Improving Clinical Decision Support for Lung Cancer Screening in an Electronic Health Record

Nicholas Riley, MD, PhD, Peter J. Greco, MD,
Yasir Tarabichi, MD, MSCR, David C. Kaelber, MD, PhD, MPH[1]
[1]Center for Clinical Informatics Research and Education, The MetroHealth System, Case Western Reserve University, Cleveland, OH

What might the attendee be able to do after being in your session?

The attendee should understand effective clinical decision support strategies for lung cancer screening orders.

Description of the Problem or Gap

Annual low dose CT (LDCT) for lung cancer screening (LCS) has been a covered Medicare preventive service since 2015[1]. LCS eligibility criteria are more complex than those for other preventive services, and are likely responsible for low utilization of LCS nationally[2]. Of these criteria, a shared decision-making requirement unique to LCS has been particularly challenging[3]; EHR tobacco smoking history is often insufficiently accurate for use in LCS eligibility[4].

Our health care system (The MetroHealth System, Cleveland, OH) has offered LDCTs since 2013 and clinical decision support (CDS) evaluating LCS orders against Medicare eligibility criteria since 2016. Through three versions of CDS, we sought to address established gaps in both generalist and specialist knowledge regarding LCS indications, risks and benefits[5], reducing ineligible LCS orders while guiding clinicians to the correct imaging study.

Methods

Our CDS serves primarily to confirm eligibility for LCS based on age, tobacco smoking history (current or former smoker, pack-years and years quit), the absence of lung cancer screening signs or symptoms and documented completion of shared decision-making. For orders it judges ineligible, CDS recommends an alternate study or the removal of the order. A clinician can always elect to override CDS and sign the order.

In our initial CDS (version 1), eligibility criteria were not exposed in the EHR ordering interface. Instead, upon signing a blank LCS order, the clinician confirmed eligibility through a "wizard" style interface presented in a modal pop-up window. Tobacco smoking history and age were prepopulated from the EHR. The clinician could update smoking history from within the wizard, but changes were not propagated back to the EHR as structured data.

In our second CDS version, the eligibility criteria were presented in the EHR ordering interface through a series of grouped checkboxes. Smoking pack-years and years quit were presented in the order as text fields, prepopulated from the EHR. Unlike in the first version, a fully specified LCS order meeting eligibility criteria could be signed directly without any interaction with the wizard, while incompletely specified orders would prompt the wizard to further interview the clinician.

Our current, third CDS version represents the eligibility criteria as a series of interactive, cascading required questions in the EHR ordering interface. Unlike in prior versions, this design spares clinicians the need to enter further information once the patient does not meet LCS criteria. For example, the order first asks whether the patient has signs or symptoms of lung cancer; if the answer is "yes", or if the patient's age makes them ineligible, no further questions appear, and CDS either recommends removing the LCS order or a diagnostic chest CT as appropriate. Should the patient have a recent positive lung cancer screening warranting follow-up rather than annual screening, additional history is not collected, and an alternate study recommended. Unlike in version 2, the order cannot be signed without answering these questions, therefore the wizard no longer appears except when recommending another study.

To evaluate CDS performance, we extracted from our EHR every LCS order placed and not later cancelled by the ordering clinician since CDS was deployed. We retrospectively determined if each order included information which would render it eligible, simulating an ideal CDS. A signed, yet ineligible, order either represents failure of the CDS to extract eligibility criteria from the order, or failure to effectively inform the clinician as to why the order is ineligible.

Results

Table 1 includes the percentage of orders satisfying each eligibility criterion and all criteria based on our retrospective analysis (ideal CDS), eligibility as determined by the actual CDS in use, and the total orders processed by each CDS version. There was a statistically significant improvement in actual versus ideal CDS eligibility determination with CDS version 2 ($p < 0.001$). Table 2 summarizes differences between the LCS order and EHR's smoking history.

Table 1. LCS orders satisfying eligibility criteria by CDS version.

CDS version	Date deployed	Orders satisfying eligibility criteria			Orders satisfying CDS			Order count
		Age	No signs/symptoms	Smoking history	Ideal	Actual	Difference	
1	June 2016	97.2%	91.8%	89.1%	85.4%	80.8%	4.6%	2130
2	June 2018	99.2%	93.1%	92.8%	87.5%	85.4%	2.1%	1454
3	October 2019	100.0%	96.6%	85.8%	85.8%	84.4%	1.4%	212

Table 2. Comparing pack-years in LCS orders versus the EHR's tobacco smoking history as of the order date.

CDS version	Order pack-years > EHR pack-years	Order pack-years < EHR pack-years	Order pack-years = EHR pack-years
1	26.4%	7.7%	49.4%
2	19.7%	3.3%	65.9%
3	13.7%	6.6%	62.2%

Discussion of Results

Some clinicians using CDS version 1 would enter relevant clinical information in the empty order rather than in the wizard. As CDS only evaluated data from the wizard, this resulted in orders incorrectly being determined ineligible.

Version 2 reduced ineligible LCS ordering due to the presence of lung cancer signs/symptoms and improved documentation of eligible smoking history. As shown in table 2, smoking history was frequently updated only within the order and not (manually) propagated back to the EHR.

Version 3 has been successful thus far in further reducing ineligible orders due to age or lung cancer signs/symptoms. However, early results suggest the percentage of orders with insufficient smoking history has increased from version 2. We suspect that by removing the wizard's prompts for tobacco smoking history, we no longer make it as obvious how to update this history. We are currently in the process of revising our CDS to incentivize updating the EHR's structured tobacco smoking history, rather than limiting the utility of updated history to a single LCS order.

Conclusion

LCS presents challenges to CDS including nuanced eligibility criteria and well-documented gaps in patient and clinician knowledge. While our CDS has improved, much work remains in building an integrated LCS workflow.

Attendee's Take-away Tool

The attendee will be provided with a flow chart depicting our version 3 LCS CDS.

References

1. Centers for Medicare & Medicaid Services. Decision Memo for Screening for Lung Cancer with Low Dose Computed Tomography (LDCT) (CAG-00439N). 2015.
2. Carter-Harris L, Gould MK. Multilevel Barriers to the Successful Implementation of Lung Cancer Screening: Why Does It Have to Be So Hard? Ann Am Thorac Soc N Y. 2017 Aug;14(8):1261–5.
3. Brenner AT, Malo TL, Margolis M, Lafata JE, James S, Vu MB, et al. Evaluating Shared Decision Making for Lung Cancer Screening. JAMA Intern Med. 2018 Oct 1;178(10):1311–6.
4. Modin HE, Fathi JT, Gilbert CR, Wilshire CL, Wilson AK, Aye RW, et al. Pack-Year Cigarette Smoking History for Determination of Lung Cancer Screening Eligibility. Comparison of the Electronic Medical Record versus a Shared Decision-making Conversation. Ann Am Thorac Soc. 2017 Apr 13;14(8):1320–5.
5. Triplette M, Kross EK, Mann BA, Elmore JG, Slatore CG, Shahrir S, et al. An Assessment of Primary Care and Pulmonary Provider Perspectives on Lung Cancer Screening. Ann Am Thorac Soc N Y. 2018 Jan;15(1):69–75.