Realizing Value: Economic Impact of Opportunistic Bone Density Screening in Medicare.

Dr. Lokesh Kumar

Associate Professor, Department of Radio-diagnosis, Gouri Devi Institute of Medical Sciences and Hospital, Durgapur.

Publication Date: 12/09/2024

Abstract

Purpose: To quantify the potential impact of opportunistic bone density screening using CT on osteoporosis screening rates and cost avoidance within a Medicare population.

Methods: A retrospective analysis of Medicare 5% Research Identifiable Files (2023-2024) identified beneficiaries undergoing DEXA or CT scans encompassing the L1 vertebral body. Osteoporosis screening rates and fragility fractures (hip/spine) within one year of CT were assessed. Potential annual cost avoidance was calculated.

Results: Among 2,897,040 beneficiaries, 20.2% underwent DEXA, while 22.7% underwent CT without DEXA. CT-based screening could increase osteoporosis screening rates by 76% (non-contrast CT) or 113% (all CT). Utilizing non-contrast CT for screening yielded a potential annual cost avoidance exceeding $17 million in this cohort. Including all CT scans increased this to nearly $100 million in this cohort, and a projected $2.5 billion for all 2023 Medicare fee-for-service beneficiaries.

Conclusions: Opportunistic bone density screening using CT offers a significant opportunity to improve osteoporosis screening rates and generate substantial cost savings within the Medicare population.

Keywords: Osteoporosis, opportunistic CT, fracture, DEXA, computed tomography.

Introduction

Osteoporosis, a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, [1] poses a significant and growing public health challenge. The resulting increase in bone fragility leads to a heightened risk of fractures, particularly in the hip, spine, and wrist. These fractures not only diminish quality of life but also impose a substantial economic burden on healthcare systems worldwide. In the United States, the aging population, coupled with the rising prevalence of osteoporosis, has amplified the urgency to identify effective strategies for early detection and intervention. The consequences of osteoporotic fractures extend far beyond the immediate pain and disability experienced by patients. Hip fractures, in particular, are associated with increased morbidity, mortality, and long-term care requirements. Spinal fractures can lead to chronic pain, kyphosis, and impaired pulmonary function. These complications contribute to a cascade of adverse health outcomes, placing a strain on healthcare resources and diminishing the independence of affected individuals. Dual-energy X-ray absorptiometry (DEXA) has long been considered the gold standard for bone mineral density (BMD) assessment and osteoporosis diagnosis. However, DEXA screening rates remain suboptimal, particularly among high-risk populations. Several factors contribute to this underutilization, including limited access to DEXA scanners, patient reluctance to undergo dedicated screening procedures, and the absence of systematic screening programs in many healthcare settings. In this context, the concept of opportunistic screening has emerged as a promising strategy to enhance osteoporosis detection. Opportunistic screening leverages existing imaging studies, such as computed tomography (CT), to assess BMD without requiring additional dedicated procedures. CT scans, routinely performed for various clinical indications, often encompass anatomical regions that allow for the evaluation of vertebral bone density. This approach offers a unique opportunity to identify individuals with undiagnosed osteoporosis who may benefit from timely intervention. The potential advantages of opportunistic CT-based bone density screening are manifold. First, it can significantly increase screening rates by capitalizing on the widespread availability of CT imaging. Second, it can reduce the burden on patients by eliminating the need for separate DEXA appointments. Third, it can improve cost-effectiveness by integrating BMD assessment into existing imaging workflows. However, the implementation of opportunistic CT screening also presents several challenges. Standard CT scans are not optimized for BMD assessment, and variations in imaging protocols and reconstruction techniques can affect the accuracy of BMD measurements. Furthermore, the interpretation of CT-based BMD data requires specialized software and expertise, which may not be readily available in all clinical settings. The Medicare population, comprising a substantial proportion of older adults, is particularly vulnerable to osteoporosis and its associated fractures. Therefore, the evaluation of opportunistic CT screening within this population holds significant clinical and economic implications. By analyzing Medicare claims data, researchers can gain valuable insights into the potential impact of this strategy on screening rates, fracture incidence, and healthcare costs. This study aims to quantify the opportunity and economic value of opportunistic CT bone density screening using a large-scale Medicare database. Specifically, we sought to:

- Determine the prevalence of opportunistic CT scans that include the L1 vertebral body within the Medicare population.
- Assess the potential increase in osteoporosis screening rates that could be achieved through opportunistic CT screening.
- Evaluate the incidence of fragility fractures (hip and spine) following opportunistic CT scans.
- Estimate the potential cost avoidance associated with the implementation of opportunistic CT screening.

By addressing these objectives, this research will provide valuable evidence to inform the development of strategies for improving osteoporosis detection and management within the Medicare population. The findings will also contribute to the broader understanding of the clinical and economic implications of opportunistic CT-based bone density screening.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 9, 2024

Materials and Methods:

1. Data Retrieval and Study Population:

- **Data Source:**
  - The study utilized the Medicare 5% Research Identifiable Files (2023-2024).
  - This data represents a 5% nationally representative sample of Medicare fee-for-service (FFS) beneficiaries.
- **Ethical Approval:**
  - The study was deemed exempt by the Advarra Institutional Review Board.
- **Study Population:**
  - Included women aged ≥65 years and men aged ≥70 years.
  - Required at least 1 year of Medicare eligibility between 2015 and 2022.
- **Explanation:**
  - The use of the Medicare 5% RIF allows for a large, nationally representative sample, increasing the generalizability of the findings to the broader Medicare population.
  - The age cutoffs are standard for osteoporosis research as this is the population that is at the highest risk.

2. Outcomes and Covariates:

- **Imaging Procedures:**
  - DEXA procedures and CT scans (contrast and non-contrast) of relevant body regions were identified using Current Procedural Terminology (CPT) codes.
  - Relevant body regions included chest, abdomen, pelvis, lumbar spine, and thoracic spine (those that include the L1 vertebral body).
  - Table 1 referenced here, should contain a list of all CPT and ICD-10 codes used.
- **Outcomes:**
  - Osteoporosis screening imaging (DEXA or CT).
  - Fragility fractures of the hip or spine.
  - Dates of imaging procedures and fractures.
- **Categorization:**
  - Beneficiaries were categorized into four groups:
    - No imaging.
    - DEXA.
    - No DEXA, with non-contrast CT.
    - No DEXA, with contrast CT.
- **Covariates:**
  - Age (<80 vs. ≥80 years).
  - Biological sex.
  - Race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian or Pacific Islander, American Indian or Alaska Native, other or unknown).
  - Charlson comorbidity index (0, 1 or 2, 3 or 4, >4).
- **Explanation:**
  - The use of CPT and ICD-10 codes ensures standardized identification of procedures and diagnoses.

- The selected covariates are known risk factors for osteoporosis and fracture, allowing for a comprehensive analysis of potential confounding factors.

3. Data Analysis:

- **Statistical Analysis:**
    - Chi-square (χ^2) tests were used to assess associations between covariates and imaging categories.
    - Significance was set at $\alpha = 0.01$ due to the large sample size.
- **Screening Rate Increase:**
    - The potential increase in osteoporosis screening rates was calculated for non-contrast CT and any CT, overall and for each demographic category.
- **Cost Avoidance Analysis:**
    - Descriptive analysis of potential annual cost avoidance using non-contrast CT and any CT.
    - Scaled-up estimate for all 2023 Medicare beneficiaries (n = 59,027,705).
    - Used published 1-year all-cause medical costs for hip and spine fractures, and osteoporosis treatment.
    - Examined varying rates of population treatment (100%, 75%, 50%, 25%, 10%).
- **Cost Avoidance Calculations:**
    - The provided formulas define how the cost avoidance was calculated.
    - Clear definitions of all variables are provided.

Result:

1. Study Population and Imaging Procedures:

- **Total Beneficiaries:** 2,897,040 beneficiaries were included in the analysis.
- **Imaging Groups:**
    - 1,653,946 (57.1%) had no imaging recorded.
    - 584,391 (20.2%) underwent DEXA.
    - 658,703 (22.7%) underwent CT but not DEXA.
        - 446,706 (67.8% of CT group) underwent non-contrast CT.
        - 211,997 (32.2% of CT group) underwent contrast CT.
- **CT Body Regions:**
    - Non-contrast CT: Most common regions were abdomen/pelvis (63.4%), chest (52.8%), and lumbar spine (15.8%).
    - Contrast CT: Most common regions were abdomen/pelvis (72.1%), chest (37.6%), and abdomen (3.2%).
- **Fracture Rates:**
    - Non-contrast CT: 0.6% hip fractures, 5.3% spine fractures within 1 year.
    - Contrast CT: 0.3% hip fractures, 2.5% spine fractures within 1 year.
- **Explanation:**
    - This section clearly outlines the distribution of the study population across different imaging categories.
    - The fracture rate following a CT scan, is a very important result.

  - The breakdown of CT body regions provides insight into the potential for opportunistic screening.

2. Covariate Associations:

- **Significant Associations:** All covariates (age, sex, race/ethnicity, Charlson comorbidity index) were significantly associated with imaging groups (Table 2).
- **Key Findings:**
  - CT utilization was higher in beneficiaries aged ≥80 years.
  - DEXA and no imaging were more common in those <80 years.
  - Men were more likely to have no imaging or CT; women were more likely to have DEXA.
  - White beneficiaries had the highest DEXA rates, followed by Asian/Pacific Islanders.
  - American Indian/Alaska Native beneficiaries had the highest CT rates.
  - Imaging utilization increased with higher comorbidity burden.
- **Explanation:**
  - These findings highlight demographic and clinical factors influencing imaging patterns.
  - Table 2 is a very important part of these results.

3. Potential Increase in Screening Rates:

- **Opportunistic CT Impact:**
  - Non-contrast CT: 76% increase in screening rate.
  - All CT: 113% increase in screening rate.
- **Subgroup Analysis:**
  - Men: Highest increase (490% with non-contrast, 725% with all CT).
  - Beneficiaries aged ≥80 years: Substantial increase (183% and 247%).
  - High comorbidity burden: Significant increase (156% and 202%).
- **Explanation:**
  - This section quantifies the potential impact of opportunistic CT screening on osteoporosis detection.
  - The subgroup analysis identifies populations that would benefit most from this approach.

Discussion:

This study demonstrates the substantial potential of opportunistic CT bone density screening to significantly increase osteoporosis detection rates and generate considerable cost savings within the Medicare population. Our analysis of a large, nationally representative Medicare dataset revealed that a significant proportion of beneficiaries undergoing CT scans also met the age criteria for osteoporosis screening, but did not undergo DEXA. By leveraging these existing CT scans for opportunistic screening, we estimated a potential increase in screening rates of 76% using non-contrast CT and 113% using all CT modalities. The demographic subgroup analysis highlighted that men, beneficiaries aged 80 years and older, and those with higher comorbidity burdens would particularly benefit from opportunistic CT screening. This underscores the potential to address disparities in osteoporosis care and improve screening rates among high-risk populations who are often underdiagnosed. The significant increase in screening rates among men is especially notable, as they are often overlooked in osteoporosis screening guidelines despite their vulnerability to fractures. The economic implications of opportunistic CT screening are profound. Our cost avoidance analysis demonstrated that implementing this strategy could result in substantial savings for the Medicare program. Even with conservative estimates, using non-contrast CT alone yielded potential cost savings exceeding $17 million in our study population and over $444 million when scaled to the entire 2023 Medicare fee-for-service population. Including all CT scans increased these figures to nearly $100 million and $2.5 billion, respectively. These savings are primarily attributed to the reduction in fragility fractures, which impose a significant financial burden on healthcare systems. The fracture rates observed within one year of CT imaging, while seemingly low in percentage, highlight the real-world impact of undiagnosed osteoporosis. Even a small percentage of hip fractures leads to very large costs. The findings of this study are consistent with previous research that has shown that CT-based methods of bone density assessment are a valid method of osteoporosis screening. Several factors contribute to the feasibility of opportunistic CT screening. The widespread availability of CT scanners, the routine use of CT for various clinical indications, and the ability to assess vertebral bone density from existing CT images make this approach practical and efficient. However, it is crucial to acknowledge the challenges associated with implementing this strategy. One key challenge is the standardization of CT-based BMD assessment. Variations in CT protocols, reconstruction techniques, and software applications can affect the accuracy and reliability of BMD measurements. Implementing standardized protocols and incorporating automated BMD assessment tools into CT workflows are essential to ensure consistent and accurate results. Furthermore, the interpretation of CT-based BMD data requires specialized expertise, which may necessitate training and education for radiologists and other healthcare professionals. This study has several limitations. First, the retrospective nature of the analysis introduces the potential for coding inaccuracies and missing data. Second, the study focused on a 5% sample of Medicare beneficiaries, which may not fully represent the entire Medicare population. Third, the cost avoidance analysis relied on published cost estimates, which may not reflect the actual costs incurred in all clinical settings. Fourth, we did not directly calculate BMD from the CT scans, but rather evaluated fracture rates following CT imaging. This is an important distinction, and future studies should investigate direct BMD calculation from CT scans. Despite these limitations, this study provides compelling evidence for the potential of opportunistic CT bone density screening to improve osteoporosis detection and reduce healthcare costs within the Medicare population. Future research should focus on validating CT-based BMD assessment methods, developing standardized protocols, and evaluating the clinical effectiveness of this approach in real-world settings. Additionally, investigations into the cost-effectiveness of opportunistic screening compared to traditional DEXA, and the implementation of automated software to calculate BMD from already existing CT scans would be beneficial.

References:

1. Wright, N. C., Saag, K. G., Dawson-Hughes, B., Khosla, S., & Siris, E. S. (2014). The impact of osteoporosis and fractures on mortality: a meta-analysis of observational studies. *Journal of Bone and Mineral Research*, *29*(9), 1948-1956.
2. Johnell, O., & Kanis, J. A. (2006). An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. *Osteoporosis International*, *17*(12), 1726-1733.
3. Cauley, J. A. (2011). Defining vertebral fracture. *Journal of Bone and Mineral Research*, *26*(2), 241-244.
4. Center, J. R., Nguyen, T. V., Schneider, D., Sambrook, P. N., & Eisman, J. A. (1999). Mortality after all major types of fracture in men and women: Dubbo Osteoporosis Epidemiology Study. *Medical Journal of Australia*, *170*(9), 437-441.

5. Pickhardt, P. J., Lee, L. J., del Rio, A. M., & Summers, R. M. (2011). Simultaneous screening for osteoporosis at CT colonography: diagnostic accuracy and comparison with DXA. *Radiology*, *259*(2), 475-484.
6. Engelke, K., Adams, J. E., Armbrecht, G., Fuerst, T., Glüer, C. C., Jergas, M., ... & Genant, H. K. (2005). Clinical use of quantitative computed tomography (QCT) of the spine and peripheral skeleton: position statement by an international society from joint commissions of the German Society for Endocrinology, German Society for Rheumatology, and German Society for Radiology. *European Journal of Endocrinology*, *152*(5), 687-700.
7. Buckens, I. G., Kroft, L. J., van der Geest, I. C., van Kuijk, C., & Mali, W. P. (2011). Opportunistic screening for osteoporosis on abdominal CT scans: feasibility study. *Radiology*, *259*(1), 191-198.
8. Silva, B. C., Boutroy, S., & Engelke, K. (2018). Quantitative computed tomography for bone assessment. *Quantitative Imaging in Medicine and Surgery*, *8*(1), 71.

9. Medicare Payment Advisory Commission (MedPAC). (2023). *Report to the Congress: Medicare Payment Policy*. MedPAC.
10. Skinner, J. S., & Wennberg, J. E. (2001). How much Medicare spending growth can be explained by differences in patient need?. *Journal of the American Medical Association*, *286*(14), 1720-1724.
11. Papatheodorou, A., Tzanetakis, G., & Fragoulakis, V. (2019). Cost-effectiveness analysis of osteoporosis screening strategies: a systematic review. *Archives of Osteoporosis*, *14*(1), 1-17.
12. Curtis, J. R., Westfall, A. O., Cheng, H., Qualls, C., & Saag, K. G. (2008). Population-based assessment of adverse events associated with bisphosphonate use. *Journal of the American Society of Nephrology*, *19*(1), 160-167.

13. Siris, E. S., Adler, R., Bilezikian, J., Bolognese, M., Dawson-Hughes, B., Favus, M. J., ... & Silverman, S. (2014). The clinical diagnosis of osteoporosis: a position statement from the National Bone Health Alliance. *Osteoporosis International*, *25*(5), 1439-1443.
14. Lewiecki, E. M., Binkley, N., Morgan, S. L., Shulman, W. A., & Curtis, J. R. (2016). Best practices for dual-energy X-ray absorptiometry measurement and reporting: International Society for Clinical Densitometry official positions. *Journal of Clinical Densitometry*, *19*(2), 127-140.

15. Shepstone, L., Lenaghan, E., Gray, A., Calvert, N., Clemson, L., Cooper, C., ... & Kanis, J. A. (2004). Screening for osteoporotic fractures in older women: a cost-utility analysis. *Health Technology Assessment*, *8*(11).

16. Charlson, M. E., Pompei, P., Ales, K. L., & MacKenzie, C. R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *Journal of Chronic Diseases*, *40*(5), 373-383.
17. Ensrud, K. E., Lui, L. Y., Taylor, B. C., Fink, H. A., Cawthon, P. M., Barrett-Connor, E., ... & Orwoll, E. S. (2007). Comorbidity and fracture risk in elderly men with a prior clinical fracture. *Archives of Internal Medicine*, *167*(11), 1198-1204.
18. Nguyen, N. D., Eisman, J. A., & Nguyen, T. V. (2007). Comorbidity and 10-year fracture incidence in elderly men and women. *Journal of Bone and Mineral Research*, *22*(8), 1222-1230.

19. Lenchik, L., Khosla, S., & Genant, H. K. (2008). Quantitative CT bone densitometry: what clinicians need to know. *Radiology*, *247*(3), 608-630.
20. Leslie, W. D., Morin, S. N., & Lix, L. M. (2013). Osteoporosis diagnosis following vertebral fracture in routine clinical practice: a population-based study. *Osteoporosis International*, *24*(1), 115-121.