Improved Diagnostic Echocardiographic Analysis and Reporting Quality using Decision Support

Neil L. Greenberg, PhD, Cleveland Clinic; Richard A. Grimm, DO

Background

Echocardiography is critically dependent on the skilled acquisition and interpretation of the data acquired. Guidelines developed under the care of the echocardiographic community (1) and standards mandated by accrediting bodies (2), are all important in driving quality and improving the field of echocardiography. However, without mechanisms to monitor the process and assure quality control, the degree at which a laboratory is successful at delivering the best outcomes is unclear. Figure 1 demonstrates the percentage of the 2500 total exams reviewed in our QA peer review process over 2 years that had missing data. Figure 2 demonstrates some key parameters reported in our echo template with missing data over a 6 month period. Our reporting template has a mandatory component that aids in reporting an EF for each exam. EF is reported on 99.4% of all complete echo exams. However, while we would like to have a segmental functional assessment on all complete echocardiograms, this is not a simple mandatory field in the reporting environment and just over 28% of all exams did not have this assessment completed. Two other sampled variables that should be valued when moderate valve disease is identified, are mitral valve regurgitant orifice area (MV ROA) and aortic valve (AV) area. Given that our echo reporting template has a default AV area reported but requires MV ROA to be specifically reported, it is not surprising that the degree that MV ROA is unreported is much higher. Wall motion index (WMI) and MV ROA reporting are two parameters for which reporting could be greatly improved. We have sought to incorporate rules or decision support during the echocardiographic structured reporting process to ensure completeness and accuracy.

Figure 1

<table>
<thead>
<tr>
<th>Key Area</th>
<th>missing data</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV size</td>
<td>0.5%</td>
</tr>
<tr>
<td>LV sys fx</td>
<td>0.7%</td>
</tr>
<tr>
<td>LV dias fx</td>
<td>4.5%</td>
</tr>
<tr>
<td>LV seg fx</td>
<td>9.7%</td>
</tr>
<tr>
<td>RV size</td>
<td>0.5%</td>
</tr>
<tr>
<td>RV fx</td>
<td>0.5%</td>
</tr>
<tr>
<td>AI</td>
<td>1.2%</td>
</tr>
<tr>
<td>AS</td>
<td>1.8%</td>
</tr>
<tr>
<td>MR</td>
<td>0.9%</td>
</tr>
<tr>
<td>TR</td>
<td>0.8%</td>
</tr>
<tr>
<td>RVSP</td>
<td>3.4%</td>
</tr>
<tr>
<td>Ao</td>
<td>2.6%</td>
</tr>
<tr>
<td>Prior compare</td>
<td>12.3%</td>
</tr>
</tbody>
</table>

Table 1: Percentage of QA exams demonstrating disagreement or missing data
Implementation of decision support rules has been a recent addition to our structured reporting process. The process is performed using Siemens syngo Dynamics (version VA20B) cardiovascular image and structured reporting system enhanced with a decision support rules implementation using Microsoft Biztalk. We began with a set of very simple rules including checks for completeness of the echocardiographic report under various situations as well as checks for consistency between measured variables and descriptive observations (such as EF and systolic function). The architecture of biztalk rules is demonstrated in Figure 3 where the list of specific rules that make up a policy is defined in the upper left, and a rule example for EF vs LV function is show on the right. A rule is structured such that IF conditions are met, THEN actions are taken. We also have included checks on the billing process (a key area that can be greatly expanded in scope) and begun to address other consistency parameters, included the severity of mitral stenosis and the measured regurgitant orifice area (ROA). We have also enabled triggers that run the rules automatically when the sonographer completes a draft report and when the physician verifies a final report. When rules are executed, the results are displayed to the user in the popup show in Figure 3. If there is an issue, it is displayed to the users and they are asked to investigate the issue and resolve if possible. If the issue cannot be resolved, there is a mechanism to add a reason for the inconsistency and sign the report. Only 2% of exams have not passed the check of the implemented set of rules since this was put in production. These comments have fallen mostly into 2 categories (structures not well seen and ROA discrepancies). Changes to the rules to handle structures that are not well seen (but make sure this is documented) are planned along with a finding to describe and document the reason why ROA has not been calculated or reported.
Figure 3 Close Ups

Policy Explorer
- Version 1.6 - Deployed
  - Cleanup_Popup_logic
  - ECHO Billing 3D check
  - ECHO Billing Contrast check
  - ECHO Billing Sonographer Name
  - ECHO Billing Strain check
  - ECHO Complete Ao size
  - ECHO Complete AV area
  - ECHO Complete BP
  - ECHO Complete Height Weight
  - ECHO Complete HR
  - ECHO Complete LA size
  - ECHO Complete LV diastolic function
  - ECHO Complete LV size
  - ECHO Complete MV ROA
  - ECHO Complete RA size
  - ECHO Complete Regional Wall Motion
  - ECHO Complete Rhythm
  - ECHO Complete RV size
  - Location check
  - LVEF_Reported
  - LVsize_Reported
  - MVROA_Reported
  - STRESS Blood Pressure
  - STRESS METS
  - STRESS Result
  - TEE Staff
  - TEE Stop Time
- CCHS sD ECHO MV Jet
- Version 1.1 - Published
- CCHS sD ECHO Policy

Facts Explorer

Properties
- LVEF_Reported
  - Name: LVEF_Reported
  - Priority: 50

Name
Name of the rule.
Discussion

The decision support tool presented can greatly enhance the echocardiographic reporting process, which is often complicated by complex patient specific findings and compliance with protocols and guidelines. An example of the reporting environment is shown in Figure 5 with a few issues as detected by the rules process. The tool can assist the provider in integrating information in a consistent fashion to produce a high quality product. The capabilities to construct rules that can be utilized in real-time with syngo Dynamics structured reporting allows for a quality control mechanism that is much different than other approaches and will allow the traditional QA process to be fine-tuned on acquisition and interpretation as the importance of completeness and accuracy of the report is increasingly better defined and supported by this method.
Figure 4

- Study performed on 12/16/2016

Policy Execution DateTime: 12/16/2016 12:53:27 PM
Policy Execution Result: Success

TEE Results
- Staff not confirmed
- Stop Time missing

STRESS Results
- Stress Result Missing
- Blood Pressure Missing
- METS Missing

Billing Issues
- 3D documentation missing
- Strain documentation missing
- Contrast documentation missing
- Location does not match order
- Sonographer name issue
- other

Discrepancy between Observations and Measurements
- LV systolic function and EF
- LV size and EDV index
- Pulmonary hypertension and RVSP
- LA size and LA EDVi
- MR severity and ROA
- other

ECHO Complete Missing Data
- Blood Pressure
- Heart Rate
- Rhythm
- Height + Weight
- LV size + function
- RV size + function
- Regional Wall Motion
- Diastolic Function
- LA size
- RA size
- Ao size
- MV ROA
- AV area

Close
Figure 5

Cleveland Clinic
Sydell and Arnold Miller Family Heart and Vascular Institute

Echocardiography Reports: Transthoracic Echo
Main Campus JI-1
Date of service: 12/16/2016 5:45:40 PM
Accession #: test
Location: Chest Pain

Technologists: Neil Greenberg PhD
Interpreting physician: Richard A Grimm DO

PATIENT:
Name: test
HNI: test
Age: 0

Primary rhythm: sinus.
Height: 152.40 cm
Weight: 73.56 kg
BMI: 35.12 kg/m²
Heart rate: 60 bpm
Blood pressure: 120/80 mmHg

MEASUREMENTS:
Max aortic dimension: 2.0 cm
Indexed: 1.14 cm²/m²
Ejection Fraction: 90% (visual est.)
Normal: EF > 52

FINDINGS:
LEFT VENTRICLE
The left ventricle is normal in size.
Left ventricular systolic function is normal.
Baseline left ventricular diastolic function is normal.

RIGHT VENTRICLE
The right ventricle is normal in size.
Right ventricular systolic function is normal.

LEFT ATRIUM
The left atrial cavity is normal in size.

RIGHT ATRIUM
The right atrial cavity is normal in size.
Conclusion

The feedback provided by the decision support mechanism will help improve the quality of sonographers and physicians throughout their training and practice. The completeness and accuracy of reports should also have an overall positive impact on outcomes for our patients. One future possibility would be in the comparison of data from prior exams. The decision support engine could compare current and prior data and assess changes that could be presented to the providers to check accuracy of measurements and flag significant changes much more easily than can be done today.

References


Keywords

decision support; quality; echocardiography