup>.  
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50 Among all the different stages during the hospital stay, the pre-operative length of stay is one  
51 of the most important factors that affect clinical outcomes. In many clinical studies, the shorter  
52 the pre-operative waiting time, the fewer the complications and the lower the mortality rate<sup>6</sup>  
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3 16. Therefore, the significant reduction of the pre-operative waiting time is considered one of  
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6 the major accomplishments in the clinical pathway. Besides, the post-operative length of stay  
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9 and thus the total length of stay were both improved accordingly.

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11 Geriatric trauma service cannot achieve success without the support of the hospital  
12  
13 administration itself. The availability of a dedicated day-time trauma operating room is certainly  
14  
15 a big help to the efficient running of the whole management process <sup>17</sup>. This trauma list caters  
16  
17 for all patients that need fracture care. There are several advantages of a day-time trauma list  
18  
19 that contribute to the significant reduction in hospital stay. First is the flexibility of the trauma  
20  
21 cases allocated for operation. When there is a dedicated day time list caters for trauma only,  
22  
23 the more difficult cases, in terms of anesthesia or surgical technical difficulty, can be allocated  
24  
25 to the time when more experienced surgeons or anesthetists are available. Second is the  
26  
27 availability of the operating room staff. The operating room for trauma cases will have a team  
28  
29 of nurses and supporting staff always ready for trauma care and fracture fixation. This helps to  
30  
31 shorten the operating time and the transit time between cases. Third is the readiness of the  
32  
33 anesthetists for geriatric trauma patients. These anesthetists, when they are allocated for the  
34  
35 trauma list, are prepared psychologically and knowledge wise to take care of the fragile and  
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37 patients approaching extreme age. Finally is the group of the dedicated trauma surgeons in the  
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39 trauma list. These surgeons understand the philosophy of the geriatric hip fracture care. Their  
40  
41 common goal is to help these patients safely and efficiently, managing their hip fractures with  
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43 the appropriate implants or prosthesis. All the XR of the hip fractures are audited weekly with  
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45 the senior surgeons. All these factors work together resulting in a significant decrease in the  
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3 hospital length of stay because of much improved efficacy. The pain and suffering caused by the  
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5 unfixed unstable fracture is reduced and the complications due to prolong immobilization are  
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7 also kept to the minimum.  
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11 In rehabilitation hospital, rehabilitation doctors, nurses, therapists and medical social workers  
12  
13 all work together to speed up the whole rehabilitation process. Early active walking exercise  
14  
15 and post-discharge rehabilitation by community nurses and therapists play a great role in  
16  
17 shortening the need of in-patient treatment. The overall shortened rehabilitation hospital stay  
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19 reflects the effectiveness and cooperation with this multidisciplinary approach<sup>9 10</sup>.  
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25 Behind all the managing process in the clinical pathway, it is led by an experience clinical  
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27 champion, whom should be familiar with all the details of managing the geriatric fractures and  
28  
29 the related issues. He is responsible for the development of the prototype of the pathway, the  
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31 recruitment of the related clinical staff, the coordination of the pathway and negotiation with  
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33 the stake holders, especially the hospital administration. A case manager, who is preferably a  
34  
35 full-time nurse, is a major key to success of the smooth running of the pathway. He/she is  
36  
37 usually responsible for not just one pathway in the hospital but may be few. His/her main duty  
38  
39 is daily monitoring and the collection of the data. He/she is also the one who communicates  
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41 most with all the different clinical departments to understand the needs and the difficulties. If  
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43 there is any problem arises in any part of the pathway, the case manager is the first to know.  
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49 The problem should then be solved as soon as possible, usually through the communication and  
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51 discussion with the clinical champion, case manager and the involved clinical department.  
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3 Regular yearly audit of the performance and the clinical outcomes is another important aspect  
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5 leading to the early success and the sustainability of this clinical pathway for the last five years.  
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8 All the data were analyzed and presented during the half yearly meeting. Everyone has the  
9  
10 opportunity to review what has been achieved and what was not done well. Any setback of any  
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12 clinical outcome is discussed during the meeting, even to the case by case level, in order to seek  
13  
14 for the solutions and revision of the clinical pathway if needed.  
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19 Extra resources in the form of better communication, dedicated altitude and eliminate  
20  
21 inadvertent wastage have achieved excellent clinical outcomes in the last 5 years in terms of  
22  
23 short term mortality rate. Our 30 days mortality rate were generally much lower than the  
24  
25 commonly quoted figures, ranging from 5.1% to 13%<sup>6 9 11 14 18-20</sup>. It probably just reflected the  
26  
27 difference in general health of the local population. Although there is no statistical significance  
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29 in the mortality rate before and after the clinical pathway, it definitely showed a general  
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31 decreasing trend. Most important is that despite we operate more and more hip fractures with  
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33 increasing number of co-morbidities, the mortality rate was kept low. Moreover, it also proved  
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35 that despite the patients were operated as short as 2 days, these patients were operated in a  
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37 safe and well prepared clinical situation. The shortened hospital length of stay is not a result of  
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39 administrative pressure but a better preparation and coordination of all the involved clinical  
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41 staff. Yet, the substantial shorter length of stay in both acute and rehabilitation hospitals can  
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43 lead to significant decrease in cost of care.  
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## 52 **Conclusion**

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3 Our geriatric hip fracture clinical pathway was introduced 5 years ago to improve our fragility  
4 fracture service as well as to face the ever growing challenge from the elderly population. This  
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6 was proven to be successful in terms of both clinical and administrative point of view. The  
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8 principle of using a clinical pathway to provide multidisciplinary approach to the geriatric  
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10 fracture problem is also proven to be very effective as well.  
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**Conflict of Interest:**

The authors certify that there are no financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work.

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3 **Table**  
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7 Table 1: ASA score trend from year 2007-2010  
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10 Table 2: Wound infection rate of hip fracture surgeries 2006-2010  
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13 Table 3: Post-operative pneumonia rate 2006-2010  
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3 **Figure caption**  
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10 Fig. 1 The model of geriatric hip fracture clinical pathway  
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13 Fig. 2 The number of co-morbidities for hip fracture patients in the years 2007-2010  
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17 Fig. 3 The average preoperative length of stay in terms of days during the period 2006-2010  
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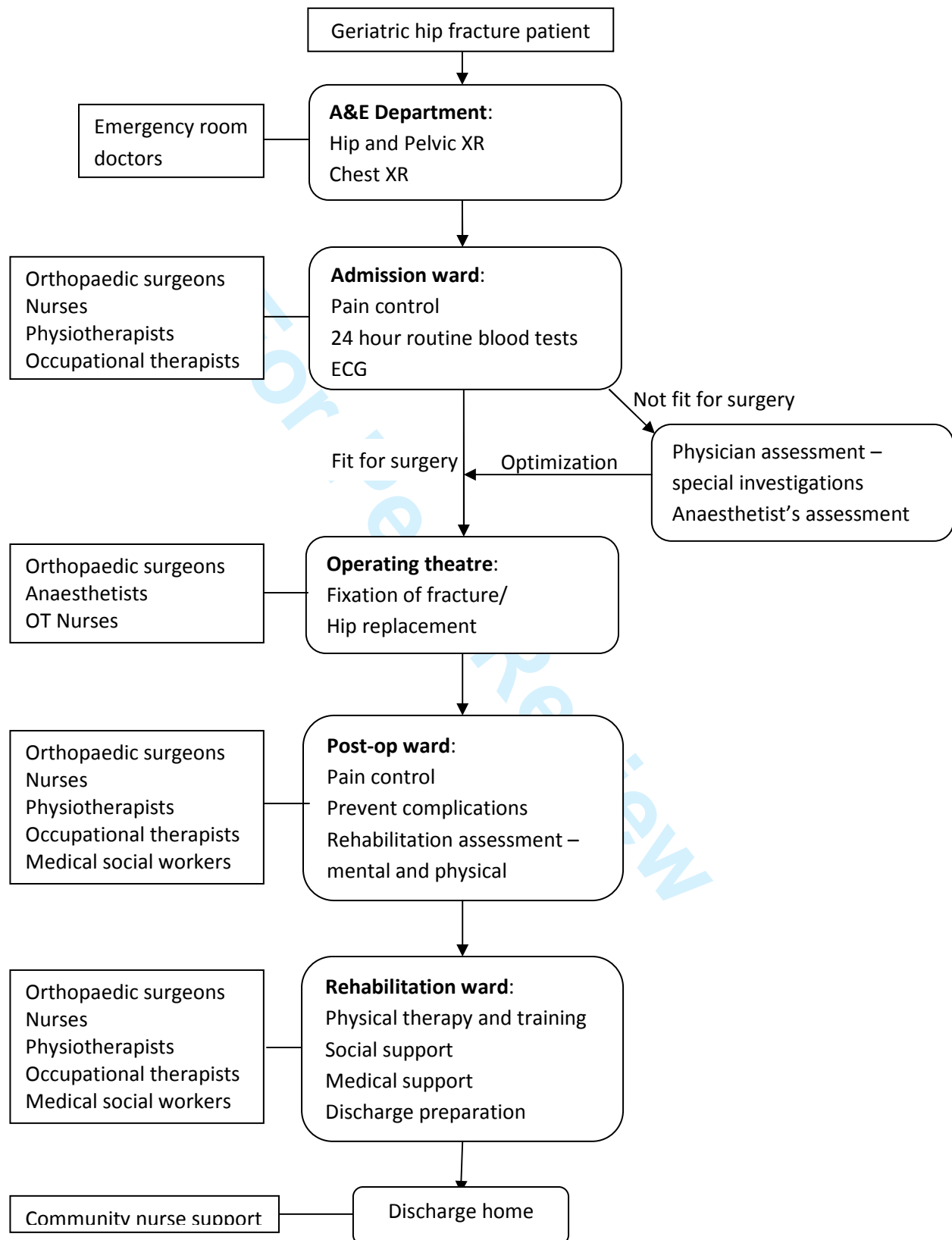
20 Fig. 4 The average length of stay in the rehabilitation hospital in terms of days during the period  
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22 2006-2010  
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26 Fig. 5 The in-patient mortality rate during the period 2006-2010  
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29 Fig. 6 The 30 days mortality rate during the period 2006-2010  
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Fig. 2

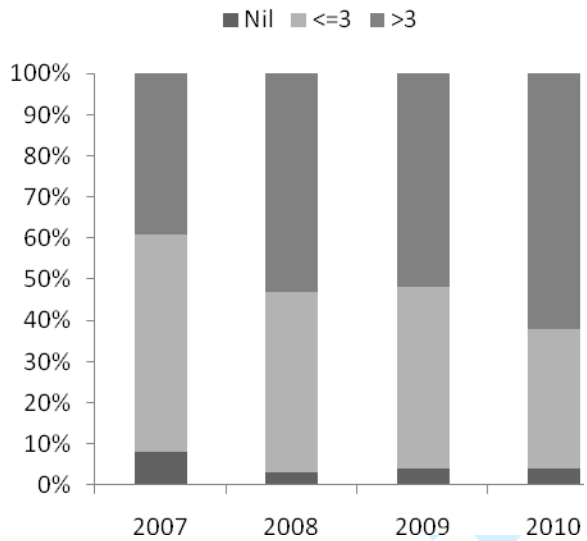


Fig. 3

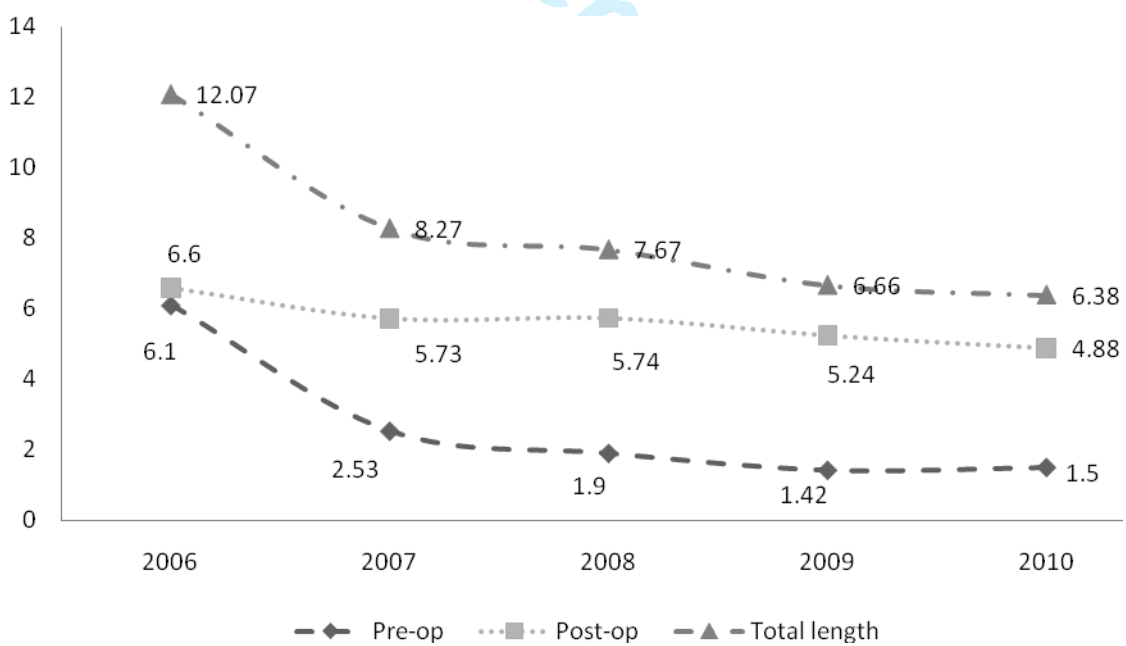


Fig. 4

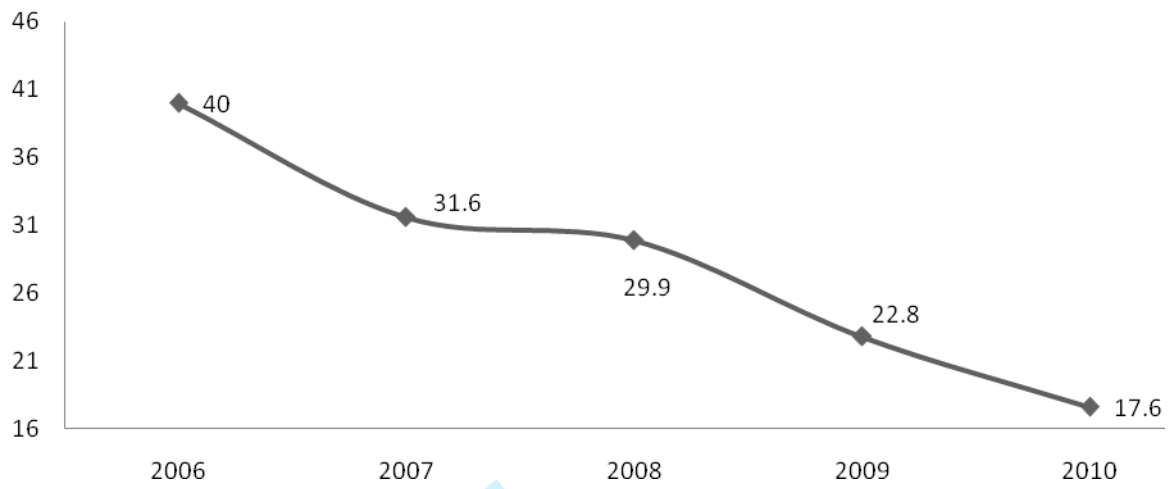
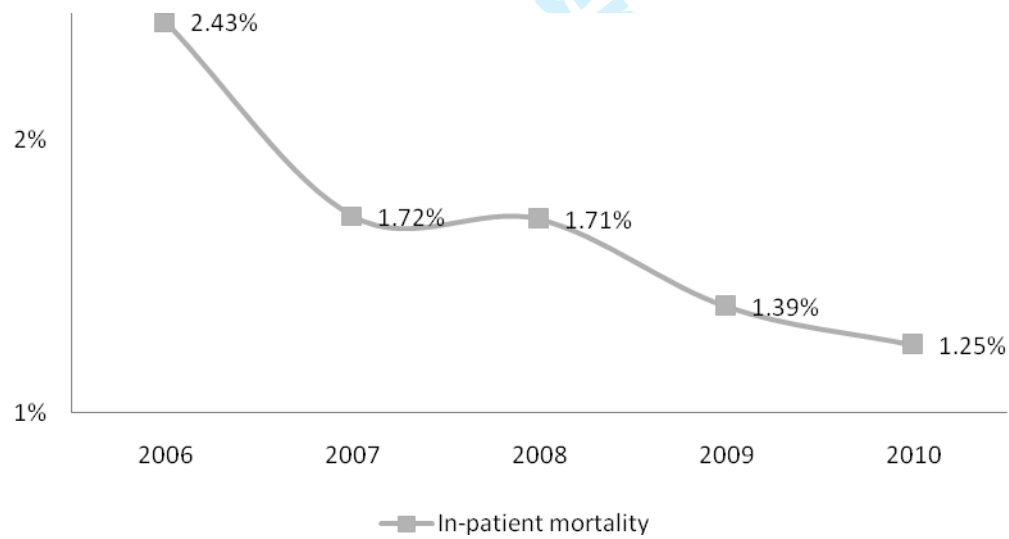
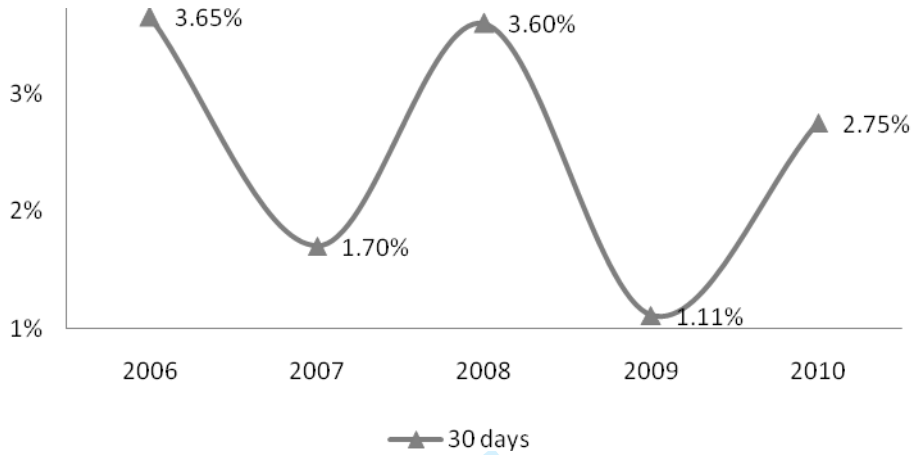


Fig.5



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Fig. 6



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