

Effect of an Automated Tracking Registry on the Rate of Tracking Failure in Incidental Pulmonary Nodules

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Abstract

Objective: Following incidental lung nodules with interval CT scanning is an accepted method to detect early lung cancer, but delayed tracking or failure to track is reported in up to 40% of patients.

Methods: Our institution developed and implemented an automated lung nodule registry tracking system. This system uses a code at the time that a suspicious nodule is discovered to populate the registry. Suspicious nodules were defined as any nodule, solid or ground glass, <3 cm that the radiologist recorded as a potential malignancy or recommended for follow-up imaging. We exported the system to eight other Veterans Administration Medical Centers (VAMCs) with over 10,000 patients enrolled. We retrospectively reviewed 200 sequential CT scan reports containing incidental nodule(s) from two tertiary care university-affiliated VAMCs, both before and after the implementation of the registry tracking system. The primary outcome was the rate of tracking failure, defined as suspicious nodules that had no follow-up imaging or whose follow-up was delayed when compared with published guidelines. Secondary outcomes were predictors of tracking failure and reasons for tracking failure.

Results: After implementation of the registry tracking system in the two VAMCs, we found a significant decrease in tracking failure, from a preimplementation rate of 74% to a postimplementation rate of 10% ($P < .001$). We found that age, nodule size, number, and nodule characteristics were significant predictors.

Conclusions: The automated lung nodule registry tracking system can be exported to other health care facilities and significantly reduces the rate of tracking failure.

Key Words: Nodule, incidental, tracking, follow-up

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INTRODUCTION

The failure to pursue abnormal test results is a common problem in medicine [1,2]. Published reports indicate that pulmonary nodules incidentally discovered on CT imaging are not pursued according to published guidelines in up to 70% of cases, potentially resulting in delays in diagnosis and harm to patients [3-10]. With the recent recommendation for lung cancer

screening with low-dose chest CT in high-risk patient populations, the incidence of pulmonary nodules will increase, highlighting the need to find novel solutions for efficient and reliable monitoring of these patients for the development of lung cancer [11].

The goal for providers is to track and evaluate incidental pulmonary nodules using established guidelines to identify early-stage malignancies where interventions can impact outcome [8,9,12]. Results from the National Lung Screening Trial demonstrate that early recognition and intervention of lung cancer improves survival [13]. Institutions across the country have approached this problem by developing interventions to reduce the loss-to-follow-up rates, with varying degrees of success [3,4,14-17]. With the expansion of the electronic health record (EHR),

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there are new tools to reduce the frequency of failed follow-up and potentially save lives [17].

Our local institution developed an automated tracking registry to monitor incidentally found lung nodules that is directly linked to our EHR and follows published guidelines [8,9]. Patients are entered into the automated registry via a code initiated by the radiologist when a nodule is identified on any imaging that includes any portion of the chest. This prototype was implemented at the Minneapolis Veterans Administration Medical Center (VAMC) in early 2012 and showed marked improvement in the rate of tracking failure (nodules lost to follow-up or with significant delays) at our home institution. After the initial success at our home institution, the system was expanded to all of the regional VAMCs, including implementation at two tertiary care facilities similar to our own. The system was implemented at site A in January 2013 and site B in March 2014. We set out to determine if multi-site implementation of this tracking system would decrease the rate of tracking failure in patients with incidentally detected lung nodules.

METHODS

Lung Nodule Tracking Program

Our lung nodule tracking registry uses a facet of the standard VAMC EHR to assign patients unique identifiers when a pulmonary nodule that warrants tracking is found. We use these identifiers as a means for populating an automatic lung nodule registry tracking system that interacts with the EHR to ensure that tracking is completed on a schedule following established guidelines [13]. Patients are automatically entered into the registry if the radiologist assigns a code to the imaging report when a lung nodule meeting guideline criterion is identified. Nonradiologist providers can also place patients into the registry tracking system through an EHR request. The EHRs of patients identified as candidates in the registry tracking system are reviewed by support staff to determine if the nodule meets criteria for serial chest CT surveillance. If tracking is indicated, the support staff completes a templated EHR note indicating the time to the next CT scan based on published guidelines. The EHR template automatically interacts with the registry via embedded data fields, creating an expected timeline to the next CT scan. The process repeats until tracking is completed or a definitive workup for suspected lung cancer is initiated. The registry tracking system contains an automated system to identify overdue scans, allowing patient contact and rescheduling, if indicated.

Subjects

The Minneapolis Veterans Administration Health Care System Institutional Review Board approved this study protocol and waived informed consent and HIPAA requirements. We retrospectively reviewed the management of 50 patients with lung nodules incidentally found on CT scans at each of two university-affiliated VAMCs. At site A we reviewed imaging immediately before and roughly two years after implementation of the automated tracking registry. At site B we reviewed patients before and six months after implementation. In the preimplementation review, nodules were identified via a review of sequential chest CT scan reports until we identified 50 patients at each site with a report of an incidental pulmonary nodule. We defined a nodule as any solid, mixed, or ground glass opacity <3 cm in largest diameter for which the radiologist recommended follow-up or that was described as concerning for malignancy. After implementation of the registry tracking system, we repeated the audit to identify 50 unique patients at each site with incidental nodules.

Outcome Measures

Our primary outcome is “tracking failure,” defined as a composite of (1) lost to follow-up and (2) delayed follow-up. We defined “lost to follow-up” as any patient who did not complete nodule tracking per guidelines in the absence of having a separate diagnosis that would have made nodule tracking unnecessary or documentation that the patient declined nodule tracking. We defined “delayed follow-up” as follow-up imaging that was delayed by at least 30 days beyond guideline criteria, as previously published [7]. CT scans performed earlier than recommended by guideline criteria were not deemed tracking failure.

For the analysis of postimplementation tracking failure, we defined human error as failure of the radiologist to enter the code despite noting a nodule requiring tracking in the report or registry tracking staff failing to use the proper template during enrollment, resulting in exclusion from the registry tracking system. Patient preference leading to delays in follow-up imaging despite imaging ordered at the appropriate timeline was also identified and considered a form of tracking failure, though this was based on the individual patient’s travel and availability rather than an error or fault in the system.

Statistical Analysis

Patient and site characteristics before and after implementing the lung nodule tracking program are described as

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