Summary

Outcomes of major trauma

This thesis evaluates the short-term and the long-term outcomes of severely injured patients. Severely injured patients are of interest, not only from a medical, but also from a social and an economic point of view. It is generally assumed that severe injuries have considerable physical, emotional and social consequences in the predominantly young victims of trauma. Remarkably, only a little information is available on the subsequent outcomes of severely injured patients. Follow-up studies are necessary (1) to provide patients, the patient's relatives or insurance companies with better information, (2) to evaluate and to improve treatment strategies, (3) to answer questions concerning the allocation of resources and (4) to develop preventive measures and health care policies. The purpose of this study is to analyse the short-term and long-term physical, psychological and social consequences of major trauma, not only in adult, but also in elderly and pediatric polytrauma patients. Secondary questions concern the different outcomes experienced by severely injured patients and those with lesser injuries, as well as by patients with injuries of the upper and lower extremities.

The first chapter explains the general concepts used in this study. The following chapters describe various outcome results of severely injured patients of all ages (chapter 2 and 3) and then from three age groups: the elderly (chapter 4 and 5), adults (chapter 6 and 7) and children (chapter 8). The final chapter draws conclusions and recommendations from the above studies.

Chapter 1. General concepts

This chapter provides an overview of injuries in the Netherlands. The registration systems currently available are described and the way these systems register the severity of injury is outlined. Morbidity, mortality and disability rates are summarized and the costs of injuries in the Netherlands are indicated. Scoring systems used to define injury severity are explained, in particular the Injury Severity Score, which is used throughout this study. Then, the concepts used to delineate the outcome of major trauma are explained. In this thesis, the outcome is evaluated in terms of the patient's mortality, length of hospitalization, discharge disposition, return to work or school and the functional status based on WHO's ICIDH model (pathology-impairment-disability-handicap). Although many measurement instruments can be used to assess the consequences of trauma, only the Glasgow Outcome Scale is discussed in detail because this scale is used in nearly every chapter of the thesis. Finally, a review of the literature is presented.

Chapter 2. All ages: Epidemiological data

A survey was made of the epidemiological data from 932 severely injured patients to analyse the relation between the severity of the injuries and the outcomes estimated by means of the discharge destination. A second concern was to examine whether injuries to certain organ systems influenced the discharge destination. All multiply injured patients with an HTI/ISS of ≥ 18 who were treated at the University Hospital Groningen between 1985 and 1989 were analysed. The vast majority of the multiply injured patients were young and male. Seventy-five per cent of the injuries had been caused by traffic accidents; car occupants had the highest mortality risk. Elderly patients over 80 years of age and young children also had a greater chance of dying. The mortality rate of 22% was mainly
produced by severe head injuries and it increased with increasing ISS. The length of hospitalization averaged 23 days, which is short compared to the situation abroad. Half of the patients could be discharged home. Discharge to a rehabilitation centre depended on age and on injury severity: younger, more severely injured patients were transferred to a rehabilitation centre, whereas older patients with less complicated injuries were admitted to a nursing home. Injuries to the extremities predominantly determined admission to a rehabilitation centre or a nursing home. In view of the number of patients who could be discharged home, it may be assumed that the ultimate functional results of severely injured patients will be good.

Chapter 3. All ages: An overview of the outcome
Over a 5-year period, the final functional outcome of 723 consecutive patients with severe injuries (AIS/ISS of $\geq 16$) was assessed by measuring the degree of disability at various intervals after injury. The patients were young (mean age 33 years) and mainly injured in traffic. The mortality rate was 26%, in the majority of cases due to severe head injuries. Half of the survivors could be discharged home and 29% were transferred to a rehabilitation centre. Severe injuries of the head/neck, the spine/spinal cord and the lower extremities were responsible for permanent disablement. Outcomes deteriorated with increasing AIS/ISS, indicating that the ISS is a reasonable predictor of permanent disablement. Recovery mainly took place in the first half year after injury. After that, severe disability was likely to persist. In patients with moderate disabilities slight further improvements were found in the second half year after injury. These findings have implications for employers and insurance companies. In the light of the severity of the injuries sustained, the final functional outcome was good: Two years after injury, 68% had mild or no disabilities, 19% were moderately disabled, 7% had severe disabilities and none were in a persistent vegetative state.

Chapter 4. Elderly: Major trauma in young and old
Over a 5-year period, differences in the outcomes of 167 young (20-29 years of age) and 121 elderly (over 60 years of age) severely injured patients were evaluated. Mortality in the young was lower than in the elderly (20% versus 39%). Death in all young patients occurred within one week after hospitalization, whereas 30% of the nonsurviving elderly died at a later stage of hospitalization, due to diminished physiological reserve. This condition also explained why all elderly with an ISS of $\geq 50$ died. Nearly all deaths in young and elderly were caused by severe brain injuries. Deaths related to multiple organ failure were not observed in the young and were rare in the elderly. The duration of artificial ventilation, the lengths of stay at the ICU or at the hospital were longer in the elderly severely injured patients. Those who were over 80 years of age had the worst outcomes. The surviving young and elderly could be discharged home in equal percentages. Despite a higher initial mortality rate in the elderly severely injured patients, both patient groups had comparable outcomes at two years after injury. In the light of the these good outcome results, there are no valid arguments to treat severely injured elderly patients any differently from their younger counterparts. Increased trauma care cost is also justified for severely injured elderly.

Chapter 5. Elderly: Injury severity and host factors
The outcomes of injury are determined by time of definite care, quality of care, injury severity and host factors (age, sex and the pre-injury medical state of the patient). To gain insight into the influence of injury severity and host factors on the long-term outcome of elderly injured patients, 42 severely injured elderly patients were compared to 76 elderly patients with a fracture of the femoral neck. The in-hospital mortality rate was 31% in the severely injured patients in contrast with 3% in those with a femoral neck fracture. However, at one year after injury the former group showed less disability and no further deaths after hospital discharge. Limited physiological reserve explained the majority of fatalities in those with a fracture of the femoral neck. At 7 to 8 years after injury, young, active females had the greatest chance to be alive. Age, sex and the pre-injury medical state of the patient were better predictors of long-term survival than injury severity. It is clear that simple comparisons between elderly injured patients cannot be made. Physicians and policy makers should be careful in predicting the outcome of elderly injured patients merely on the basis of injury severity because host factors are of greater importance.

Chapter 6. Adults: Upper limb arterial injuries
Twenty-five severely injured patients with arterial injuries of the upper limbs were investigated to document the impact of arterial damage and associated injuries on long-term functional outcomes. Patients were treated at the Sunnybrook Health Science Centre (SHSC, Toronto, Ontario, Canada) between January 1986 and January 1995. Nineteen out of the 25 patients were victims of blunt trauma. The mortality rate was 24%. There were 10 primary and no secondary amputations. An autogenous vein interposition graft was employed in 10 patients (63%). Concomitant fractures and nerve injuries in the upper limbs were present in 80% and 86% of the patients, respectively. Vascular injuries were relatively unimportant in determining the high overall disability rate. Persistent nerve deficits, joint contractures and pain were principal reasons for long-term functional impairment. Associated injuries in other body areas also contributed to overall disability. Only 21% of the patients recovered completely or had only minor disabilities.

Chapter 7. Adults: Consequences of severe injuries versus an ankle fracture
Differences in long-term physical, psychological and social outcomes between severely injured patients and patients with a lesser injury (a fracture of the ankle) were assessed over a one-year period (1989) using a postal questionnaire (at six years after injury). Physically, the 55 severely injured patients were mainly suffering from problems in the spine and in the extremities. Their complaints were similar, but more severe, as those of the 68 patients with a lesser injury. Severely injured patients mentioned more psychological complaints (poor memory, slowness, fatigue) than those with a minor injury, although the patients with a fracture of the ankle also indicated that they had psychological complaints as a result of the injury sustained. Psychological complaints should be a matter of concern in the treatment of injured patients, not only in severely injured patients but also in those with a lesser injury. The self-reported present state of general health was the same in both patient groups. Equal proportions of the severely injured patients and those with an ankle fracture returned to work. The severely injured patients needed more time to resume work. These findings are important for employers and company doctors. Further social changes (marital status, leisure activities) due to the initial injury were mostly found in the severely injured group. It is clear that severely injured patients as well as those with lesser injuries were affected by long-term consequences. The differences
between the two groups were not as pronounced as is generally assumed, probably because the consequences after lesser injuries are frequently disregarded and because the severely injured patients are doing well.

Chapter 8. Children: Pediatric polytrauma
Pediatric polytrauma patients (≤ 15 years of age) who were 18 years or older at follow-up (1996) were evaluated to assess the short-term and long-term outcomes and to analyze the extent to which short-term outcomes can predict long-term outcomes. Fifty-nine out of 74 patients survived (80%). The children needed on average six months to recover. Those who were severely disabled six weeks to three months after injury were at risk for long-term disability.

One year after injury, 22% of the patients were disabled, due to severe brain injuries and other neural injuries. Over one third of the patients had changed school or failed to pass one or more classes. Although the short-term impact of injuries was extensive, the long-term outcomes were satisfactory. After nine years of follow-up, the degree of physical disablement was 12%. Cognitive impairments were found in 42% of the patients; in the majority of cases cognitive disability was mild. The degree of long-term disability was predicted by the Glasgow Outcome Scale measurements from 6 weeks after injury and onwards. Ultimately, only 10% of the patients were in receipt of disability allowances; the majority were employed or attended school. The quality of life enjoyed by the patients did not differ from that enjoyed by a healthy reference population of the same age. In conclusion, severe injuries sustained during childhood do not lead to a permanent deterioration of adult life.

Chapter 9. Conclusions
The results from this study demonstrate that it is worthwhile to provide optimal medical care to severely injured patients. Despite the high mortality rate, which is still a matter of concern, the degree of long-term disability in adult, elderly and pediatric severely injured patients is low and the quality of life, at least in pediatric polytrauma patients, is good. The results described in this thesis can be used to provide information to the patient and the patient's relatives, to evaluate treatments, to take decisions if resources cannot meet the needs and to develop preventive measures or health care policies. To be able to provide even better prognostic information, further research should focus on the development of a measurement tool to assess the prognosis of an injured patient at an early stage. To improve the treatment of trauma victims, more extensive data on the outcomes of injuries of the extremities or the long-term consequences of lesser injuries would be useful. Additionally, more attention should be focused on the psychological effects of injuries. Since neural injuries are attended with a high degree of long-term disability, the development of new techniques for nerve repair should have a high priority. In the light of the allocation of resources specific patient groups should be studied more intensively (i.e. those with an ISS of over 50, patients of 80 years and older, etc.). Finally, further research is necessary to develop preventive measures in order to protect young traffic participants in particular.