NHS
Eastern and Coastal Kent

Health Needs Assessment:
Osteoporosis and Fall Prevention

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Introduction

Osteoporosis is a chronic, progressive condition associated with micro architectural deterioration of bone tissue that results in low bone mass. As the condition progresses there is an increase in bone fragility that consequently increases the susceptibility to fracture.

The agreed definition of osteoporosis is:

> *A progressive systemic skeletal disease characterised by low bone mass and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture.*
> (World Health Organisation 1994[1])

The ramifications for osteoporosis are two fold. Firstly the clinical significance of osteoporosis lies in the fractures that occur, most commonly observed in the vertebrae, the femur and the radius, which result in substantial morbidity. The most serious consequence arises in patients with hip fracture, which is associated with a significant increase in mortality (15-20%), particularly in elderly men and women (Royal College of Physicians 1999)[2]. The cost to the NHS of hospital care alone, just for fractured neck of femur is £250 million per annum for hospital care alone (Royal College of Physicians 1999).

Secondly, osteoporotic fracture is increasing in the UK and this trend is likely to increase still further because of the marked rise in the elderly population.

Fracture risk depends ultimately on the strength of the bone and propensity to trauma. Bone mineral content (BMC) provides an indirect assessment of bone mass and there is an inverse and continuous relationship between bone mass and fracture risk, in that the risk of fracture increases in individuals with lower bone mineral density. Assessment of fracture risk in an individual should ideally be expressed as absolute (incidence of disease in any defined population) rather than relative risk (ratio of the incidence rate in the exposed group to the incidence in the non-exposed group) and should be related to a time interval. Marshall (1996) showed that the risk of hip fracture increases 2.6 fold for each standard deviation decrease in hip bone mineral density. This paper showed how well measures of bone mineral density predicted occurrence of osteoporotic hip fracture.

Bone mineral content or bone mineral density (BMD) in young healthy adults is normally distributed. This is because skeletal mass is relatively constant once growth has ceased until the age of about 50 years.

Alterations in bone density throughout life fall into three phases: growth, consolidation and loss[3]. It occurs in both sexes and in all races. Most cross-sectional studies demonstrate a biphasic pattern of bone loss. A slow rate of loss starts around 40 years in both sexes. The initial rate of loss is about 0.3–0.5% of peak bone mass per year, and this gradually decreases with age. Superimposed on this slow phase is an accelerated post-menopausal phase of bone loss in women. Rates of loss during this period may be as great as 5–6% per year.

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[1] World Health Organisation. Assessment of fracture risk and its implication to screening for postmenopausal osteoporosis: Technical report series 843. Geneva: WHO,1994.
[2] Royal College of Physicians (1999) Clinical guidelines for the prevention and treatment.
[3] Riggs, B.L., Melton, L.J. Medical progress: involutional osteoporosis. New England Journal of Medicine. 1986; 314: 1676–1686.

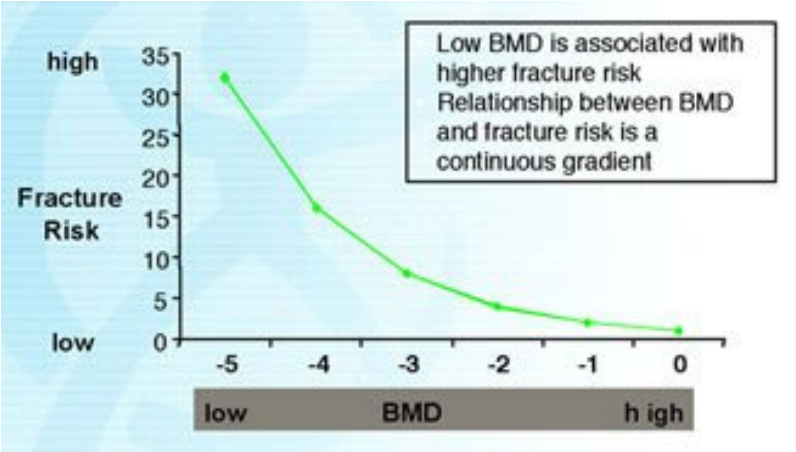
It has been shown that the lower the bone mineral density (BMD) the higher the fracture risk. Bone mass can be assessed at a number of sites including the lumbar spine, the hip, the forearm, and other sites. BMD (usually of the hip and the spine) assessed by dual-energy X-ray absortiometry (DXA) remains the gold standard for the diagnosis of osteoporosis. BMD can be expressed as:

- T-score (the number of standard deviations (SD) above or below the mean BMD values for a young healthy adult)
- Z-score (the number deviations above or below the mean BMD values for a population of the same age and gender)

Based on the 1994 WHO report[4], osteoporosis in women is defined as a BMD value at least -2.5 SD below the mean value of a young healthy population (T-score≤-2.5).

Fig 1: Bone mineral density scores and fracture risk

Status	Hip BMD
Normal	T-score of -1or above
Osteopenia	T-score lower than -1 and greater than -2.5
Osteoporosis	T-score of -2.5 or lower
Severe osteoporosis	T-score of -2.5 or lower, and presence of at least one fragility fracture



Source: International Osteoporosis Foundation
http://www.iofbonehealth.org/health-professionals/about-osteoporosis/diagnosis.html

[4] Christodoulou C, Cooper C. What is osteoporosis? Postgraduate Medical Journal. 2003; 79: 133-138.

Bone density and fracture risk

Clinical risk factors can provide information on the risk of fractures in individual patients. However the indices which have been developed, based on the use of clinical risk factors, can only be used as screening tools. BMD assessment is required to confirm the diagnosis since fractures only occur at advanced stages of the disease.

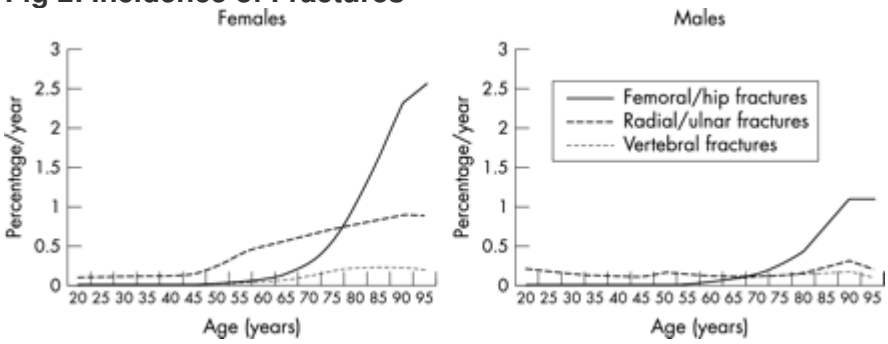
Epidemiology of the disease

Fractures of the hip, vertebral body and distal forearm have long been regarded as the typical osteoporotic fractures. However, the effect of osteoporosis on the skeleton is systemic and prospective studies have shown that there is a heightened risk of almost all types of fracture in individuals with low bone density and, irrespective of fracture site. Adults who sustain a fracture are at substantially greater risk of sustaining another fracture of a different type[5].

Incidence

It is estimated that more than 2 million women have osteoporosis (that is, have a T-score of –2.5 SD or below) in England and Wales[6]. Worldwide, older people represent the fastest growing age group, and the yearly number of fractures is likely to rise substantially with continued ageing of the population. The age specific risk of hip, vertebral, and wrist fracture among white people reveals that there is a steep increase in the incidence of fracture with age and there is a higher incidence in women than in men. By age 85, white women have about a 3% annual incidence of hip fracture[7].

Fig 2: Incidence of Fractures



Source: Christodoulou C, Cooper C. What is osteoporosis? Postgraduate Medical Journal. 2003; 79: 133-138.

It was estimated in 1993 that the annual incidence of hip fractures in the UK is around 60,000, that of radial fracture around 50,000, and that of clinically diagnosed vertebral fractures around 40,000[8]. However, the true incidence of vertebral fractures is higher as many vertebral

[5] Kanis JA, Johnell O, De Laet C, et al. A meta-analysis of previous fracture and subsequent fracture risk. Bone 2004; 35: 375-82.
[6] NICE technology appraisal guidance 160. 2008. Alendronate, etidronate, risedronate, raloxifene and strontium ranelate for the primary prevention of osteoporotic fragility fractures in postmenopausal women. Available at: http://www.nice.org.uk/nicemedia/pdf/TA160guidance.pdf
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[8] Cooper C. Epidemiology and public health impact of osteoporosis. Clin Rheumatol 1993;7:459–77.

fractures, certainly more than two thirds and possibly as many as 85%, do not come to medical attention[9].

Prevalence

The lifetime risk of osteoporotic fracture in 50 year old British white women has been estimated at 14% for the hip, 11% for the spine, and 13% for the radius[10]. A Yorkshire based study showed a prevalence of 24% in women aged 60-69 years[11]. BMD decreases, and consequently the risk of osteoporosis increases with age. Osteoporosis is most common in older white women. The latest NICE guidance[12] estimates that after the menopause, the prevalence of osteoporosis increases markedly with age, from approximately 2% at 50 years rising to more than 25% at 80 years.

A significant increase in prevalence with each decade after age 60 has been demonstrated in various studies. The United States National Health and Nutrition Survey (NHANES) III survey of postmenopausal women showed that the prevalence of osteoporosis in non-Hispanic white American women was 27% (50-59 years), 32% (60-69 years) and 41% for those >=70 years[13]. A previous estimate based on data from Rochester, Minnesota indicated a lower (though still high) prevalence – 14.8% (age 50-59 years), 21.6% (aged 60-69 years), 38.5% (70-79 years) and 70% (>=80 years)[14].

Mortality

The mortality attributable to osteoporosis results largely from hip fractures. Hip fracture causes a 12-20% reduction in expected survival[15]. In those who survive mobility remains permanently impaired in over half of the patients[16]. It appears that excess mortality also occurs after vertebral fracture and that mortality is worse for vertebral fracture and that mortality is worse for vertebral fractures that occur, secondary to mild to moderate trauma than for those associated with severe trauma. Survival at five years appears to be 72% in men and 84% in women[17]. In patients suffering vertebral fractures secondary to mild to moderate trauma, only 8% of the deaths were thought to be due to osteoporosis. It is thought that a significant proportion of the excess mortality in patients with vertebral fractures is due to the presence of comorbid conditions[18].

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[9] Christodoulou C, Cooper C. What is osteoporosis? Postgraduate Medical Journal. 2003; 79: 133-138.

[10] Kanis JA and the WHO Study Group. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: a synopsis of the WHO report. Osteoporosis Int 1994;4:368–81.

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[13] Snelling A, Crespo C, Schaeffer M, Smith S, Walbourn L. Modifiable and nonmodifiable factors associated with osteoporosis in postmenopausal women: results from the Third National Health and Nutrition Examination Survey, 1988-1994. J Womens Health Gend Based Med 2001;10(1):57-65.

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[15] Sexso SB, Lehner JT. Factors affecting hip fracture mortality. Journal of Orthopaedic Trauma. 1988; 1: 298-305.

[16] Royal College of Physicians of London. Fractured neck of femur: prevention and management. London; Royal College of Physicians, 1989.

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[18] Christodoulou C, Cooper C. What is osteoporosis? Postgraduate Medical Journal. 2003; 79: 133-138.

Morbidity

Osteoporotic fractures cause varying degrees of morbidity. In the United States about 7% of patients who survive all types of fragility fractures have some degree of permanent disability and 8% require long term nursing home care. A 50 year old white woman in the US has a 13% chance of experiencing fracture related functional decline after any fracture [19]. Colles' fractures have only short term consequences, while hip fracture causes much disability. Many hip fracture patients become permanently disabled. Up to a third of hip fracture patients become totally dependent, necessitating institutionalisation[20].

Multiple vertebral fractures may result in acute and chronic back pain, limitation of physical activity, and progressive kyphosis and height loss. The loss of functional capabilities might result in depression and low self-esteem. Moreover pain and fear of additional fracture can cause decreased physical activity, which in turn worsens osteoporosis and therefore the risk of further fractures is increased[21]

Known risk factors of the disease

At present there is no universally accepted policy for population screening in the UK to identify individuals with osteoporosis or those at high risk of fracture. Patients are identified opportunistically using a case-finding strategy on the finding of a previous fragility fracture or the presence of significant clinical risk factors. Some of these risk factors act independently of BMD to increase fracture risk whereas others increase fracture risk through their association with low BMD.

Non-modifiable risk factors

- **Age**
  Being past the menopause for women, and over the age of 65 for men

- **Sex**
  Women are at greater risk of osteoporosis as they have smaller bones and hence lower total bone mass. Additionally, women lose bone more quickly following the menopause, and typically live longer. Osteoporosis is less common in men but is still a significant problem. The rate of bone loss in men is less than that in women. In the Framingham Osteoporosis Study annualised percent bone loss for women was 0.86% to 1.21% at different sites and for men, 0.04% to 0.90%[22]. Secondary causes of osteoporosis are, however, more common in men, affecting approximately 40% of cases[23] [24]. Excepting reproductive factors and taking into account the increased influence of secondary factors in men, the risk factors in women also apply to men.

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- **Low body mass index (≤19kg/m2)**
  Weight loss or low body mass index (BMI) is an indicator of lower BMD[25]. In addition, those in the lowest tertile of BMI have a two-fold greater bone loss than those in the highest tertile over two years. Post menopausal women with below average BMI should be considered as being at increased risk of osteoporosis[26].

- **History of previous fracture**
  Women who have suffered a previous fragility fracture (defined as a fracture occurring after a fall from standing height or less) are at increased risk of further fractures, independent of BMD[27] Women who develop a vertebral fracture have a 19.2% (95% CI 13-6-24.8%) risk of a further vertebral fracture within one year.33 Men and women aged 65 years or older with a vertebral fracture have a five year risk of femur or hip fracture of 6.7% and 13.3% respectively[28]. In women, the presence of one or two vertebral fractures increases the risk of further fracture 7.4 fold[29]. Those at highest risk of fracture are those who have already fractured including those with loss of height or kyphosis which can indicate (what may have been painless) vertebral fractures[30 31].

- **Parental history of hip fracture**
  Lower BMD is found in women and men with a family history of osteoporosis, a family history being defined as a history of osteoporosis or brittle bones, kyphosis ("dowager's hump"), or low trauma fracture after age 50 years as reported by the offspring. Individual BMD decreases as the number of family members with osteoporosis increases. Overall family history is a more sensitive predictor of osteoporosis risk than maternal or paternal history alone[32]. Prevalence of a positive history in sisters is similar to prevalence reported for mothers[33 34] In one epidemiological study the greatest risk of categoric osteopaenia (RR 2.16, CI=1.38-3.37) was in patients whose father had a history of osteoporosis[35].

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[28] van Staa T, Leufkens H, Cooper C. Does a fracture at one site predict later fractures at other sites? A British cohort study. Osteoporos Int 2002;13:624-9.

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[33] ibid

[34] Snelling A, Crespo C, Schaeffer M, Smith S, Walbourn L. Modifiable and nonmodifiable factors associated with osteoporosis in postmenopausal women: results from the Third National Health and Nutrition Examination Survey, 1988-1994. J Womens Health Gend Based Med 2001;10(1):57-65.

[35] Soroko S, Barrett-Connor E, Edelstein S, Kritz-Silverstein D. Family history of osteoporosis and bone mineral density at the axial skeleton: the Rancho Bernardo Study. J Bone Miner Res 1994;9(6):761-9.

- **Ethnicity**
  Afro-Caribbean women have a higher BMD than white women at all ages due to a higher peak bone mass and slower rate of loss[36 37]. White women have a 2.5-fold greater risk of getting osteoporosis[38].

- **Reproductive factors**
  A late menopause or short time from menopause to BMD measurement are associated with higher BMD. There is consistent evidence that low BMD is associated with early menopause[39]. Consequently, women with an early menopause should be considered at higher risk of osteoporosis than others at a similar age. BMD decreases most rapidly in the early postmenopausal years[40]. There is no consistent evidence that tubal ligation, parity, number of previous miscarriages, or breast feeding affect BMD. Current use of oestrogen replacement therapy is associated with a higher BMD[41].

Modifiable risk factors[42]

- **Glucocorticoid treatment (any dose, by mouth for 3 months or more)**
  In 2002 Christodoulou and Cooper[43] reported that only 14% of UK patients taking continuous oral glucocorticoids received treatment to prevent bone loss, which is a major complication. Bone loss is highest in the initial months of treatment and between 30-50% of patients taking long term corticosteroids will experience fractures[44].
- **Smoking**
  There is an inverse relationship between cigarette smoking and BMD. Many factors are believed to contribute to this including reduced body weight, an earlier menopause, and increased metabolic breakdown of exogenous oestrogen in women. In a meta-analysis, although there was no significant difference in bone density between smokers and non-smokers at age 50, bone density in women diminished by 2% more in smokers than in non-smokers for each 10 year increase in age, with a difference between the two of 6% at age 80 years[45].
- **Alcohol intake of 3 or more units daily**

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[36] Snelling A, Crespo C, Schaeffer M, Smith S, Walbourn L. Modifiable and nonmodifiable factors associated with osteoporosis in postmenopausal women: results from the Third National Health and Nutrition Examination Survey, 1988-1994. J Womens Health Gend Based Med 2001;10(1):57-65.
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Consumption of large quantities of alcohol may be detrimental to bone. This might be due to adverse effects on protein and calcium metabolism, mobility, gonadal function, and a toxic effect on osteoblasts. However, moderate quantities of alcohol appear to be protective against bone loss at the hip and against the risk of vertebral fracture[46].

- **Physical inactivity**
  It has been shown that physical loading and mechanical stress increase BMD and that certain forms of exercise may retard bone loss. Studies have shown that a relationship exists between physical inactivity in the elderly and the risk of hip and vertebral fracture. Some of this effect might be due to the increased risk of falling[47].

- **Falls**
  With increasing age, 'simple' falls from standing height or less become more and more frequent[48]. About one third of people aged 65 or over fall at least once a year[49] [50]. In patients with osteoporosis, falls contribute to numerous appendicular and proximal fractures. Hip fracture is the most serious resulting complication because the morality rate increases from 12% to 20% when compared to people of the same age and sex who have not sustained such a fracture[51]. Among people who survive surgical intervention for an osteoporotic hip fracture, only one-third are restored to their former physical status[52].

  In an institutional setting, a high incidence of falls is the determining factor in the onset of hip fractures, more than low BMD[53]. Fracture risk is greatest when a high risk of falls and low BMD are present concurrently. Risk of hip fracture is nearly 25 times higher in older women with a history of both a recent fall and osteoporosis than in those with neither a fall nor decreased BMD[54].

Secondary causes of osteoporosis[55]

- Rheumatoid arthritis
- Untreated hypogonadism in men and women
- Prolonged immobility
- Organ transplantation
- Type I diabetes
- Hyperthyroidism
- Gastrointestinal disease
- Chronic liver disease

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• Chronic obstructive pulmonary disease

The FRAX® tool[56]

There are many risk factors associated with an increased risk of fracture. The World Health Organization (WHO) has used these in the FRAX® tool to calculate the chance of somebody breaking a bone over the next 10 years. This can be for a hip fracture alone or any major osteoporotic fracture (wrist, upper arm, vertebra, hip). FRAX® can be used in men over the age of 50 years and in women after the menopause. The risk of fracture determined by FRAX® can then be used to decide what to do next. If the risk of fracture is low, lifestyle advice about diet and exercise is given but medication is not required. If the risk is high then treatment is considered. If the risk is in between high and low then a DXA scan is indicated. The FRAX® risk is then recalculated and the decision made on whether medication is needed. Women who have already had a fracture after the menopause may be offered treatment without the need to calculate their risk.

Falls

Numerous studies show that among older people falling, not osteoporosis is the strongest risk factor for fracture[57]. Thus preventing falls is a logical approach to preventing fracture. Evidence from systematic reviews and meta-analyses of randomised trials shows that at least 15% of falls in older people can be prevented, with individual trials reporting reductions of up to 50%

About 30% of over 65s living in the community will fall per year and 60% of people in nursing homes. Both the incidence of falls and the severity of fall related complications rise steadily after the age of 60. In the age 65 and over approximately 35% to 40% of community dwelling, generally healthy older persons fall annually (AGS 2001). After the age of 75, the rates are higher. Incidence rates in nursing homes and hospitals are almost three times the rates of community dwelling rates (Campbell 1990).

There are complex causal links between risk factors and falls occurrence. The risk of falling appears to increases with the number of risk factors (Tinetti 1988). However, attributing the risk of different risk factors (attributable risk) to risk of fall is very difficult due to the fact that falls in the elderly population commonly result from the accumulation of multiple impairments that contribute to the absolute risk of fall. This fact makes it problematical to predict within in a given population the likelihood of the percentage of over 65s who would benefit form intervention.

Campbell (1989) investigated the risk for falls in a community-based prospective cohort study of people 70 years and older. The study was critical of previous retrospective community based studies in that they were methodologically flawed due to problems of recall with the subjects (information bias). Campbell acknowledged the work of Tinetti who had developed a fall risk index for those admitted to an intermediate care facility. This index would have had poor external validity to the general population due to the fact that the study population would be frailer than those living in the community. The study followed 761 subjects for one year and the sample frame included those in the community and those in residential care, therefore the sample was felt to be representative of the country as a whole. Initial assessment procedures into the study where very thorough and comprehensive and details of falls were examined by

[56] Kanis JA, McCloskey EV Johansson H et al (National Osteoporosis Guideline Group) Case finding for the management of osteoporosis with FRAX – assessment and intervention thresholds for the UK. Osteoporos Int. 2008; 19: 1395-1408.
[57] Shifting the focus in fracture prevention from osteoporosis to falls, BMJ;336;124-126 January 2009

two sets of clinicians which increased internal validity. The sample was checked for self selecting bias by analysing those subjects that refused to participate in the study. Those refusing were not more frail those subjects that went into the study.

The study reported that the distribution of fall frequency differed significantly from the Poisson distribution, which verified that falling was not just a random happening but was influenced by other factors which were then investigated again strengthening the studies internal validity.

The study drew on clinical experience and previous institutional and community retrospective studies to generate variables that were considered as either important in causing falls or had a possible value in predicting an increased risk of falling. Variables that were significantly different in the fall group compared to the no fall group were further analysed to determine the relative risk of being in the fall group incurred by each variable Table 3 (appendix 5). This analysis could therefore demonstrate that women in the 80-84 age groups had an increase risk of falling than younger women (relative risk of 2.5 to 1.2). The confidence intervals showed that the relative risk of age is more reliable then other measures such as stroke, which although showed a high relative risk score of 13.6 also showed a very large confidence interval between 2.6-71.3. Body sway showed a 1.7% increase in risk and showed tight confidence intervals (1.0-2.9). Campbell's paper shows robustness in its methodology and also demonstrates the complexities of risk factors associated with falls.

In another paper published by the American Geriatrics Society (2001) a comparison is made between a number of studies that have identified risk factors for falling. A problem with this comparison is that the investigators have not used consistent classifications.

The relative risk ratios were calculated for prospective studies (because subjects and controls are selected) and odds ratios were calculated for retrospective studies. Range indicates relative risk with 1.0 being, 'no more risk'. Out of the 16 studies analysed, muscle weakness, history of falls and gait and balance deficits came out as the 4 most common risk factors identified with falling.

Vision problems and falls prevention

Intrinsic risk factors which contribute to falls and fall-related injuries include poor balance, strength, age, gender and eyesight[58]. Impaired vision is highly prevalent and commonly unreported in the elderly population. The issue of causality is very important if we want to intervene to prevent falls. Poor vision provides a biologically plausible mechanism for predisposition to falls but there has not been a randomised controlled trial showing that improving vision decreases risk of falls. Although poor vision is an established risk factor for falls[59], falls prevention guidelines contain few vision-related recommendations because there is only limited evidence that assessing and treating vision problems prevents falls.

In 2001[60] Harwood reported that falls risk increases as visual impairment worsens and that visual impairment in 70% or more of elderly people is remediable with relatively simple interventions (correcting refractive errors and cataract surgery[61]), making it an important

[58] Lord SR, McLean D, Strathers G. Physiological factors associated with injurious falls in older people living in the community. Gerontology. 1992; 38: 338-46.
[59] Harwood RH. Visual problems and falls. Age and Ageing. 2001; 30-S4: 13-18.
[60] ibid
[61] Harwood RH, Foss AJE, Osborn F et al. Falls and health status in elderly women following first eye cataract surgery: a randomized controlled trial. Br J Ophthalmol. 2005; 89: 53-59.

potential target for intervention at the population level. Harwood recommended assessing risk of falls by measuring visual acuity, contrast sensitivity and depth perception. Provision of adequate glasses and better access to cataract surgery are the main interventions to consider. A survey in London showed that these were the causes of 67% of visual impairment[62]. Age-related macular degeneration, diabetic retinopathy and glaucoma account for the majority of the remaining causes of visual impairment. For these conditions, the main ophthalmological objective is to prevent deterioration rather than restoring normal vision. However, measures can be taken to optimise the visual environment, remove physical hazards, and reduce other falls risk factors. Risk of falling increases progressively with number of risk factors[63]. If visual impairment is irremediable, attention to other risk factors becomes more important.

In 2002 Day et al[64] tested the effectiveness and explored the interactions between three interventions to prevent falls among older people, one of which was reduced vision management. This study showed a limited effect on falls outcome with vision improvement treatment and modification of home hazards. However, even though home hazard management and vision screening were not markedly effective in reducing falls when used alone, they gained value when combined with an effective exercise programme.

In 2006 Campbell et al[65] investigated a home safety programme designed to prevent falls in older people with severe visual impairment. It was shown that the programme, delivered by an experienced occupational therapist, significantly reduced the numbers of falls both at home and away from home. It was not clear from this study whether some mechanism apart from the removal of environmental hazards or behavioural changes led to the significant reduction in falls.

The 2004 the NICE clinical guideline, 'Falls: the assessment and prevention of falls in older people' stated that there is no evidence that referral for correction of vision as a single intervention for community-dwelling older people is effective in reducing the number of people falling. However, vision assessment and referral had been shown to be a component of successful multifactorial falls prevention programmes.

In 2005 Campbell et al[66] investigated the effectiveness of two home based strategies to prevent falls in elderly people with impaired vision – a programme to address safety in the home environment and a programme of strength and balance retraining plus vitamin D supplements. This study found that community based programmes for prevention of falls should be targeted at particular population groups. For example a home based strength and balance retraining programme (the Otago exercise programme) is effective in reducing falls in older people with normal sight living in the community[67] but it was not effective in reducing falls in this sample with visual impairment (possibly due to lower levels of adherence). This study also found that older

[62] Reidy A, Minassian DC, Vafidis G et al. Prevalence of serious eye disease and visual impairment in a north London population: population based, cross sectional study. BMJ. 1998; 315: 1643-6.

[63] Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. New England Journal of Medicine.

[64] Day L, Fildes B, Gordon I et al. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ. July 2002; 325:1-6

[65] La Grow SJ, Robertson MC, Campbell AJ et al. Reducing hazard related falls in people 75 years and older with significant visual impairment: how did a successful program work? Injury Prevention. 2006; 12: 296-301.

[66] Campbell AJ, Robertson MC, La Grow SJ et al. Randomised controlled trial of prevention of falls in people aged ≥75 with severe visual impairment: the VIP trial. BMJ. Sept 2005; doi:10.1136/bmj.38601.447731.55.

[67] Robertson MC, Devlin N, Gardner MM, Campbell AJ. Effectiveness and economic evaluation of a nurse delivered home exercise programme to fervent falls.1: RCT. BMJ 2001; 322:701-4.

people with severe visual impairment can benefit from a specially developed programme of home safety assessment and modification.

In 2007 the Cummings RCT[68] vision and eye testing did not lead to reduced risk of falls and fractures (population - 616 men and women age 70 and older - mean age 81). In fact, a higher risk of falls and fractures was found in those in the intervention group. This study recommended that it may be premature to implement a wide range of vision-related interventions to prevent falls that have been proposed by others. Even providing new eyeglasses was called into question. Although providing new eyeglasses may have a positive effect on many aspects of the lives of older people, this 2007 study suggested that new eyeglasses could have the adverse effect of causing falls. This latest study should compel eye care professionals to prescribe conservatively and give appropriate advice about the need for caution during adaptation to new eyeglasses.

Calcium and vitamin D in the home care setting

As people age the reduction in cutaneous production and impaired metabolism of vitamin D leads to malabsorption of calcium and secondary hyperparathyroidism, which in turn may contribute to bone loss, postural instability and an increased risk of falls and fractures. Vitamin D insufficiency and secondary hyperparathyroidism are common in older people. This provides a rationale for the use of vitamin D, either alone or combined with calcium, for the prevention of falls and fractures. As renal function declines with age and patients with osteoporosis have a relative resistance to the action of vitamin D, active metabolites of vitamin D (calcitriol or alfacalcidol) may be theoretically more useful, as they do not require hydroxylation in the kidneys[69].

A number of randomised controlled trials have examined vitamin D alone, combined calcium and vitamin D supplementation and vitamin D metabolites in the prevention of falls and/or fractures in older people. There is considerable heterogeneity in these trials, as regards the dose and preparation, frequency and route of administration and study populations[70].

A meta-analysis published in early 2005 suggested that oral vitamin D 700-800 IU daily (with or without calcium) reduced the risk of hip and other non-vertebral fractures in older people, whereas 400 IU vitamin D daily was ineffective[71]. Since then large randomised controlled trials have been published, which cast doubt on the role of vitamin D supplementation in the primary and secondary prevention of fractures in older people[72 73 74 75 76 77]. A 2006 Cochrane Review,

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[68] Cummings RG, Ivers R, Clemson L et al. Improving vision to prevent falls in frail older people: a randomized trial. Journal of the American Geriatrics Society. 2007; 55(2): 175-181.

[69] Francis RM. The role of vitamin D, calcium and vitamin D and the vitamin D metabolites in the prevention of falls and fractures. 2006. National Knowledge Week on Osteoporosis and Fragility fractures. Accessed 17 October 2009. Available at: http://www.library.nhs.uk/LaterLife

[70] Francis RM, Anderson FH, Patel S, Sahota O, van Staa TP. Calcium and vitamin D in the prevention of osteoporotic fractures. QJM 2006; 99: 355-363.

[71] Bischoff-Ferrari HA, D, Willett WC, Wong JB, Giovannucci E, Dietrich T, Dawson-Hughes B. Fracture prevention with vitamin D supplementation: a meta-analysis of randomized controlled trials. JAMA 2005; 293: 2257-2264.

[72] Grant AM, Avenell A, Campbell MK et al; RECORD Trial Group. Oral vitamin D3 and calcium for secondary prevention of low-trauma fractures in elderly people (Randomised Evaluation of Calcium Or vitamin D, RECORD): a randomised placebo-controlled trial. Lancet 2005; 365: 1621-1628.

[73] Porthouse J, Cockayne S, King C et al. Randomised controlled trial of calcium and supplementation with cholecalciferol (vitamin D3) for prevention of fractures in primary care. Br Med J 2005; 330: 1003-1006.

[74] Smith H, Anderson F, Raphael H, Crozier S, Cooper C. Effect of annual intramuscular vitamin D supplementation on fracture risk: population-based, randomised, double-blind, placebo-controlled trial. Osteoporos Int 2004; 15 (Suppl 1): S8.

which did not include the most recent RCTs concluded that vitamin D alone was not associated with any reduction in hip or other non-vertebral fracture[78]. Combined calcium and vitamin D supplementation marginally decreased the incidence of hip and non-vertebral fractures, but *this effect appeared to be restricted to those living in institutionalised care*. The Cochrane Review also concluded that there was no advantage of the active vitamin D metabolites compared with plain vitamin D. Another recent meta-analysis also showed a small reduction in the risk of hip fractures with calcium and vitamin D supplementation with no beneficial effect of vitamin D alone[79].

The results of studies which examine the effect of vitamin D on falls risk are conflicting. In a systematic review of 13 trials of vitamin D or its metabolites in older people, there was no effect on falls or physical performance in ten of these studies, but three reported a positive effect for the combined vitamin D and calcium supplementation[80]. A second meta-analysis reviewed the results of five randomised controlled trials, where 'vitamin D' was compared with calcium or placebo in older people[81]. Two of these studies used an active metabolite of vitamin D, rather than plain vitamin D. Although 'vitamin D' was associated with a reduction in the risk of falls, the only individual trial to show a significant reduction used calcitriol[82]. The Cochrane Review on interventions for falls prevention in older people concluded that vitamin D, with or without calcium, was of unknown effectiveness[83]. A systematic review by Tang et al in 2008 concluded that the evidence supports the use of calcium, or calcium in combination with vitamin D supplementation, for osteoporotic fractures and bone mineral density in adults over 50. This review included studies of older adults (mean age ranging from 52 to 85) with osteoporosis, many of whom lived in the community.

Exercise interventions in later life

Those aged 75 years and over tend to lose the ability to correct 'slips and trips' and right themselves due to poor balance, co-ordination or strength[84]. Exercise is effective in lowering falls risk in selected groups and should form part of falls prevention programmes[85]. Individualised exercise interventions with balance training at the core of the programme are most effective for those at risk of falls[86].

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[75] Jackson RD, LaCroix AZ, Gass M et al; Womens Health Initiative Investigators. Calcium plus vitamin D supplementation and the risk of fractures. N Engl J Med. 2006; 354: 669-683.
[76] Law M, Withers H, Morris J, Anderson F. Vitamin D supplementation and the prevention of fractures and falls: results of a randomized trial in elderly people in residential accommodation. Age Ageing 2006 Apr 26;e publication.
[77] Lyons RA, Johansen A, Brophy S et al. Preventing fractures among older people living in institutional care: a pragmatic randomised double blind placebo controlled trial of vitamin D supplementation. Osteoporos Int 2007; 18: 811-818.
[78] Avenell A, Gillespie W, Gillespie L, O'Connell D. Vitamin D and vitamin D analogues for preventing fractures associated with involutional and post-menopausal osteoporosis. Cochrane Database Syst Rev. 2005(3): CD000227.
[79] Boonen S, Lips P, Bouillon R, Bischoff-Ferrari HA, Vanderschueren D, Haentjens P. Need for additional calcium to reduce the risk of hip fracture with vitamin D supplementation: evidence from a comparative meta-analysis of randomized controlled trials. J Clin Endocrinol Metab 2007; 92: 1415-1423.
[80] Latham NK, Anderson CS, Reid IR. Effects of vitamin D supplementation on strength, physical performance and falls in older persons: a systematic review. J Am Geriatr Soc 2003; 51:1219-1226.
[81] Bischoff-Ferrari HA, Dawson-HughesB, Willett WC, Staehelin HB, Bazemore MG, Zee RY, Wong JB. Effect of vitamin D on falls: a meta-analysis. JAMA. 2004; 291:1999-2006.
[82] ibid
[83] Gillespie LD, Gillespie WJ, Robertson MC, Lamb SE, Cumming RG, Rowe BH. Interventions for preventing falls in elderly people. The Cochrane Database of Systematic Reviews 2003, Issue 4.
[84] Skelton DA. Exercise and falls prevention in older people. CME Geriatric Medicine. 2007; 9(1); 16-21.
[85] Gardner MM, Robertson MC, Campbell AJ. Exercise in preventing falls and falls related injuries in older people: a review of randomised controlled trials. Brit J Sports Med. 2000; 43: 7-17.
[86] Skelton DA. Exercise and falls prevention in older people. CME Geriatric Medicine. 2007; 9(1); 16-21.

The Otago Exercise Programme is a focused home exercise programme, targeting women aged over 80 years. Exercises are individually prescribed from a set number of warm up, muscle strength and balance training exercises and are taught to participants in their own homes. Participants are also encouraged to walk outdoors at their desired pace, building up to 30 minutes, two to three times a week. Skelton reported that this type of training programme has been delivered by physiotherapists and district nurses (who had been trained by a physiotherapist) and investigations have shown that this approach results in a significantly lower rate of falls and relative hazard for first four falls[87]. Further studies have shown a significant difference between the effect of the Otago programme on falls when those aged 80 years and over were compared with those 75-79 years, with the exercise having no significant effect on falls in the younger group. The Otago programme has also been studied in routine healthcare settings where falls were reduced by 30%[88].

Research has shown that in those aged over 65 years with poor strength and balance, modified T'ai Chi appears effective as a preventative group exercise[89]. In a further investigation, Wolf et al found that T'ai Chi over a 48 week period was not beneficial to reducing falls in older (aged 70 years and over) group with signs of frailty. In those over 70 years, a 15 week group-based exercise programme had a more significant effect on falls risk than a vision check or home safety check and hazard management[90].

Here in the UK independent living frequent fallers halved their risk of falls with nine months of weekly group balance and strength exercises led by a postural stability exercise instructor, combined with twice weekly home exercises in the FaME study[91]. This intervention consisted of progressive resistance, gait, balance, function activity, floor work, endurance and flexibility training. The exercise was individually tailored in both type and intensity, with most exercises in weight-bearing positions reducing upper limb support.

There are special concerns when older people, who have poor balance, increase their levels of physical activity and exercise. It is likely that, in some individuals, preparatory strength and flexibility training is needed before balance challenging exercise commences. There may be a point at which people become too frail to benefit from balance exercise[92].

In 2008, Sherrington et al[93] found that greater relative effects are seen in exercise programmes that include exercises that challenge balance (exercises conducted while standing in which people aimed to stand with their feet closer together or on one leg, minimize use of their hands to assist, and practice controlled movements of the centre of mass), use a higher dose of exercise (> 50 hours over the trial period), and do not include a walking program. Further

[87] Campbell AJ, Robertson MC, Gardner MM et al. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. BMJ. 1997; 315: 1065-9.
[88] Robertson MC, Gardner MM, Devlin N et al. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 2. Controlled trail in multiple centres. BMJ. 2001; 322: 701-4.
[89] Wolf SL, Barhart HX, Kutner NG et al. Reducing frailty and falls in older persons: an investigation of T'ai Chi and computerised balance training. J Am Geriatr Soc. 1996; 44: 489-97.
[90] Day L, Fildes B, Gordon I et al. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ. 2002; 325: 128-32.
[91] Skelton DA, Dinan S, Campbell M, Rutherford O. Tailored group exercise (Falls Management Exercose – FaME) reduces falls in community dwelling older frequesnt fallers. Age and Ageing. 2005. 34; 6: 636-9.
[92] Skelton DA. Exercise and falls prevention in older people. CME Geriatric Medicine. 2007; 9(1); 16-21.
[93] Sherrington C, Whitney JC, Lord SR et al. Effective Exercise for the Prevention of Falls: A Systematic Review and Meta-Analysis. Journal of the American Geriatrics Society. 2008; 56(12):2234-2243.

investigation in a 2009 systematic review by Gillespie et al[94] confirmed that multiple component group exercise programmes should target strength, balance, flexibility or endurance and that programmes containing two or more components reduce the rate of falls and the number of people falling.

Encouraging physical activity and the provision of exercise sessions as a part of a wider campaign including literature, medication reviews and environmental changes has been shown to decrease fall related injuries[95]. Exercise, even at advanced ages and in people of varying physical activities, can improve balance, strength and other risk factors for falls and injury. The evidence for the promotion and provision of safe, effective exercise to prevent falls is strong[96] [97] [98].

Below is a list of interventions that work and perhaps do not work with regard to visual problems, calcium and vitamin D to prevent falls/fracture, and exercise training in later life:

What works

- Cataract surgery and prevention of deterioration of vision rather than restoring normal vision
- Home hazard management and vision screening gain in value when combined with an effective exercise programme in a multifactorial falls prevention programme
- Community based programmes targeted at particular population groups (e.g. The Otago Exercise Programme is effective in reducing falls in those older people with normal sight but has not proved to be effective for those with severe visual impairment)
- Calcium and vitamin D supplementation can result in a small reduction in the risk of hip fractures
- Individualised exercise interventions with balance training at the core
- The Otago Exercise Programme for those aged 80 and over
- Modified T'ai Chi for groups of over 65s with poor strength and balance
- Frequent fallers living in the community benefited from weekly group balance and strength exercises combined with home exercises twice a week
- Multiple component group exercise programmes targeting strength, balance, flexibility or endurance and programmes containing two or more components
- Exercise sessions as a part of a wider campaign including literature, medication reviews and environmental changes

What may not work

- Correction of vision as a single intervention for community dwelling older people
- New eyeglasses – may have the adverse effect of causing falls
- A T'ai Chi programme for over 70s with signs of frailty
- Balance exercises for those who are very frail and have not benefited from preparatory training

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[94] Gillespie LD, RobertsonMC,Gillespie WJ, Lamb SE,Gates S,CummingRG, Rowe BH. Interventions for preventing falls in older people living in the community. CochraneDatabase of Systematic Reviews 2009, Issue 2.

[95] Mc Clure R, Turner C, Peel N, Spinks A et al. Population-based interventions for the prevention of fall-related injuries in older people. Cochrane Database of Systematic Reviews 2005, Issue1.

[96] NICE. Falls Guideline. Falls: the assessment and prevention of falls in older people. National Institute of Clinical Evidence, London. 2004.

[97] Gillespie LD, Robertson MC,Gillespie WJ, Lamb SE, Gates S, CummingRG, Rowe BH. Interventions for preventing falls in older people living in the community. CochraneDatabase of Systematic Reviews 2009, Issue 2.

[98] Mc Clure R, Turner C, Peel N, Spinks A et al. Population-based interventions for the prevention of fall-related injuries in older people. Cochrane Database of Systematic Reviews 2005, Issue1.

The case for a joint strategy

There is a strong argument for a joint strategy that addresses both fall and osteoporosis. A particularly high-risk group is older people that have a history of falling and who also have osteoporosis. More than 95% of all hip fractures in older people occur as a result of a fall and over 90% of all hip fractures in the over 75's occur in people who have osteoporosis (Cryer 2001).

Around 5% of falls in older people result in fracture, with 1% resulting in hip fracture. Because of this strong relationship between falls, osteoporosis and hip fracture the evidence suggests that approaches to fall prevention must address both the force of the fall, the incidence of failing and the bone fragility.

As already intimated in the absence of evidence to promote a population based screening approach, a strategy that targets high risk sub-groups is recommended as the best approach.

In a document by Cryer (2001) the recommendation was for two assessments to be carried out, one for falls and one for osteoporosis. It was recommended that all patients over the age of 70, who had sustained the following, should receive a falls assessment.

- an injurious fall
- multiple falls in that year
- had a fall that resulted from balance or gait problems
- had a recent low trauma fracture or
- had a diagnosis of low bone density

Evidence would suggest that before initiating treatment for osteoporosis assessment is recommended. In General Practice this can be broken down into, previous fracture, steroid use and bone densitometry.

The Royal College of Physicians (2000) states, "*A previous fragility fracture is a strong independent risk factor for further fracture and may be regarded as an indication for treatment without the need for BMD measurement when the clinical history is unequivocal.*"

In 2009 the Department of Health published 'Falls and Fractures: Effective interventions in Health and Social Care'. The document set out four key areas for intervention that commissioners, ideally working collaboratively across health and social care, should consider in the context of local services for falls, falls prevention and fractures.

The document set out four objectives which were prioritised in terms of impact and evidence-base.

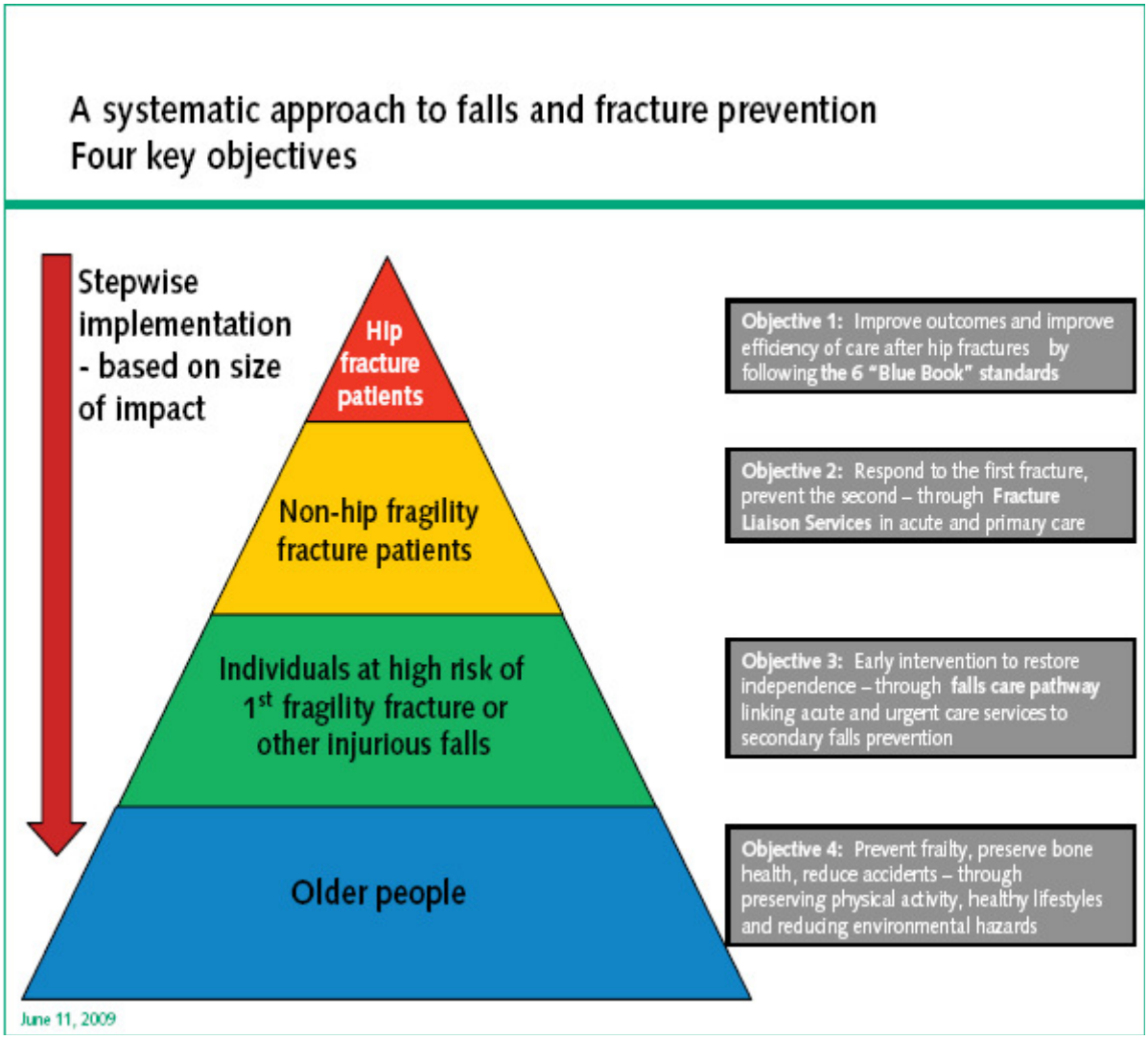
● Objective 1: Improve patient outcomes and improve efficiency of care after hip fractures through compliance with core standards.

● Objective 2: Respond to a first fracture and prevent the second – through fracture liaison services in acute and primary care settings.

● Objective 3: Early intervention to restore independence – through falls care pathways, linking acute and urgent care services to secondary prevention of further falls and injuries.

● Objective 4: Prevent frailty, promote bone health and reduce accidents – through encouraging physical activity and healthy lifestyle, and reducing unnecessary environmental hazards.

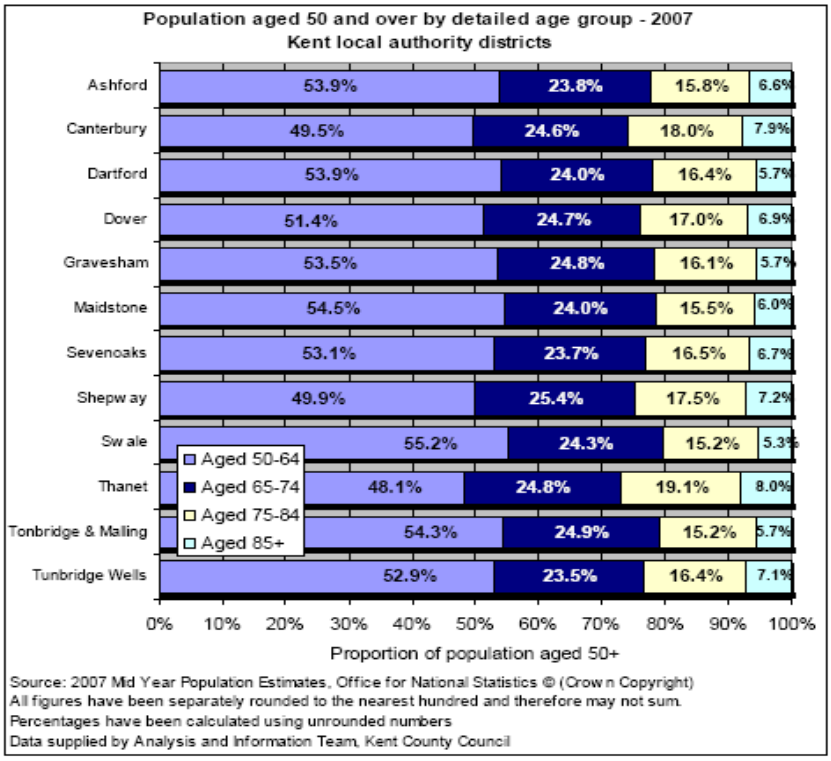
Fig 3: A systematic approach to falls and fracture prevention



In summary

Evidence would suggest that a strategy should identify populations of high risk individuals and provide an intervention that will reduce both the risk of fall and treat osteoporosis so as to reduce falls and fractures.

Table 1: Breakdown of older people in each Kent district



The general pattern is that the proportion decreases as age increases in each district. There are more 50-64 year olds for example than 85+ year olds. However, the proportion of each age group does vary between the districts. Swale has the greatest proportion of 50-64 year olds (55.2% of all people aged 50+). Shepway has the highest proportion of people aged 65-74 years old (25.4%). Thanet has the highest proportion of 75-84 year olds (19.1%). Thanet also has the greatest proportion of people aged 85+ years old (8%).

Table 2: Forecast of Kent's older population to 2026[99]

Local authority	2006	2011	2016	2021	2026
Ashford	39,000	43,100	49,200	56,000	62,100
Canterbury	52,400	54,100	56,900	59,100	60,200
Dover	42,100	45,500	49,700	52,400	53,900
Shepway	40,000	42,400	45,500	48,300	50,200
Swale	44,500	48,100	53,300	57,400	60,300
Thanet	52,200	54,400	57,800	61,000	63,100
Total	**270,000**	**287,300**	**312,400**	**334,200**	**349,800**

[99] *South East Plan Strategy-based Population Forecasts (Sept 07)Forecasts produced by The Analysis and Information Team, Kent County Council .All figures have been separately rounded to the nearest hundred and therefore may not sum Percentages have been calculated using unrounded numbers*

Table 3: Ten year change in population by local authority area

	10-year change (2006-2016)		20-year change (2006-2026)	
Local authority	**Numbers**	**% change**	**Numbers**	**% change**
Ashford	10,200	26.1	23,000	59.0
Canterbury	4,400	8.5	7.8	14.9
Dover	7,700	18.8	11,800	28.0
Shepway	5,600	13.9	10,200	25.4
Swale	8,700	19.6	15,800	35.4
Thanet	5,600	10.7	10,900	21.0

Current and Future Population Structure of NHS Eastern and Coastal Kent

Total Population

- The total resident population is 720,483
- The resident population is 52% female and 48% male
- The majority of the resident population is aged between 35 and 59

Fig 4: Mid-2006 Resident population by age and gender, NHS Eastern and Coastal Kent

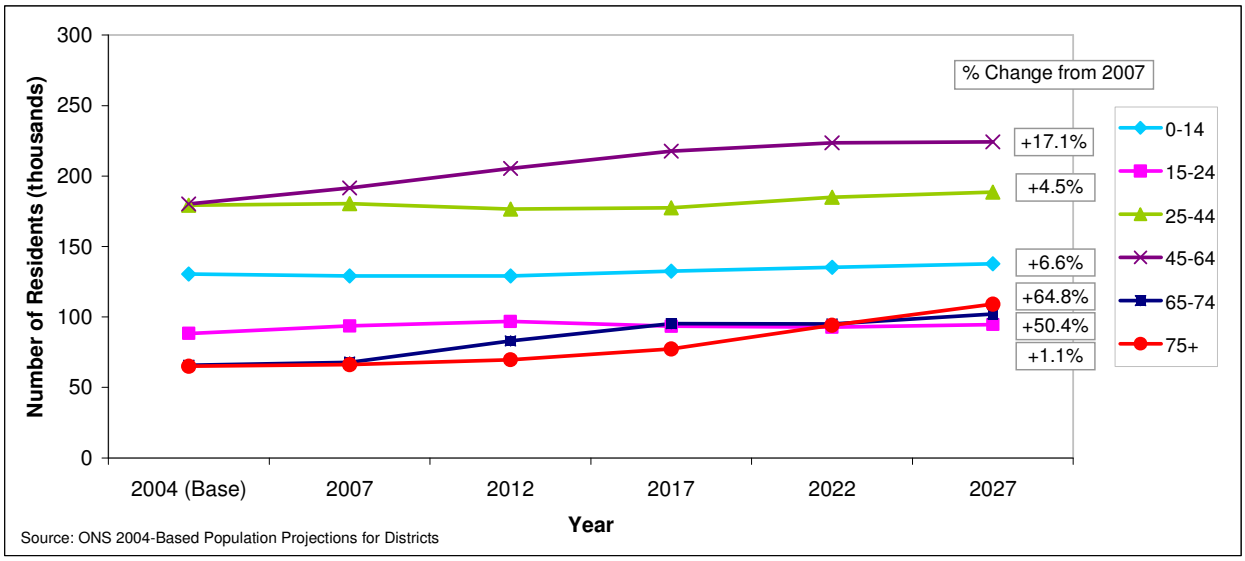
Population forecast

Over the last 10 years Kent's older population has increased by 13.3%. In the next 10 years Kent's older population is forecast to increase by 16% and within the next 20 years it is forecast to increase by 30.7%. The older population is forecast to grow at a faster rate than the whole population of Kent. Over the next 10 years the whole population of Kent is forecast to increase by 4.5% and in the next 20 years, 8.3%. The large increase in the older population is attributed to the high birth rate leading up to and during the 1960s. Those people born during the baby boom will be entering their 60s by 2026. Although current forecasts do not go beyond 2026, it is expected, given longer life expectancy, that there will be a bulge in the 85+ population by 2046. The 85+ population in 2046 will be the 1960s baby boomers.

Projected population change

- The Office of National Statistics predicts a dramatic increase in population size over the next 20 years
- The older population will experience the greatest increase
- In NHS Eastern and Coastal Kent, the all-age population of 2007 is predicted to increase by 9% by the year 2017 and 18% by the year 2027
- In 2006, people aged over 65 accounted for 18% of the population. This will increase to 22% in 2017 and 25% in 2027
- Proportionate population increases within the PCT will be greater than those in Kent County as a whole due to the large elderly population and their predicted increases in the areas of Thanet, Shepway and Swale Local Authorities

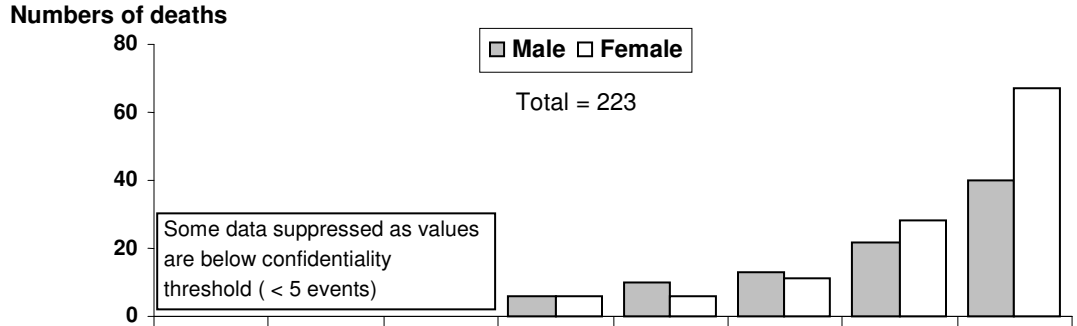
Fig 5: Population projections to 2027 for residents all ages showing percentage change from 2007



Falls among people aged 50 years and older

There are on average around 223 deaths per year in NHS Eastern and Coastal Kent PCT which are the direct result of a fall. The deaths occur in ages 65 and older and the numbers of deaths increase with age. Over half of all female deaths from falls occur in the 85 and older age group.

Table 3: Numbers of deaths from falls, 2006-08 (pooled), by age band and sex



	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
Male	0	0	0	6	10	13	22	40
Female	0	0	0	6	6	11	28	67

Ageband and numbers

Source: Public Health Mortality File

Table 4: Numbers of deaths from falls, 2006-08 (pooled), by local authority and sex

	Ashford	Canterbury	Dover	Shepway	Swale	Thanet
Male	11	20	18	15	15	21
Female	10	38	13	25	11	26

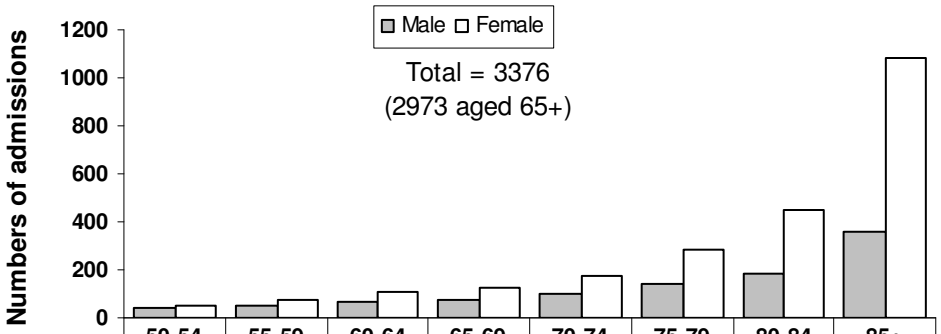
Local authority and numbers

Source: Public Health Mortality File

The highest incidence of death from falls is in Canterbury, with 58 deaths from falls in the two year period. Thanet and Shepway also recorded some of the highest numbers with the lowest number occurring in Ashford.

There were 3,376 hospital admissions in the 50+ group as a result of a fall in the year 2008/09. As with mortality, numbers rise with age and this is particularly noticeable in females aged 85+, who comprise more than one third of all these fall-related admissions.

Table 5: Numbers of hospital admissions for falls,2008-09,by sex

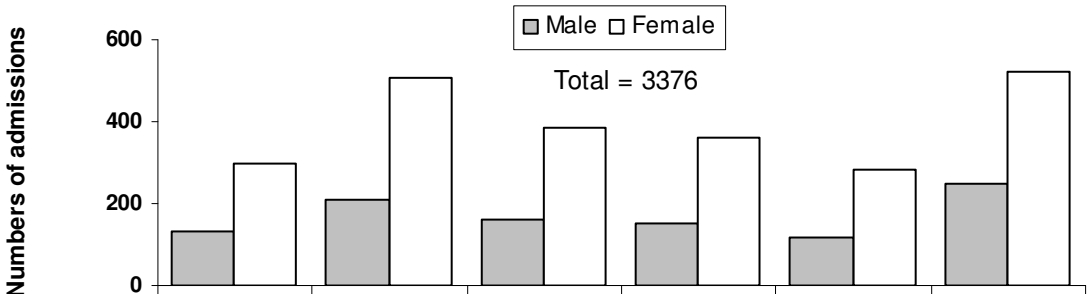


	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
Male	43	53	69	74	99	140	183	357
Female	51	76	111	129	173	282	450	1086

Ageband and numbers

Source: SUS

Table 6: Numbers of admissions for falls, 2008-09, by local authority and sex



	Ashford	Canterbury	Dover	Shepway	Swale	Thanet
Male	132	212	159	151	116	248
Female	297	509	383	363	282	524

Local authority and numbers

Source: SUS

The highest numbers of admission for falls are in the Thanet and Canterbury Local Authority areas with Swale recorded as the lowest. This is not surprising given that Thanet has the highest proportion of 65-74 year olds and the highest number of 75-84 year olds. However given that Shepway has the highest proportion of 65-74 year olds the figures for the Local Authority appear to be lower than Canterbury.

Table 7: Numbers of admissions as the result of falls 200-/09, showing numbers of bed days and mean length of stay by severity of admission

Severity of fall	Numbers of admissions	Total bed days	Mean length of stay (days)
Long stay - severe (4 days or more)	1823	35440	19.4
Short stay - less severe (less than 4 days)	1546	1202	0.78
All falls	**3369**	**36642**	**10.9**

Source: SUS

While some injuries are relatively minor, requiring only short hospital stays, other falls may result in quite long spells. With short stay injuries the mean length of stay is under one day, while with more serious falls (those which result in a hospital stay of four days or more) the average length of stay is nearly three weeks.

In total there are around 36,642 occupied bed days a year caused by falls in NHS Eastern and Coastal Kent residents aged 50 years and over.

Table 8: Number and percentages of falls patients dying within one and two years of admission, 2006-07, NHS Eastern and Coastal Kent

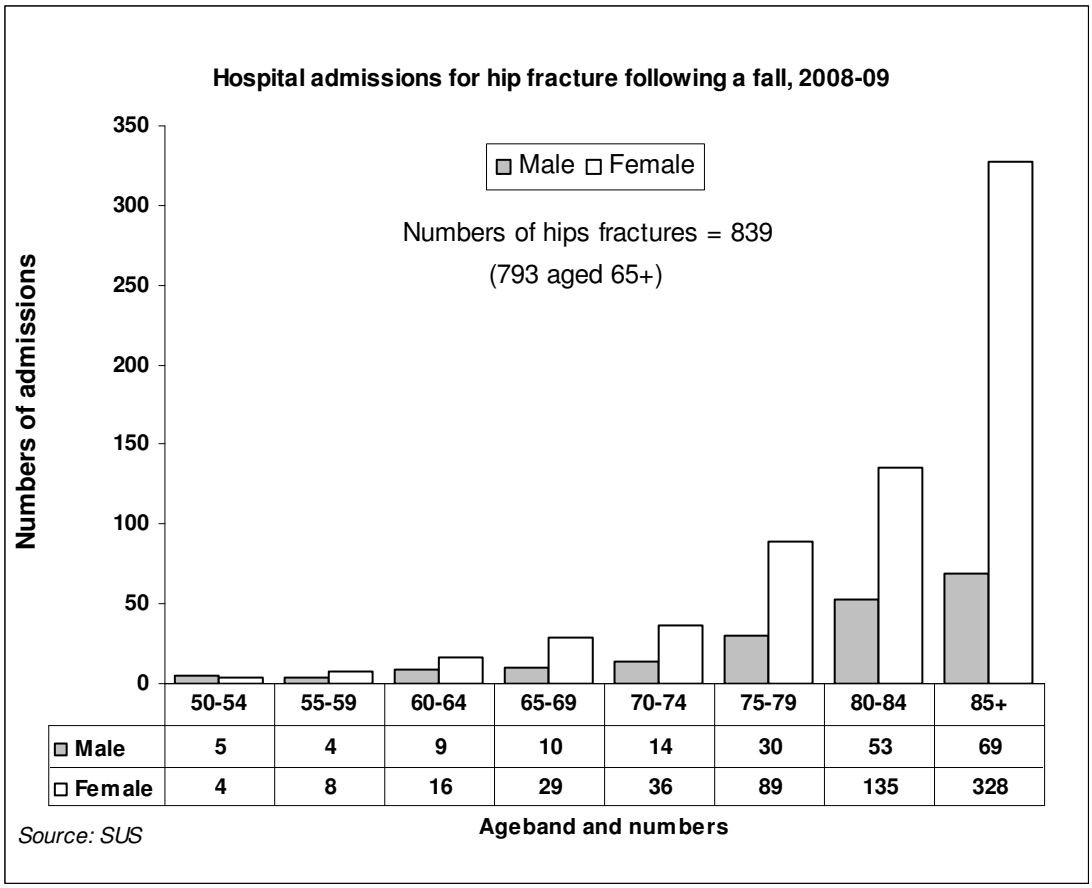
	Within 365 days of first admission		Between 1 and 2 years of first admission		Still alive 2 years after fall		Total	
Area	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Ashford	26	44	5	17	52	162	**83**	**223**
Canterbury	37	92	14	45	85	237	**136**	**374**
Dover	29	47	11	36	60	176	**100**	**259**
Shepway	32	65	7	27	69	191	**108**	**283**
Swale	36	70	13	29	74	182	**123**	**281**
Thanet	35	93	8	32	88	229	**131**	**354**
East Kent	**195**	**411**	**58**	**186**	**428**	**1,177**	**681**	**1,774**

Source: SUS, ONS

	Percentage of patients admitted for a fall dying								
	Within one year			Within second year			Within two years		
Area	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Ashford	31.3	19.7	22.9	6.0	7.6	7.2	**37.3**	**27.4**	**30.1**
Canterbury	27.2	24.6	25.3	10.3	12.0	11.6	**37.5**	**36.6**	**36.9**
Dover	29.0	18.1	21.2	11.0	13.9	13.1	**40.0**	**32.0**	**34.3**
Shepway	29.6	23.0	24.8	6.5	9.5	8.7	**36.1**	**32.5**	**33.5**
Swale	29.3	24.9	26.2	10.6	10.3	10.4	**39.8**	**35.2**	**36.6**
Thanet	26.7	26.3	26.4	6.1	9.0	8.2	**32.8**	**35.3**	**34.6**
East Kent	**28.6**	**23.2**	**24.7**	**8.5**	**10.5**	**9.9**	**37.2**	**33.7**	**34.6**

Source: SUS, ONS

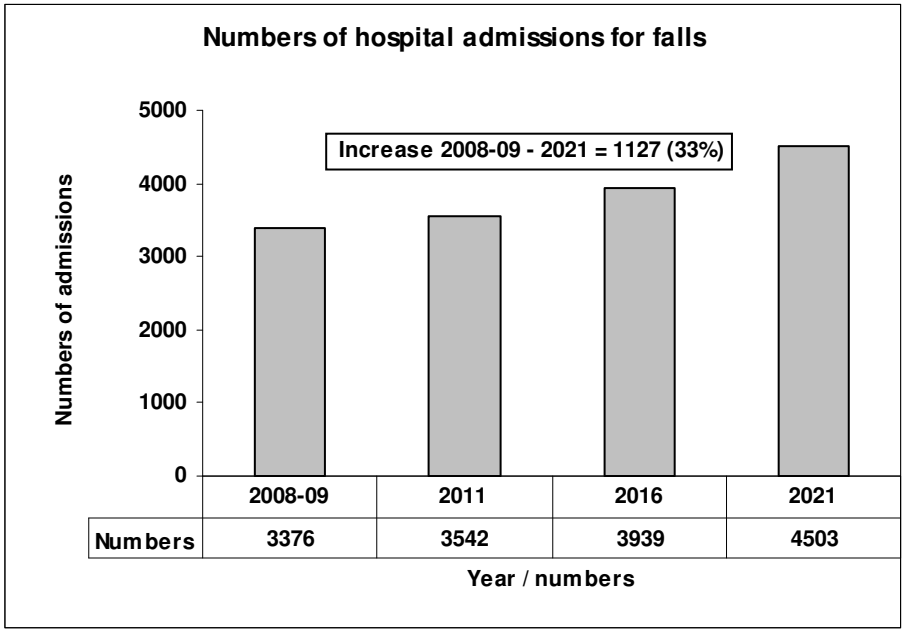
Fig 6: Hospital admission for hip fracture following a fall, 2008-9



	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
Male	5	4	9	10	14	30	53	69
Female	4	8	16	29	36	89	135	328

Fig 6 shows the age band and numbers of hip fracture following a fall. The total number of fractures for 08/09 was 839, meaning that of the 3376 admissions due to a fall, a quarter, 24.9%, were hip fractures. In the age group 65 and over, at 26.7%, this proportion was somewhat higher.

Fig 7: Projected numbers of hospital admissions from falls, NHS Eastern and Coastal Kent residents

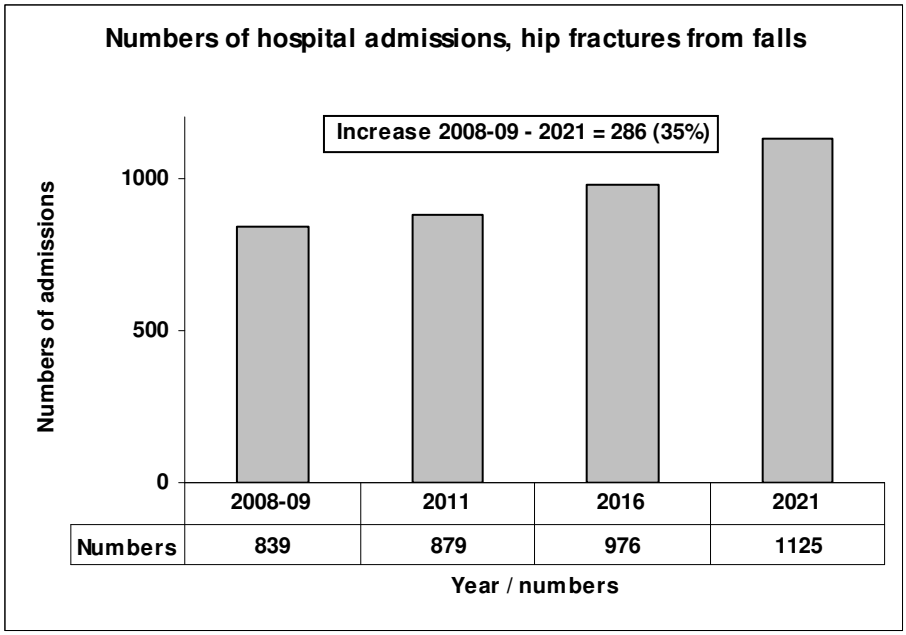


	2008-09								
Area	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**	**Total**
Ashford	17	18	23	23	34	59	91	164	**429**
Canterbury	17	21	31	42	58	71	142	339	**721**
Dover	15	34	26	32	44	70	105	216	**542**
Shepway	11	14	34	27	51	61	96	220	**514**
Swale	12	10	29	28	33	68	67	151	**398**
Thanet	22	32	37	51	52	93	132	353	**772**
East Kent	**94**	**129**	**180**	**203**	**272**	**422**	**633**	**1,443**	**3,376**

Source: SUS

Fig 7 shows the gradual increase in the number of hospital admissions from falls, with a predicted 33% percent increase in the number by 2021. With Ashford and Swale predicted to have the highest percentage change in increased admissions (detailed projections in Appendix 3).

Fig 8: Actual and projected numbers of admissions for hip fracture resulting from falls, 2008-09, 2021, NHS Eastern and Coastal Kent



Numbers of hospital admissions for hip fracture resulting from a fall - NHS Eastern and Coastal Kent residents, 2008-09

Area	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	Total
Ashford	2	4	2	5	6	19	28	49	**115**
Canterbury	0	0	1	10	9	17	38	88	**163**
Dover	1	3	5	4	8	23	32	59	**135**
Shepway	2	1	5	3	10	16	28	63	**128**
Swale	1	1	6	6	6	23	23	41	**107**
Thanet	3	3	6	11	11	21	39	97	**191**
East Kent	**9**	**12**	**25**	**39**	**50**	**119**	**188**	**397**	**839**

Source: SUS

Analysis of Rates

To estimate what percentage of the local population is at risk of falling is extremely difficult as this paper has already described.

With the normal distribution pattern of BMD the prevalence of osteoporosis is a less confounding measure on which to undertake a cost analysis.

Table 9: Prevalence of osteoporosis in western women

Age range (years)	Osteoporosis of hip alone (%)
50-59	3.9
60-69	8
70-79	24.5
80+	47.6
50+	***17.0***

Source: World Health organisation 1994

Table 10: Population figures for NHS Eastern and Coastal Kent 2007

	Ageband								
Gender	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**	**Total**
Female	22,727	24,687	24,892	18,612	16,511	15,048	12,564	13,154	148,195
Male	21,523	23,190	23,250	17,584	14,716	11,596	7,963	6,129	125,951
Total	**44,250**	**47,877**	**48,142**	**36,196**	**31,227**	**26,644**	**20,527**	**19,283**	**274,146**

Source: ONS

Using the prevalence statistics it is possible to work out what the prevalence would be for the NHS Eastern and Coastal Kent for women.

Table 11: Prevalence of osteoporosis in women in NHS Eastern and Coastal Kent

Age range (years)	Osteoporosis of hip alone (%)	ECK population	Estimated prevalence
50-59	3.9	47,414	1,849
60-69	8	43,504	3,480
70-79	24.5	31,559	7,731
80+	47.6	25,718	12,241
50+	**17.0**	**148,195**	**25,301**

Source: World Health organisation 1994

We know that 30% of the over 65s and 50% of over 80s will fall. We also know that 60% in nursing homes will fall.

From the population figures there are approximately 75,889 women over 65 and 25,718 women over 80. Using the percentages above this would mean that approximately 35,625 women would experience a fall. We know that 50% of those who will fall will have osteoporosis (18,300 in east Kent).

What we don't know is who has osteoporosis and therefore who is more likely to fracture. We also know that 95% of hip fractures occur in people who have osteoporosis which means that 5% who fall will fracture but do not have osteoporosis.

Relative risk of fracture can be calculated using the ten year risk of hip fracture rates for women (Table 12). Relative risk consists of a range between parameters RR1 and RR2 and it is taken to mean the range of BMD standard deviation within the population. Using the 2001 population census data, relative risk scores have been calculated to determine how many fractures would be sustained (Figure 8, detailed projections in Appendix 4).

Table 12: Ten year risk of hip fracture in women (%) according to age, relative risk.

Age	RR1	RR2
50	0.7	1.4
60	2	4
70	5.6	11
80	13.2	24.4

Source: Royal College of Physicians (1999)

The problem with the table above is that it estimates the relative risk according to age and BMD. However, there are many other clinical predictors of hip fracture risk that are independent of bone density. Cummings (2002) reported that in a study of osteoporotic fractures, hip fracture incidence was 17 times greater among 15% of women who had five or more risk factors, exclusive of bone density, compared with 47% of the women who had two risk factors or less. The figures therefore could under estimate the prevalence of fracture within the population

Financial Cost Analysis

In a recent business case put forward by the hospitals trust a case for change was sited by stating that Interventions have been proven to reduce falls by a minimum of 15% and as much as 61% (Close et al, 2000) and fractures by 15%. Taking hip fractures alone, 15% reduction equates to 112 less fractures, (based in the figures above this would now be 129) with savings of £630,000 over 2 years. This also saved 3248 bed days over 2 years. In the year following a vertebral fracture a patient will visit their GP an additional 14 times (Cryer and Patel, 2001).

Fig 8 shows the predicted number of hospital admissions, hip fractures from falls for 2011, 2016 and 2021 (4.8%, 16.3% and 34.1%) across east Kent with a 33% increase in the number of falls by 2021.

Hollingworth et al (1993) published a study of hip fracture, which estimated the length of stay for such a fracture at 42 days. The total cost of this stay was estimated at £5,606 (£7,092 at 1998/99 costs). French et al (1995) estimated a cost of £4,018 (£4,755 at 1998/99 costs) for a stay of 20 days.

Table 13: Cost of an individual hip fracture[100]

Category of care	Cost
Hospital care	£4,760
Ambulance	£171
Long stay residential care	£20,010
GP use	£164
Outpatient use	£319
Total	**£25,424**

Currently there are 839 hip fractures in east Kent with an approximate cost of £25,424 (2000 cost price). The total approximate spends for the health economy is therefore £21,330,736. The projected cost for 2011 is £22,347,696 rising to £28,602,000 in 2021.

In Summary

Numerous studies show that among older people *falling*, not osteoporosis is the strongest risk factor for fracture [101]. Thus preventing falls is a logical approach to preventing fracture.

The evidence from systematic reviews and meta-analyses of randomised trials shows that at least 15% of falls in older people can be prevented with individual trials reporting reductions of up to 50%.

Therefore NHS Eastern Coastal Kent needs a Falls Strategy of which prevention and treatment of osteoporosis has an integral part to play.

The strategy needs to set out a framework (Appendix 1) whereby commissioned services consider the whole care pathway from the general population approach (those over the age of 65) to those at high risk and those who have already fallen and at risk of fracture to those who have already fractured.

The PCT should also consider the tool that The National Osteoporosis Guideline Group* (NOGG) has developed to provide clinical guidelines for the management of men and women at high fracture risk. http://www.shef.ac.uk/NOGG/index.html (Appendix 2).

This paper has identified approximate numbers of people that would need to be able to access these services at each point of the pathway to help reduce costs through falling and to enable this PCT to make savings from admissions to hospital through falls and fractures. The paper has also identified proportionate population increases in Thanet, Shepway and Swale due to the large elderly population and their predicted increases in these areas.

Prevention has a key role to play both at primary and secondary levels as set out in triangle.

[100] The economic Cost of Hip fracture in the UK University of York June 200

[101] Shifting the focus in fracture prevention from osteoporosis to falls, BMJ;336;124-126 January 2009

Appendix 1

CASE/RISK IDENTIFICATION IN GENERAL SERVICES
Ask if fallen in the past year and about frequency, context and characteristics of the fall. **C**
Observe for balance and gait deficit and potential to benefit from interventions to improve balance and mobility. **C**

FALLS SERVICE
All healthcare professionals dealing with patients known to be at risk of falling should develop and maintain basic professional competence in falls assessment and prevention. **D**

Primary and community care

Case/risk identified at health screen

Case/risk identified opportunistically at presentation with fall/other problem

Secondary care

Case/risk identified opportunistically at presentation with fall/other problem

Presentation at A&E with fall injury

MULTIFACTORIAL FALLS RISK ASSESSMENT
Offer multifactorial falls assessment. **C** This may include: **C**

- falls history
- gait, balance, mobility, muscle weakness
- osteoporosis risk*
- perceived functional ability
- fear of falling
- visual impairment
- cognitive impairment
- neurological examination
- continence
- home hazard
- cardiovascular examination
- medication review.

*Refer as necessary

MULTIFACTORIAL INTERVENTIONS

Offer individualised multifactorial intervention to older people at risk including: **A**

- strength and balance training
- home hazard assessment and intervention
- vision assessment and referral
- medication review/withdrawal

After medical treatment for an injurious fall, patients should be offered multidisciplinary assessment and intervention. **A**

EDUCATION AND INFORMATION

To promote participation of older people, falls prevention programmes should: **D**

- discuss changes a person is willing to make to prevent falls
- information should be relevant and available in languages in addition to English
- address potential barriers such as low self-efficacy and fear of falling.

Programmes should be flexible to accommodate different needs. **D**

Information on the following should be provided orally and in

The specialist services for falls and for osteoporosis should be operationally linked or dovetailed.

(Appendix 2)

Welcome

What is NOGG?

The National Osteoporosis Guideline Group* (NOGG) was established to provide a clinical guideline for the management of men and women at high fracture risk, particularly to address the need to integrate the expression of a patient's fracture risk as a 10-year probability (the output from FRAX®) with current clinical management of osteoporosis. This included the need to define thresholds for BMD measurement and treatment.

The NOGG Guideline has been produced with the support of the Bone Research Society, British Geriatric Society, British Orthopaedic Association, British Society of Rheumatology, Primary Care Rheumatology Society, Royal College of Physicians, Society of Endocrinology, National Osteoporosis Society, Osteoporosis 2000 and Osteoporosis Dorset.

Aims of NOGG

Given the development of FRAX® algorithms to calculate an individual's 10-year probability of fracture, the Group wished to:

- Provide assessment thresholds for the use of BMD i.e. the fracture probabilities at which a BMD test might or might not be recommended

- Revise intervention thresholds, based on the existing RCP case-finding strategy, to provide the fracture probability at which intervention is recommended

Why do we need revised assessment and intervention thresholds?

In the UK, guidance for the identification of patients at high fracture risk has been provided by the Royal College of Physicians (RCP) [RCP 1999, 2000, 2002]. Since the development of the RCP guidelines, it has become apparent that the presence of several of the risk factors used to trigger a bone mineral density (BMD) test is associated with a fracture risk greater than can be accounted for by BMD alone. Thus, the assessment of fracture risk should take account of those clinical risk factors (CRFs) that contribute to fracture risk in addition to BMD, since this increases the detection rate of individuals who would fracture.

FRAX®

The FRAX® tool for the assessment of fracture risk (www.shef.ac.uk/FRAX) integrates clinical risk factors, with or without femoral neck BMD, to calculate the 10-year probability of a major osteoporotic fracture (clinical spine, hip, forearm or proximal humerus) and hip fracture for several countries, including the UK.

Clinical use of FRAX® and NOGG Guideline

The guideline is based on an opportunistic case finding strategy in which physicians are alerted to the possibility of osteoporosis and high fracture risk by the presence of clinical risk factors (CRFs) associated with fracture. Briefly the guideline states that:

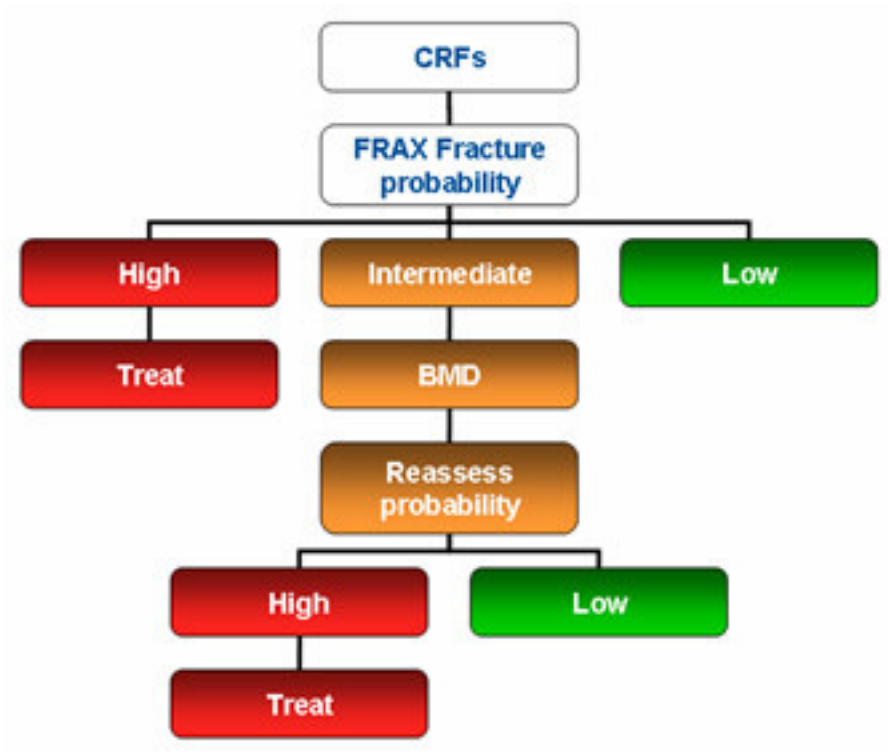
- Postmenopausal women with a prior fragility fracture should be considered for treatment without the need for further risk assessment, although BMD measurement may sometimes be appropriate, particularly in younger postmenopausal women.
- Assessment by the FRAX tool should be undertaken in:
    - Men aged 50 years or more (with or without fracture) but with a WHO risk factor or a BMI < 19kg/m².
    - All postmenopausal women without fracture but with a WHO risk factor or a BMI < 19kg/m².

Following the assessment of fracture risk using FRAX, the patient may be classified to be at low, intermediate or high risk.

- Low risk - reassure and reassess in 5 years or less depending on the clinical context.
- Intermediate risk - measure BMD and recalculate the fracture risk to determine whether an individual's risk lies above or below the intervention threshold.
- High risk - can be considered for treatment without the need for BMD, although BMD measurement may sometimes be appropriate, particularly in younger postmenopausal women.

NB - These thresholds are for guidance only and the final decision to assess BMD or to initiate therapeutic intervention lies with the individual clinician.

Management algorithm for the assessment of patients at risk of fracture:



Appendix 3

Projected numbers of hospital admissions from falls, NHS Eastern and Coastal Kent residents

	2011									Projection from 2008-09	
Area	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**	**Total**	**%age change**	**Numbers**
Ashford	19	18	23	27	36	61	95	176	**455**	**6.0**	**26**
Canterbury	18	21	31	48	63	71	145	347	**744**	**3.1**	**23**
Dover	16	34	26	38	47	70	112	230	**572**	**5.5**	**30**
Shepway	12	14	35	31	55	62	99	235	**544**	**5.8**	**30**
Swale	13	10	30	33	36	71	72	164	**427**	**7.4**	**29**
Thanet	24	32	38	59	54	90	135	370	**800**	**3.7**	**28**
East Kent	**102**	**128**	**183**	**236**	**290**	**425**	**658**	**1522**	**3542**	**4.9**	**166**

Source: SUS, ONS

	2016									Projection from 2008-09	
Area	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**	**Total**	**%age change**	**Numbers**
Ashford	23	21	21	32	45	69	109	200	**520**	**21.1**	**91**
Canterbury	20	23	28	54	74	81	149	386	**815**	**13.0**	**94**
Dover	18	38	24	44	57	78	122	265	**645**	**19.0**	**103**
Shepway	14	15	31	37	67	73	108	258	**604**	**17.5**	**90**
Swale	16	11	26	40	44	83	79	195	**493**	**23.8**	**95**
Thanet	27	35	34	69	64	100	138	395	**863**	**11.7**	**91**
East Kent	**117**	**143**	**164**	**276**	**351**	**483**	**704**	**1700**	**3939**	**16.7**	**563**

Source: SUS, ONS

	2021									Projection from 2008-09	
Area	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**	**Total**	**%age change**	**Numbers**
Ashford	24	25	25	29	53	85	123	243	**607**	**41.5**	**178**
Canterbury	20	26	31	49	86	97	173	434	**915**	**26.9**	**194**
Dover	17	43	27	40	67	96	139	314	**741**	**36.7**	**199**
Shepway	14	18	35	34	80	89	130	303	**703**	**36.8**	**189**
Swale	16	13	30	35	53	103	95	239	**583**	**46.5**	**185**
Thanet	27	40	38	63	76	120	153	437	**954**	**23.6**	**182**
East Kent	**117**	**165**	**185**	**249**	**415**	**590**	**813**	**1970**	**4503**	**33.4**	**1127**

Source: SUS, ONS

Appendix 4

Projected numbers of hospital admissions for hip fracture resulting from a fall NHS Eastern and Coastal Kent residents

	2011									Projection from 2008-09	
Area	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**	**Total**	**%age change**	**Numbers**
Ashford	2	4	2	6	6	20	29	53	**120**	**3.9**	**5**
Canterbury	0	0	1	11	10	17	39	90	**168**	**3.1**	**5**
Dover	1	3	5	5	8	23	34	63	**142**	**5.3**	**7**
Shepway	2	1	5	3	11	16	29	67	**134**	**4.9**	**6**
Swale	1	1	6	7	6	24	25	44	**115**	**7.3**	**8**
Thanet	3	3	6	13	11	20	40	102	**198**	**3.8**	**7**
East Kent	**10**	**12**	**25**	**45**	**53**	**119**	**196**	**419**	**879**	**4.8**	**38**

Source: SUS, ONS

	2016									Projection from 2008-09	
Area	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**	**Total**	**%age change**	**Numbers**
Ashford	2	5	2	7	8	22	33	60	**137**	**19.0**	**22**
Canterbury	0	0	1	13	12	19	40	100	**185**	**13.3**	**22**
Dover	1	3	5	5	10	26	37	72	**160**	**18.6**	**25**
Shepway	3	1	5	4	13	19	32	74	**149**	**16.3**	**21**
Swale	1	1	5	9	8	28	27	53	**132**	**23.6**	**25**
Thanet	4	3	5	15	14	23	41	109	**213**	**11.5**	**22**
East Kent	**11**	**13**	**23**	**53**	**64**	**137**	**210**	**468**	**976**	**16.3**	**137**

Source: SUS, ONS

	2021									Projection from 2008-09	
Area	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85+**	**Total**	**%age change**	**Numbers**
Ashford	2	6	2	6	9	27	38	73	**161**	**40.2**	**46**
Canterbury	0	0	1	12	13	23	46	113	**208**	**27.6**	**45**
Dover	1	4	5	5	12	32	42	86	**187**	**38.3**	**52**
Shepway	2	1	5	4	16	23	38	87	**175**	**37.0**	**47**
Swale	1	1	6	8	10	35	33	65	**158**	**47.8**	**51**
Thanet	4	4	6	14	16	27	45	120	**236**	**23.4**	**45**
East Kent	**11**	**15**	**26**	**48**	**76**	**167**	**242**	**543**	**1125**	**34.1**	**286**

Source: SUS, ONS