Surgery 166 (2019) 691–697

Contents lists available at ScienceDirect

Surgery

journal homepage: www.elsevier.com/locate/surg

Analysis of a thyroid nodule care pathway: Opportunity to improve compliance and value of care

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ARTICLE INFO

Article history:
Accepted 19 May 2019
Available online 9 August 2019

ABSTRACT

Background: Care pathways facilitate standardized, evidence-based treatment to improve outcomes and value of care. Care pathways consist of multiple nodes representing decision points. Few studies investigate care pathway compliance. We demonstrate nodal care pathway analysis by reviewing compliance with our institutional multidisciplinary, evidence-based care pathways on the treatment of thyroid nodule to generate strategies to increase care pathway adherence and value of care.

Methods: Patients undergoing workup and treatment of structural thyroid disease between January 2018 and June 2018 were included in a retrospective analysis of enterprise-wide compliance with the following 3 care pathway nodes: (1) laboratory testing: only patients with abnormal results from thyroid-stimulating hormone testing should have T3/T4 measured. (2) imaging: neck computed tomography, magnetic resonance imaging, and positron emission tomography ordered for the workup of nodules were reviewed to determine clinical appropriateness. (3) operative treatment: the first 200 thyroid resections conducted in 2018 were reviewed to determine whether the indication and extent of the operation complied with the care pathway. Medicare fee schedules were used for financial calculations.

Results: Care pathway nonadherence occurred in 48% of the thyroid-stimulating hormone studies and 38% of the imaging studies obtained, with annual costs exceeding $120,000. Substantial care pathway nonadherence occurred in 3% of nodule-related operations.

Conclusion: Care pathway nodal analysis can identify areas of care pathway nonadherence. Nodal analysis should be considered for care pathway maintenance and generation of strategies of quality improvement.

Introduction

The United States spends a substantially greater percentage of our gross domestic product on health care than do comparable countries; however, health outcomes in the United States are disproportionately poor.[1] The development of care pathways (CPs) began in the 1980s in an effort to decrease variations and inefficiencies in health care and thus improve costs and outcomes. The usage of CPs has increased exponentially in subsequent years. The development and usage of CPs have increased such that there now exists a European Pathway Association.[2] There is even a *Journal of Clinical Pathways*,[3] which has been in publication since 2015.

Although precise definitions have varied, Lawal et al[4] have suggested 4 criteria for CPs, which are summarized in Fig 1. CPs can be distinguished from guidelines by the fact that they aim to translate information from guidelines into a local context. CPs consist of nodes representing decision points or tests with connected, branching lines reflecting test results, clinical decisions, and outcomes. As described by Buchert et al,[5] the goal of CPs is "to provide consistent, safe, efficient, effective, and timely care that will yield positive patient outcomes while reducing the inappropriate use of unnecessary resources."

Are CPs effective at these intended functions? In a 2010 Cochrane review, CPs were associated with decreases in in-hospital complications; however, the heterogeneity of the studies reviewed prevented comparisons of cost and length of stay (LOS).[6] In surgical literature, CP effectiveness has been demonstrated repeatedly with

Presented at the 76th Annual Meeting of the Central Surgical Association, Palm Harbor, FL.

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https://doi.org/10.1016/j.surg.2019.05.054
0039-6060/

Structured, multi-disciplinary plan of care
Used to channel the translation of guidelines or evidence into local structures
Detail the steps in a course of treatment or care in a plan, pathway, algorithm, guideline, protocol, or other "inventory of actions," (i.e. has time-frames or criteria-based progression)
Aim to standardize care for a specific population

Fig 1. Defining characteristics of CPs. These 4 criteria to define CPs were suggested by Lawal et al.[4] The thyroid nodule CP analyzed in this study meets all of the listed criteria.

ERAS (enhanced recovery after surgery) pathways yielding benefits for patients undergoing a wide variety of operations, including colorectal, hepatobiliary, and pancreatic operations, primarily through reduced LOS and decreased complication rates.[7] Decreased LOS and perioperative complications have likely led to the decreases in perioperative costs demonstrated in some studies of enhanced recovery after surgery pathways.

Despite widespread adoption of CPs and the benefits that some studies have shown for CP adherence,[8–10] few studies have investigated the assessment and maintenance of CP compliance, particularly in the context of a large health care system. In this study, we demonstrate CP nodal analysis utilizing our institutional multidisciplinary, evidence-based CP for thyroid nodule. We hypothesized that nodal analysis of our thyroid nodule CP would identify areas and strategies for improvement of CP adherence and opportunities to increase value of care.

Methods

A single-center, retrospective study analyzing adherence to our institutional thyroid nodule CP was performed. This CP was selected as an appropriate workup of thyroid nodules because it is well defined, and the CP spans the domains of laboratory testing, imaging, and surgical management. Three of 9 nodes in the CP were analyzed, corresponding to the measurement of thyroid function, use of cross-sectional imaging, and extent and indication of operation (Fig 2). Examples of nodes that were not analyzed include use of fine-needle aspiration and management of abnormal lymph nodes detected intraoperatively. Our thyroid nodule CP was developed in a multidisciplinary fashion by representatives from our Endocrine and Metabolic Institute and the Departments of Otolaryngology and General Surgery, based on the guidelines for management of thyroid nodules from the American Thyroid Association,[11] which were implemented in 2014. The CP meets the 4 criteria shown in Fig 1, is regularly referenced in multidisciplinary conferences, and is readily available to all Cleveland Clinic Foundation providers as an online resource. Patients undergoing workup and treatment of structural thyroid disease within the Cleveland Clinic Foundation health system from January 1, 2018 to June 30, 2018 were included. Approval for this study was obtained from our Institutional Review Board.

Measurement of thyroid-stimulating hormone (TSH) levels are indicated for patients undergoing workup of a thyroid nodule. Additional measurements of thyroid function, T3 and T4, are rarely indicated if the TSH level is normal. Patients undergoing outpatient TSH testing for workup or management of structural thyroid disease were identified from the electronic medical record (EMR) using procedure identification and International Classification of Diseases (ICD)-10 codes corresponding to structural thyroid disease (codes C73, D34, E01.0, E01.2, E03.0, E04.0, E04.1, E04.2, E04.9, E05.00, E05.10, and E05.11). Patients with lab-associated diagnoses that were metabolic in nature and would not lead to operative intervention (eg, hypothyroidism) were excluded. TSH values were labeled as normal, high, or low based on institutional reference values. Presence or absence of concurrent T3/T4 testing, in addition to any T3/T4 testing in the subsequent 60 days, were collected. Comparisons were made between TSH results and the presence of concurrent or subsequent T3/T4 tests to determine the numbers of unnecessary concurrent T3/T4 studies and any indicated T3/T4 tests drawn at a later date. These were extrapolated for 1 year to determine associated annual costs.

Cross-sectional imaging is indicated to evaluate substernal extension or tracheal deviation associated with goiter and for definition of preoperative anatomy in the setting of more advanced cancer with suspicion of tracheal, esophageal, or vascular invasion. Patients undergoing computerized tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET) of the neck ordered for a structural thyroid disease diagnosis were identified using procedure and diagnosis codes, as described earlier. Although cross-sectional imaging may identify thyroid nodules incidentally, only studies ordered for workup of the thyroid nodule were analyzed. This approach included preoperative imaging and imaging performed in patients who ultimately did not undergo an operation. Chart review determined the indication for cross-sectional imaging and whether this was supported by the CP. Financial analysis was performed by extrapolating the test frequency and costs to estimate the associated annual costs.

The first 200 patients who underwent thyroid operations in 2018 were identified. Patients who underwent operations for a non-nodular diagnosis were excluded from analysis. Perioperative documentation was reviewed to determine whether the indication and extent of the operation were supported by the CP and whether preoperative workup was appropriate. Data were collected and analyzed using Microsoft Excel and R, version 3.5.1 (R Foundation for Statistical Computing, Vienna, Austria), using descriptive statistical methods and financial calculations as described earlier. Costs of studies were estimated using the 2018 laboratory and physician fee schedules of the Centers for Medicare and Medicaid Services, including both technical and professional costs.

Results

Results of the TSH analysis are shown in Table I. There were 6,346 TSH levels ordered for structural thyroid disease. Usage of reflex TSH, where a blood sample is tested for TSH level and then automatically undergoes T3/T4 testing if TSH is suppressed without need for an additional blood draw, was rare. There were 719 unique providers who ordered 6,226 nonreflex TSH levels. Substantial proportions of patients with normal or high TSH levels underwent avoidable concurrent T3/T4 studies. The 50 providers who ordered nonreflex TSH tests most frequently (63.1% of nonreflex TSH tests) were primarily endocrinologists and endocrine surgeons and were responsible for 63.4% and 66.2%, respectively, of avoidable, same-day T3 and T4 studies. The annual associated costs of avoidable T3 and T4 tests for the workup and treatment of structural thyroid disease exceeded $110,000. Avoidable blood draws within 60 days occurred in 8.7% of patients with a suppressed TSH level. Accounting for the fact that many patients with suppressed TSH underwent concurrent T3/T4 measurement at the time of their initial blood draw (which is specifically not indicated by the CP), these patients would have undergone an additional 761 blood

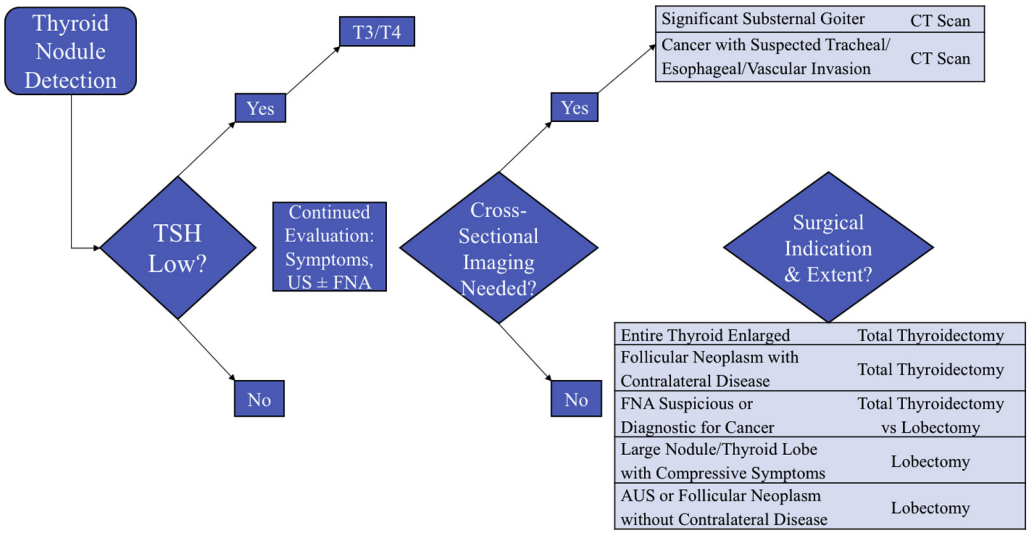

Fig 2. Analyzed thyroid nodule CP nodes. This figure demonstrates the CP nodes analyzed in this study, corresponding to use of thyroid function testing, extent of surgery, and preoperative testing. Additional nodes exist that were not studied and are not represented. This CP is based on the 2015 American Thyroid Association guidelines for management of nodular thyroid disease. *FNA*, fine-needle aspiration; *AUS*, atypia of undetermined significance; *TSH*, thyroid-stimulating hormone.

Table I
Laboratory test analysis

	N
Total TSH studies ordered	6,346
Nonreflex TSH studies ordered	6,226 (98.1)
Reflex TSH studies ordered	120 (1.9)
Nonreflex TSH by provider type	
Physician (staff, fellow, or resident)	5,732 (92.1)
Advanced practitioner (physician's assistant, nurse practitioner, certified nurse specialist)	463 (7.4)
Midwife	31 (0.5)
Nonreflex TSH by provider specialty (Top 50 highest-volume providers)	3,931 (63.1)
Endocrinology ($n = 37$)	3,245 (82.5)
Endocrine Surgery ($n = 6$)	446 (11.3)
Internal medicine ($n = 4$)	121 (3.1)
Family medicine ($n = 3$)	119 (3.0)
Nonreflex TSH result range	
Normal or high	5,014 (80.5)
Low	1,212 (19.5)
Avoidable concurrent T3 studies	1,127 (22.5)
Avoidable concurrent T4 studies	2,821 (56.3)
Annual cost of avoidable studies	$110,585
Avoidable delayed blood draws	106 (8.7)
Approximate annual delayed blood draws	212
Approximate annual delayed blood draws with perfect CP adherence	1,734

Data are *n* (%) and approximate dollar values. Results of laboratory test analysis: All TSH studies described were ordered with an associated structural thyroid disease indication. Comparisons were made to laboratory reference values to determine test normality or abnormality. Avoidable T3 and T4 studies are shown as counts and the percentage of abnormal TSH tests that had concurrent T3 and T4, respectively. Avoidable delayed blood draws are shown as a count and percentage of low TSH studies. Cost of avoidable studies is calculated using estimated annual frequency of avoidable tests and the 2018 laboratory fee schedule of the CMS. Total CMS charges rounded to the nearest dollar for T3, T4, and venipuncture are $21, $11, and $3, respectively.

Table II
Cross-sectional imaging analysis

CT (n = 75)	N
Nonindicated CTs	27 (36)
Approximate annual cost	$10,109
MRI ($n = 3$)	
Nonindicated MRI studies	3 (100)
Approximate annual cost	$2,471
Total inappropriate imaging	30 (38.5)
Total approximate annual cost	$12,580

Data are *n* (%) and estimated dollar values. The table shows findings from chart reviews with regard to the cross-sectional imaging CP node for patients undergoing workup of thyroid nodules from January 2018 to June of 2018. Chart review determined the appropriateness of cross-sectional imaging when compared with our CP imaging node (Fig 2). Cost of avoidable studies is calculated using estimated annual frequency of avoidable tests and the 2018 physician fee schedule of the CMS, including technical and professional charges. Total CMS charges rounded to the nearest dollar for CT without contrast, CT with contrast, and MRI with and without contrast are $171, $207, and $412, respectively.

draws with perfect CP adherence, bringing the estimated total of avoidable blood draws to over 1,700 annually.

Results of a cross-sectional imaging analysis are demonstrated in Table II. Of 245 cross-sectional imaging studies reviewed, 78 were ordered for workup of nodular diagnoses (75 CTs, 3 MRIs, and 0 PETs). Of these 78 studies, 30 (39%) were not supported by the CP. Common examples of studies not supported by the CP included those ordered before neck ultrasonography, those for characterization of the nodule in patients who had already undergone ultrasonography, those for evaluation of tracheal deviation or extent of goiter when other recent studies such as a CT of the chest demonstrated those findings, and those for evaluation of cervical lymphadenopathy in patients who already had an ultrasonography. The annual associated costs of these tests exceeded $12,000.

Results of the analysis of the operative treatment are shown in Table III. Of 200 thyroid resections reviewed, 168 were performed for a diagnosis of nodular thyroid disease. These operations occurred between January 2018 and early April 2018. Endocrine surgeons performed most of these operations. Extrapolated to a full

Table III
Operative details for 168 nodule-related thyroid operations

Extent of operation	N
Total thyroidectomy	109 (64.9)
Lobectomy	59 (35.1)
Number of unique surgeons by specialty	
Endocrine surgery	6 (26.1)
General surgery	8 (34.8)
Otolaryngology	9 (39.1)
Thyroid resection volume by specialty	
Endocrine surgery	99 (58.9)
General surgery	39 (23.2)
Otolaryngology	30 (17.9)
Estimated annual surgeon volume (median [interquartile range])	16 (4–52)
Indication/extent of operation not supported by CP	5 (3.0)
Acceptable deviation based on patient preference	8 (4.8)
Acceptable deviation without clear documentation	8 (4.8)

Data are *n* (%), unless otherwise indicated. The table shows findings of chart reviews with regard to the analysis of the "extent of operation" of the node in the CP. Chart review was used to evaluate appropriateness of operative indication and extent when compared with the corresponding CP node (Fig 2). Estimated annual surgeon volume pertains to nodular thyroid disease.

year, surgeon operative volume for nodular thyroid disease varied substantially. Five instances where the indication or extent of operation was not supported by the CP and was not within reasonable clinical practice based on available documentation were identified (3 by general surgeons and 2 by otolaryngologists). Three instances had an inadequate workup of contralateral nodules >1 cm in size that could have changed the extent of the operation, 1 involved lobectomy for non-Hodgkin's lymphoma of the thyroid, and 1 had documentation indicating a benign, asymptomatic, multinodular goiter without any clear indication for resection. Management deviated from the CP in 8 other instances secondary to documented patient preference, for example, for total thyroidectomy rather than lobectomy in the setting of a follicular neoplasm without contralateral disease. A review of 8 additional cases indicated a likely reasonable practice, but documentation of patient preferences or clinical reasoning was unclear. We have not presented financial analyses for operations deemed not supported by the CP because to a patient the value of avoiding a non-indicated or incomplete operation cannot be measured and substantially outweighs any monetary cost savings for a health system. A graphic summary of CP adherence and opportunity for improvement by node is shown in Fig 3.

Discussion

As the medical field shifts from a system of volume-based physician reimbursement to a more population-conscious and value-based approach, CPs that are population appropriate, cost effective, and evidence based can facilitate standardized and appropriate treatment decisions. This use of CPs will allow stewardship of resources with the same or improved outcomes and thereby provide equivalent or superior value to patients and systems. Our study, however, has shown that the existence and availability of a CP does not ensure that providers will adhere to it. To our knowledge, this is the first study to demonstrate CP nodal analysis for assessment of CP adherence and identification of opportunities for quality improvement across an enterprise. Because our system includes 15 hospitals across Ohio and Florida, we suspect that these deviations from an institutional CP are more likely to occur compared with a CP implemented at a single hospital. With increasing implementation of CPs, increasing size and complexity of health care systems, and increasing emphasis on high-value care, health care organizations will need to develop strategies and systems to monitor and maximize CP adherence.

To decrease unnecessary concurrent ordering of T3/T4, we plan to implement reflex TSH testing as a systems-level change. This implementation will limit subsequent T3/T4 tests to occur automatically for those with suppressed TSH and will prevent avoidable blood draws because of physician concern, which likely drives concurrent T3/T4 ordering. In addition to limiting additional blood draws, reflex TSH would prevent physicians and other care providers from needing to enter >1,700 subsequent follow-up lab orders. We think that encouraging thoughtful test ordering would be unlikely to yield sustained change given that >700 providers order thyroid function tests at varying volumes. Although systems-level changes are pending, it is more likely that encouraging the highest-volume endocrinologists and endocrine surgeons to use available reflex TSH testing will have the greatest short-term impact. Going forward, we will need to ensure that nonreflex TSH remains available for patients in whom TSH suppression is intentional and does not require further investigation, such as those who have undergone resection for papillary cancer.

Although inappropriate cross-sectional imaging was less common than inappropriate laboratory testing, with 30 total instances identified over 6 months, it was associated with markedly greater costs per test, with total estimated annual costs exceeding $12,000. One option would be to implement an EMR-based, best-practice advisory that would appear when a CT, MRI, or PET is ordered for thyroid nodule–related diagnoses. Published results of EMR-based, best-practice advisories to decrease nonindicated imaging have been mixed, with some studies showing a substantial decrease in nonindicated imaging and others demonstrating no difference, possibly secondary to advisory fatigue.[12,13] This intervention, however, would be low cost, with the potential to decrease inappropriate usage of lesser-frequency imaging studies, and post-implementation outcomes would be relatively easy to monitor.

Of particular relevance to surgeons is engagement of surgeons in the community whose practice may be broader, whose volume of a given procedure may be considerably less, and who may have less access to or participation in specialized multidisciplinary conferences and tumor boards where standards of care are discussed. Although endocrine surgeons performed the majority of the thyroid operations analyzed, they comprised only one quarter of surgeons performing these procedures. Extrapolated to 1 year, over half of the surgeons in this study would perform <25 thyroidectomies annually, a number of cases above which clinical outcomes for patients have been demonstrated to improve.[14] Substantial literature exists associating increased surgical volumes with improved outcomes;[15,16] however, few papers address strategies for maintaining high-quality outcomes for the lesser-volume surgeons and centers. CP utilization as a component of maintaining high quality at lesser volumes has been noted in cardiac surgery,[17] as has collaboration between high-volume and low-volume centers in hepatobiliary surgery.[18] In our system, web-based participation is now available for tumor boards and conferences, which we hope will facilitate engagement and collaboration between geographically distant surgeons.

Although this work has focused largely on the economic impact of CP nonadherence, the analyzed nodes also affect patients directly. Avoidable blood draws, imaging, and initial or additional operations put patients at risk of discomfort; unnecessary radiation exposure, and, at worst, anesthetic and operative complications. Patient satisfaction was not examined; however, we would posit that most patients would prefer to know that the decisions they

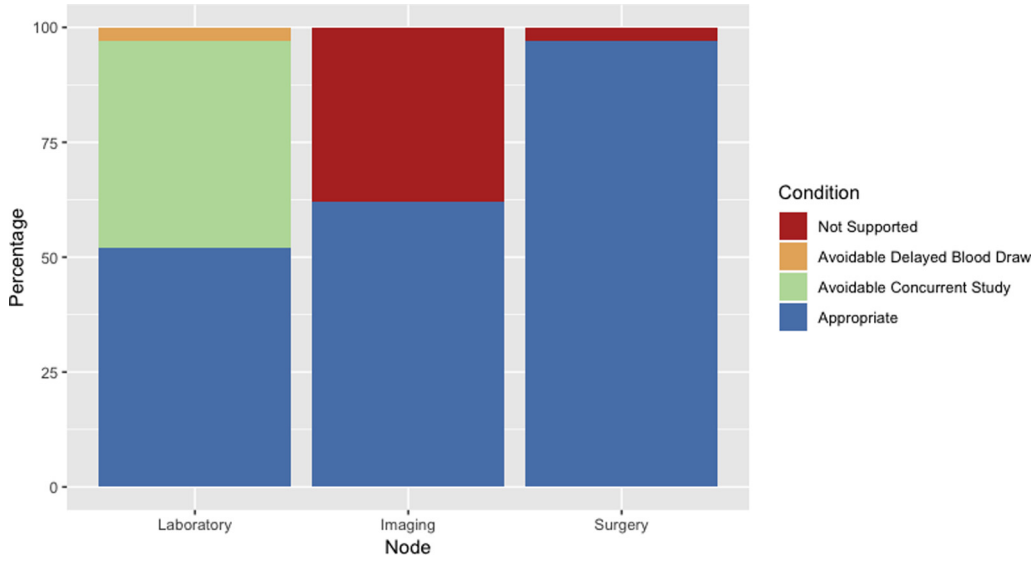

Fig 3. Areas for improvement. Relative opportunity for improvement for each of the CP nodes analyzed. Overall adherence to the CP nodes analyzed were 52% for laboratory testing, 62% for cross-sectional imaging, and 97% for indication or extent of surgery.

make in conjunction with their physician are supported by the best available evidence.

More broadly, we have demonstrated an approach to CP nodal analysis. Our approach consisted of identifying nodes where we felt opportunities for improvement would be present, obtaining relevant data to determine the current state as compared with the ideal state represented by the CP, identifying areas of CP deviation, and identifying and implementing long-term, systems-level solutions while also identifying the greatest-impact, short-term interventions, when possible. This approach is generalizable, repeatable over time, and in effect, considers each node a process measure, asking "Are we doing what we are supposed to do?" Surprisingly, few prior studies in the house of surgery have undertaken such an approach and typically dealt with smaller populations and focused on postoperative care.[10,19] This is likely due to a natural inclination of surgeons to focus on outcome measures, such as LOS and complications. Regardless, such an approach should be considered given the increasing number of CPs and the importance of high-value care, particularly for preoperative workup, where avoidable expenditures may not be noticed if the focus is only on clinically apparent outcomes.

It is fair to note that this analysis required considerable work by multiple individuals with a relatively high level of medical knowledge. A research resident and fellow in endocrine surgery performed the chart review and assessments of CP adherence with a senior endocrine surgeon to adjudicate cases of uncertainty. Increased integration of CPs into the EMR might facilitate future CP analyses. Physicians could indicate when a patient is worked up or treated according to a CP and could document reasons for deviation through either standardized order sets or templated notes. This possibility would simplify identification of patients for whom the CP is applicable and potentially increase CP awareness and adherence. Further collaboration with quality-improvement specialists may be of benefit, and it is possible that financial savings would cover costs of hiring additional quality-improvement staff to focus efforts on CP maintenance.

At the time of this study, the analyzed CP had been in place for >4 years. Although CP analysis should likely occur more often than this, we do not have empirical data to suggest an ideal, generalizable interval. Such intervals would depend on the number of patients, practitioners, and locations to which the CP applies; complexity of analysis; and potential clinical and financial costs of non-adherence. CPs should be updated regularly to reflect the guidelines on which they are based and at the discretion of the individuals charged with design and maintenance of the CP when sudden and substantial clinical advancements occur. Annual review and updates of CPs would be a reasonable upper limit to ensure CP adherence and relevance, and consideration of appropriate intervals and strategies should occur during the design and consideration of the CP.

One limitation is that a single health enterprise was examined, and thus, our specific results may not hold true in other settings. Although other institutions likely share inefficiencies in the diagnosis and treatment of thyroid nodules, specific causes, frequencies, and associated costs probably vary. However, similar analyses could be undertaken at any institution and using any CP, with system-specific initiatives in quality improvement to follow. Use of ICD-10 codes introduces some uncertainty into this study, particularly for laboratory analysis where chart review was not performed. Patients may have been misclassified if ordering providers did not enter specific diagnoses. For example, potential cost savings may be underestimated if a diagnosis of "hyperthyroidism" was entered rather than "toxic multinodular goiter." Overestimation may have occurred by including patients with ICD-10 codes corresponding to cancer diagnoses because they may undergo postoperative TSH surveillance unrelated to nodular diagnosis. Excluding cancer diagnoses and goiter diagnoses without specific mention of nodularity, over 53% of the ICD-10 codes corresponded clearly to a nodular thyroid condition. Regardless, conversion to reflex TSH testing even for non-nodular conditions would likely be cost effective and could decrease subsequent blood draws. As mentioned, physician documentation is not always clear. We have attempted to be precise and fair in describing CP deviations.

In conclusion, given the proliferation of CPs and their potential to decrease variations in care, improve patient outcomes, and decrease costs, CP nodal analysis should be considered as a method of CP maintenance and identification of opportunities for quality improvement.

Funding/Support

No external funding was received for this work.

Conflict of interest/Disclosure

The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article.

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Discussion

Dr Samuel Snyder (Harlingen, TX): Thank you for the excellent study. It was very well presented. The Cleveland Clinic group is to be applauded for the first-ever study evaluating compliance with a clinical pathway on the management of thyroid nodules over a large health care system incorporating multiple hospitals in 2 states and multiple medical and surgical specialties.

You used the 2015 American Thyroid Association (ATA) management guidelines. Clinical pathways have nodes similar to decision points that can be evaluated for compliance, and you have chosen 3 nodes to evaluate: laboratory testing, imaging, and surgery.

You have determined a potential savings of greater than 120,000, principally from eliminating nonreflexive T3/T4 testing, assuming that there was complete adherence to the clinical pathway, an auspicious goal.

The ultimate aim of this study's evaluation is to change practitioner behavior by reeducation on the best practice clinical pathway. This can be a difficult and time-consuming task, which inherently has its own invisible negative cost.

I must admit that thinking of my own practice location, I can see many of the same inappropriate testing and surgery occurring across multiple specialties. I agree, then, with the concept of clinical pathways to enhance patient care, streamline patient evaluations, and eliminate inappropriate surgical management that can lead to added cost and complications.

I have a few tough questions for the authors.

1. Follow the money. Didn't the Cleveland Clinic get paid for the extra testing and practitioners credited with income generation? Should you negatively reinforce this behavior with noncharging the patient for inappropriate testing or surgery that is not within the clinical pathway guidelines?
2. There's more to this. You chose 3 nodes to evaluate, but there are others in the 2015 ATA guidelines. Why did you not include the appropriate selection of thyroid nodules for fine-needle aspiration based on ultrasound findings and size? It seems that there could be potential cost savings here.
3. Who does what? I agree with high-volume endocrine surgeons doing more of the surgical care since they are more likely to follow the clinical pathway. How do you plan to negatively influence low-volume surgeons from doing thyroidectomy surgery?
4. Lastly, the ultimate conclusion. Your study ended in June, data analyzed, and recommendations for change made. Can you give us an update on how well you have done in improving adherence to the clinical pathway? Were there unforeseen problems?

Thank you for this excellent and very thought-provoking study, and I thank the Central Surgical Society for the opportunity to review and comment.

Dr Samuel Zolin: Thank you very much for those questions. To address the question of compensation or charging patients, standardizing care is still a work in progress. The purpose of this study was to establish a baseline and to give ourselves a report card on our performance. Our aim should be to prevent those instances of nonindicated testing from happening in the first place. Ideally, this will happen as we start to implement structural changes and by physicians starting to receive feedback on their performance.

I think once we exhaust those positive measures, then potentially that sort of negative reinforcement could be considered.

For the second question about looking at fine-needle aspiration, I do agree, we've not identified all the potential inefficiencies, even in this care pathway. What we've presented today is a very simplified view of it. We presented labs, imaging, and surgery, but you suggested a fourth category, which would be procedural testing, and I think that looking at that could be beneficial as well.

Something that you alluded to was surgeon volume, which we talked about more in the manuscript. We did note that deviations from the care pathway were more likely to be seen by lower-volume surgeons.

Our goal in this study, however, was not to negatively influence surgeons from performing operations but rather to encourage surgeons and others coming into contact with these patients to positively impact value of care. It's ultimately up to individual surgeons to determine their scope of practice, but value to patients can be maximized when the processes of care are overall consistent between providers.

We're still working on standardizing use of reflex TSH, and we have improved access to multidisciplinary conferences and tumor boards. So those are the 2 main things that we've done so far. At this point, we've not repeated this analysis to see our outcomes, but we look forward to sharing our results once we have them.

Dr Peter Angelos (Chicago, IL): I think that this is a great paper and a really interesting idea. I have some concerns, though, with the idea that the guidelines are, in fact, correct and any deviation from the guidelines is inappropriate. I raise this issue because we all know that guidelines change over time. If we all followed the guidelines (even influential guidelines like the ATA thyroid cancer guidelines) 100% of the time, there would never be a new set of guidelines. If we all followed the current guidelines, there would never be data to suggest that anything other than following the guidelines was correct.

I understand the idea of streamlining and having a uniform process, but it does seem like we're on perhaps a slippery slope if we have the electronic medical record prompting physicians to make choices according to guidelines rather than perhaps focusing more on clinical judgment for the individual patient.

Dr Samuel Zolin: Yes, I hear your concern about the fact that guidelines are not as up to date, potentially, as the field in general tends to be.

I think the point that the study makes is that care pathways require maintenance. That involves the people who design the care pathway updating it as new evidence comes out and as practice changes. It also includes people who are practicing taking care of patients to whom the care pathway applies utilizing it. I think there is an interrelationship there.

So I agree. The care pathway will never apply to 100% of patients, but the goal is that it covers the vast majority and that it does so in an efficient and high-quality manner.

Dr Steven De Jong (Maywood, IL): Did you look at how often you had to repeat the testing and imaging completed at outside hospitals and how that might affect your results?

Secondly, should your study conclusions suggest when a primary provider should ideally refer patients immediately to the specialist before the MRI, CT, or other expensive testing is done?

Dr Samuel Zolin: Thank you for those questions. I'll answer the second one first.

Our care pathway does recommend referral to either an endocrinologist or endocrine surgeon very early on in the workup prior to imaging. So, in theory, primary care providers should be referring those patients rather than ordering the studies themselves.

In terms of number of times that imaging had to be repeated, we did not look at that specifically with regard to imaging that had been obtained prereferral, but some of the CT scans that I presented as inappropriate today were ones that were repeated after other recent imaging had demonstrated the finding that was being investigated. For example, performing a CT neck to look for tracheal deviation after a CT chest within the last year had already demonstrated that finding. Those studies were not really adding to the overall value of care.