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Using Informatics to Improve Autism Screening in a Pediatric Primary Care Practice

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Abstract

Background: According to the most recent report from the CDC (2018), autism spectrum disorder (ASD) affects approximately one in 59 children in the United States (U.S.). In 2007, the American Academy of Pediatrics (AAP) issued a strong recommendation for all primary care providers to screen children for autism, using a validated tool, at the 18 and 24-month well-child visits, in order to begin the referral process for more formal testing, and intervention, promptly. Despite the strong stance of the AAP and evidence supporting the importance of early intervention for children with ASD, not all primary care providers are screening for ASD or developmental delay.

Purpose: To improve the percentage of eligible children, presenting for 18 and 24 month well-child visits in a pediatric primary care office, who are screened for ASD, by integrating the Modified Checklist for Autism in Toddlers (M-CHAT) screening tool into the electronic medical record with tablets. The specific aims were to increase the percentage of children screened and improve the documentation of the screens performed.

Methods: This quality improvement project utilized a before-after quantitative design to support the improvement. Reports were obtained for three months prior to the implementation of the tablets and process change, and again for three months following the implementation. Manual chart reviews were also performed to verify the data from the reports. The definition used for complete screening for this project included 1) presence of the completed screen in the medical record, 2) provider documentation of the result, interpretation, and plan if indicated, and 3) CPT code entry for charge capture completed in the electronic medical record.

Results: The results of the project revealed improvements in overall percentages of eligible children screened for autism at D-H Nashua Pediatrics. The percentage of complete screening increased from 64.7% to 73.9% following the implementation of the project, a change which is statistically significant (t=31.6105, df=16,p=0.05). Each individual element was also tracked and those results showed that 1) the completeness of provider documentation related to the screening increased from 93.6% to 96% (t=41.3321, df=16, p=0.05) and 2) the M-CHAT screen was present in the electronic health record (EHR) 98.9% of the time, which was an increase from 84.6% (t=295.4084, df=16, p=0.05). The charge capture completion rate remained statistically unchanged at 76.5% (t=0.4664, df=16, p=0.05). Additionally, only one screening was noted to be missed altogether, out of 280 eligible children. Prior to the project, there were four missed screenings (out of 156 eligible children) captured by the chart reviews conducted over three months prior to the implementation of the project. Overall, the results show that the project resulted in an increase the percentage of M-CHAT screening, an increase in the presence of source documentation in the electronic health record (EHR), and more complete provider documentation related to the screening.

Keywords: Informatics, autism, ASD, M-CHAT, screening, pediatrics

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Problem Description

Autism Spectrum Disorder (ASD) is a disorder impacting approximately one in 59 children in the U.S. (CDC, 2018). ASD significantly affects the individual, the individual's family, and society, in multiple ways. ASD may negatively affect the quality of life of the child (de Vries, 2015), the quality of life of the parents (Vasilpoulou, 2016), and place financial burden on families and society (Buescher, Cidav, & Knapp, 2014; Rotholtz, Kinsman, Lacy, & Charles (2017).

There is a substantial body of research concluding that early diagnosis and subsequent intervention has significant positive influence on the child's developmental outcomes. The timing of early diagnosis related to ASD has been established as ideally before the third year of life, during which time synaptic density peaks, and prior to synapse selection for strengthening or deletion around the start of the third year of life (Zwaigenbaum, 2015). Research also shows that formal, validated screening instruments are the most effective tools to find a potential developmental concern, especially given the current lack of a cause and therefore specific diagnostic test.

In 2007, Johnson and Myers, for the American Academy of Pediatrics (AAP), published a clinical report in follow-up to an AAP policy statement on developmental surveillance that had been published one year earlier. The goal of the clinical report, as well as the prior policy statement, was to assist providers in the early recognition of developmental findings specific to ASD. The report outlined the importance of early identification of developmental delays in order

to start early intervention as soon as possible. The report also urged providers to use formal

screening tools, citing the inaccuracy of provider impressions that are based on clinical

interactions alone. The specific AAP recommendation was to screen all children for ASD using

formal ASD-specific screening tool, at the 18-month well-child visit, to repeat the screening at

the 24-month well-child visit, and to screen as needed if concerns arise. The AAP also advised

pediatricians to be timely in acting upon all positive screens. In 2016, the AAP reaffirmed their

stance on the importance of ASD-specific screening for all children at both the 18 and 24-month

well-child visits, while also agreeing with a statement from the U.S. Preventive Services Task

Force (USPSTF) that more research is needed into the efficacy of universal screening in

detecting ASD and other developmental disorders.

    In 2015, Zwaigenbaum, et al. published the panel recommendations garnered from a

working group of international multidisciplinary healthcare providers and researchers with

expertise in ASD. The group met in 2010 with the goal of performing a literature review to gain

consensus on 1) the best practice for developmental screening, and 2) addressing barriers to said

screening. The results of the panel review were 1) the Checklist for Autism in Toddlers (CHAT)

could not be recommended for its low sensitivity, 2) another modification of the CHAT, the Q-

CHAT, needed more validation, 3) the Early Screening for Autistic Traits (ESAT) was

determined to have a low case detection and positive predictive value (PPV) of only 0.25, and

therefore could not be recommended, 4) additional tools such as the FYI and Baby and Infant

Screen for Children with Autism Trait to require more data before a recommendation for use can

be made, and 5) the M-CHAT, the most studied, translated, and validated tool, had a PPV of 0.54

for ASD and 0.98 for any developmental disorder, and therefore could be recommended. The

panel also found that the revised versions of the M-CHAT, the M-CHAT-R (R for revised) or M-CHAT-R/F (R/F for revised with follow-up), improved the overall ASD detection rate of the M-CHAT and reduced the initial screen-positive rate, making the newer revisions of the tool better due to a lower rate of initial false-positives.

Despite the strong stance of the AAP and the evidence behind the importance of early intervention for children with ASD, not all primary care providers are screening for ASD or developmental delay. According to Campbell, et al. (2017) and Keil, Breunig, Fleischfresser, and Ofthedal (2014), the percentage of primary care providers in the U.S. screening for ASD using a formal tool ranges from zero to 99%.

Available Knowledge

A systematic review (SR) was conducted in an attempt to ascertain the actual percentage of primary care providers in the U.S. who are adhering to the AAP recommendations to screen all children for ASD twice by 30 months of age. The SR search strategy involved the databases PubMed, Medline, CINAHL, Cochrane, ProQuest, PsyInfo, and Google. In addition, all references from full-text articles were reviewed. The search words included: M-CHAT OR M-CHAT-R OR M-CHAT-R/F OR Modified Checklist for Autism in Toddlers; Autism AND screening AND disparit*; Autism AND screening AND "cultural groups" OR "ethnic groups" OR race. The search included all (quantitative) research studies, published and not published, including randomized controlled trials, descriptive studies, and quasi-controlled studies; grey literature including theses and presentations. The date range of the search starts the year the AAP guidelines were published in 2007 to present (2018). Studies in all languages included. A total of

605 articles were found for the initial search, and 418 articles remained after merging duplicates.

Titles and abstracts for the 418 articles were screened independently by two researchers using the

PICO and inclusion and exclusion criteria. Consensus was attained and 90 articles were

chosen for full text review. All 90 full-text articles were reviewed independently by two

researchers for inclusion. Any disagreement between researchers was fully resolved and again

consensus achieved. After consensus, 84 articles were excluded. Figure 1 shows a total of six

studies were included for review. Of the six studies included in the SR, five of the studies were

survey studies, and one was a quasi-experimental before-after QI study.

Figure 1. SR PRISMA diagram

The results of the SR revealed that the overall percentage of children screened at 18 months ranged from 59.8% to 99%, and screening at 24 months ranged from 44% to 99%. The overall percentage of children screened for ASD using the M-CHAT and for both 18 and 24 months ranged from 38% to 99%. With regards to the utilization of the M-CHAT as the validated tool, the use of the M-CHAT ranged from 45% to 100% for five studies, with one survey study not explicitly stating the percentages for the type of screening tool used. The SR supported that screening for ASD using the M-CHAT was not being done per the AAP recommendations.

A literature review (LR) was also conducted to support the position that there is an advantage to using electronic screening over a paper modality. To expand the results, the search was not specific to screening for ASD. The LR search included the databases CINAHL, Medline, Cochrane, and PubMed. The first search words included "primary care" + electronic + questionnaire, and yielded 2145 articles. The second included the search terms "developmental screening" + pediatrics + electronic and yielded 41 results. Of the 2166 non-duplicate abstracts, figure 2 shows that of the 34 articles retrieved for full text review, nine were included for synthesis. One researcher conducted the search, screen, and selection.
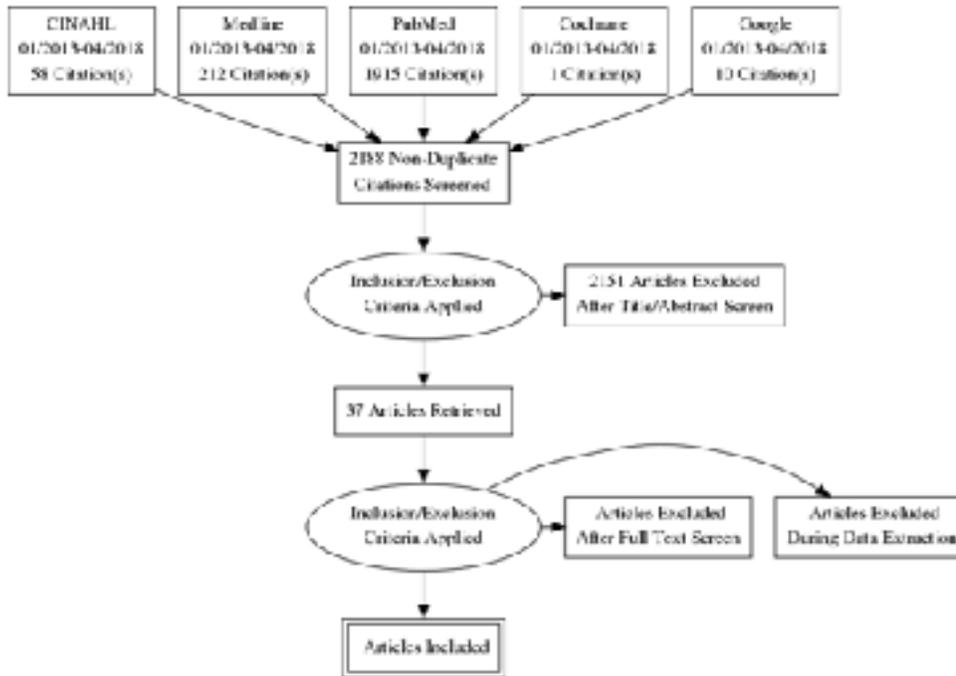
Figure 2. PRIMSA Diagram

The results of the LR reveal that paper screening may be inefficient, and the manual

aspect of paper screening, scoring, and documenting, is prone to error (Harrington, Bai, &

Perkins, 2013). A study by Brooks, Haynes, Smith, McFadden, and Robins (2016) found a 58.5%

increase in M-CHAT screening by changing from a paper modality to a web-based electronic

version of M-CHAT, as well improvements in documentation and accuracy of referrals. A study

by Campbell, et al. (2017) showed that the accuracy of documentation improved from 54% to

92% following the change from paper M-CHAT modality to electronic delivery. This is similar to

a study by Brooks, Haynes, Smith, McFadden, and Robins (2016) which found a 58.5% increase

in M-CHAT screening using web based electronic version of M-CHAT, as well improvements in

documentation and accuracy of referrals. A study by Aleem, Torrey, Duncan, Hort, and

Mecchella (2015) found that depression screening, using a validated tool presented to patients on

tablets, also increased screening rates. Carrol, Bauer, Dugan, Anand, Saha, and Downs (2014) found that adding electronic clinical decision supports into the electronic medical record as reminders to screen increased screening rates for general developmental delay significantly, which also speaks to the effectiveness of using technology to improve processes. These studies help to demonstrate how quality of care may be enhanced by utilizing technology to improve a process such as screening for ASD in toddlers.

LR results also yielded insight into patient preference for electronic or paper. Goodyear-Smith, Warren, Bojic, and Chong (2013) surveyed patients regarding lifestyle risk factors and found that 97% felt a tablet was easy to use for completing questionnaires. Harrington, Bai, and Perkins (2013) found parents preferred the iPad format of the M-CHAT questionnaire the over paper version. Barentsz, et al. (2014) looked at the usefulness of electronic questionnaires for breast cancer patients and found that 1) younger patients and patients with higher education attainment preferred electronic over paper, and 2) electronic versions improved completeness of screening for patients who were inpatient (but not outpatient). Harrington, Bai, & Perkins also found that electronic modality with automatic scoring decreased scoring errors compared with the manual scoring needed for paper screening. Of note, an important consideration regarding modality of screening questionnaires is whether they are equally accurate. Belasario, Jamsek, Huckvale, O'Donoghue, Morrison, and Car (2015) found no significant difference in mean overall scores between self-administered questionnaires given electronic or paper, as long as translation/transfer not altered.

Rationale

Rogers' theory of diffusion of innovation is used as the theoretical framework underpinning this DNP project. According to Rogers (1995), the rate of acceptance of an innovation is influenced by several variables, including "the perceived attributes of the innovation, the type of the innovation, the communication channels, the nature of the social systems, and the extent of the change agent's promotion efforts" (Rogers, p. 207). In his writings Rogers points out that small, more individual-level innovations are more rapidly implemented than organizational innovations that involve large groups of people.

Understanding this has been an important scaffolding for the project at Dartmouth Hitchcock Medical Center (DHMC). As the main hub of the Dartmouth-Hitchcock (D-H) system, the medical center is a large academic medical center, and the approval of a project at such a large organization involved many steps and approvals from several departments. The process for the project approval was started nearly two months before the projected commencement date, and started with the largest departments and potential organizational hurdles first. In his theory, Rogers posits that the rate of innovation is influenced by the change agent's promotion efforts, and this view has proven valuable when promoting this project in a large organization with many departments. The change agent, as an early adopter, helps influence the effort towards the diffusion level. Following the diffusion of the innovation, there may be late adopters for whom the innovation had not been easily accepted. Rogers' diffusion S curve is depicted in figure 3.
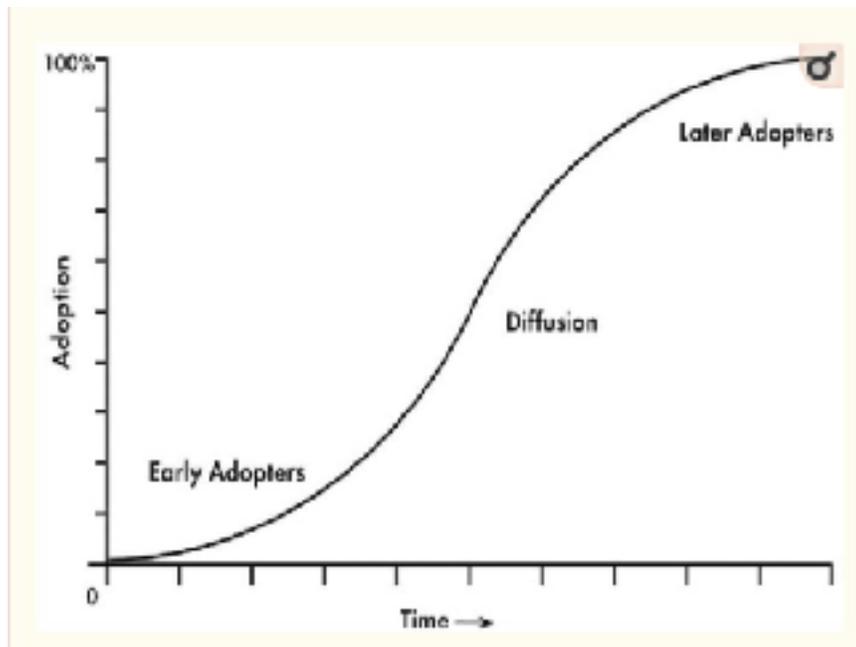
Figure 3. The Diffusion S-Curve (Rogers, 1995)

After approval of the project, the "opinion leaders" (Rogers, p. 207) were contacted. These stakeholders included the site department chair, former department chair, and manager, and their backing for this project very positively affected the rate of adoption and success. Dearing (2009) wrote of Rogers' theory and outlined 10 errors when disseminating an innovation. According to Dearing, the first error is to assume that evidence matters with potential adopters. He advises that evidence matters with the initial champion buy-in, but once opinion leaders are behind the innovation, emphasize other elements such as cost and ease of implementation. Another error outlined is the introduction of the innovation before it is ready. Therefore, ensuring thorough preparation and vetting is key. The stages of adoption specific to this project may be found in Table 1.

Table 1.

Five stages of the adoption process

Stage	Definition
Knowledge	Meetings with site stakeholders provided additional education on the M-CHAT and the revised version with follow up. Education was provided to all site members involved regarding the new process, with at-elbow support at implementation and as needed for the duration of the project. Data was collected and shared with the stakeholders throughout the project, and at the conclusion.
Persuasion	All questions were fielded, and data shared to demonstrate the improvement the new process was expected to bring. Site champion(s) worked to increase buy-in and maintain momentum.
Decision	Once the process was fully vetted, approved by the stakeholders, and the timeline agreed upon, the date for go-live was set.
Implementation	The implementation phase started with full-time, at-elbow support within the department for the first two weeks, when the process was at its inception. Assessment throughout that time revealed an increase in the comfort level with the process by the team. Once each provider/nurse had completed at least one successful screen without questions or glitches, the at-elbow support was decreased to weekly check-in and as needed support, either in person or via phone or email.
Confirmation	The feedback from the stakeholders was evaluated to help determine confirmation that the process was going well. Weekly data collection confirmed the process was overall effective and stable.

Specific Aims

Local Aim : To increase the percentage of children screened for ASD, using the M-CHAT

R/F, at 18 and 24-month well child visits, as evidenced by 1) provider documentation of the

screening, including the result with analysis and plan if indicated, in the provider's well-child

exam note, 2) the presence of the source documentation (parent-completed M-CHAT

questionnaire) in the EHR, and 3) the entry of CPT code 96110 into the EHR for charge capture,

from 64.7% to 100% within three months of implementation.

Global Aim: To develop an effective, stable process that other pediatric departments may adopt to increase the percent of children screened for ASD in their respective organization, as well as to improve the completeness of the documentation of the screen.

Methods

Context

D-H Nashua is a community group practice in the D-H system. D-H is a non-profit, research and academic medical center in the upper valley of New Hampshire, serving northern New England. D-H provides more than 1,000 primary and specialists, is one of 45 comprehensive cancer centers in the country, has a dedicated children's hospital, 24 community ambulatory centers (including Nashua), and is a level 1 trauma center with an advanced response team able to provide air and ground transport throughout northern NE. DHMC is a 396-bed, level 1 trauma center and tertiary care teaching hospital.

D-H Nashua provides primary, specialty, and urgent care, as well as ancillary services such as laboratory and radiology, to the approximately 87,000 residents of Nashua, NH (US Census, 2016), as well as the surrounding towns. The pediatric primary care department at D-H Nashua employs 11 primary care providers, including seven pediatricians, three nurse practitioners, and one physician assistant, as well as more than 20 licensed practical nurses (LPNs), and several medically-trained administrative professionals. The team provides primary care for approximately 10,000 children, and is a National Committee for Quality Assurance (NCQA) level III certified medical home.

The physical layout of the department is designed for collaboration. There are three central pods where the provider and LPN sit side-by-side during the time patient appointments are held. There is an office close to the central pod where two to three triage registered nurses (RNs) manage phone calls. The reception area is staffed by at least two medical receptionists, and there are two to three other medical secretaries at designated check-out desks.

The pediatrics department flows, without partition, into the Nashua Family Practice department, then to Nashua Internal Medicine. Other areas comprising the second floor of the six-year old building include the call center, which answers all primary care calls, and administrative offices for the scheduling coordinator, supervisors, and manager.

Interventions

This process improvement project used before-after quantitative design. Aggregate data was obtained through EHR report capabilities and verified through manual chart reviews, with results reported as percentages before and after the implementation of the project.

The pre-implementation phase of the project included obtaining organizational approval of a student project, re-establishment of employee status as required for approval, D-H Internal Review Board (IRB) approval of a QI project, securing of a clinical and faculty mentor, establishing D-H Information Systems (IS) collaboration regarding equipment and computer programming build needs, and approval from the implementation site.

The project site approval was first obtained from the department chair and the manager, and shortly thereafter a synopsis of the project was presented at a provider meeting. The meeting was a success and all providers in attendance verbalized that they were on board with the change.

Of note, it came to light at the provider meeting that the department had been using the older

version of the M-CHAT, and had not moved to the revised version that had been developed in

2013. During the meeting, many of the questions from the providers were related to questions

that they had found confusing, and it was shared that those confusing questions were actually

deleted from the revised version. Education was provided regarding the follow-up process for

new version as well, and the providers were assured that the new process would include the new,

revised M-CHAT R/F.

Once departmental buy-in was established, close collaboration was begun with the D-H

IS department to build programming rules into the EHR to automatically trigger the

questionnaire to a queue once an appointment is made within the designated parameters.

Specifically, the screen would trigger once an appointment for a well-child visit under CPT

99382 or 99392, ICD-10 Z00.121 or Z00.129, was made for a child between the ages of 16 and

26 months. The M-CHAT R/F is validated for use between the ages of 16 and 30 months, and

the ages for screening for this project were chosen catch any child that presented for an 18 or 24

month well-child visit a month or so early or late. Additionally, a provider, nurse, or staff

member could add on a screen at any time outside of those age parameters, or well child visit

codes.

A virtual visit with the principal in charge of the electronic M-CHAT implementation at

the Children's Hospital of Philadelphia (CHOP) had taken place prior to starting the project.

CHOP had moved from paper modality to tablets a few years previously as part of a government

grant. After speaking with the principal investigator for that grant, a blueprint of EHR build

parameters and needs was created, and the team in charge of informatics projects at D-H was

contacted. Once in communication with the build team lead, the build was not as difficult as

anticipated, since another office at D-H was using a similar tablet program to screen in primary

care, so the analyst was able to use some of that programming already in place.

Once the EHR build was set and tested with the new tablets and a test patient, the pre-

implementation phase continued with in-person departmental and stakeholder education, and

continued with meetings with stakeholders to determine readiness, until the go-live date arrived.

The GANTT chart in figure 4 illustrates the project schedule.
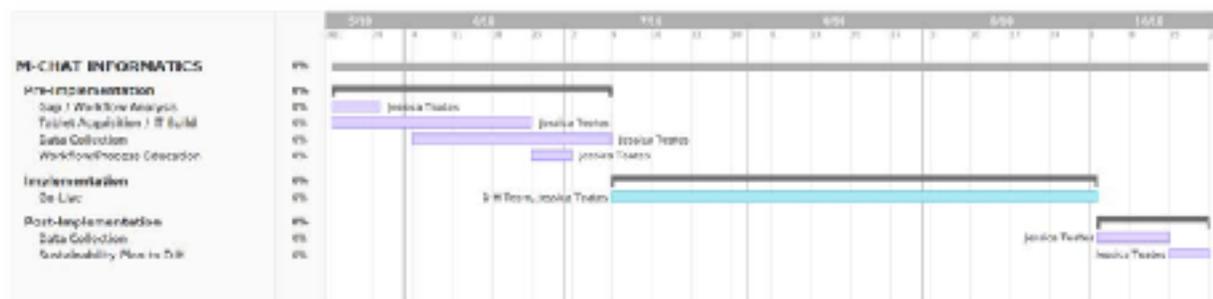
Figure 4. GANTT chart

On-site at-elbow support and guidance was in place for the first two weeks of

implementation, and support remained available via phone, email, or in person thereafter.

During the first week, there were no technical glitches, and only intermittent questions from

providers and nurses were fielded. Specific deliverables for the first week included 1) assisting

with adding a smart phrase to provider's 18 and 24-month well-child visit templates, which

would pull the M-CHAT score into the note with a generic plan which could be tailored if

needed, and 2) adding the "questionnaires" tab to the nurses' schedule so they could see if a

screen was queued, in process, or completed. In addition, since the current application was unable to highlight or bold the "incorrect" responses in the screen, providers had voiced that it was difficult for them to quickly spot the questions to follow up on. In response, small "cheat sheets" were created for providers who were interested to assist with this. The "cheat sheets" were a small reminder that all answers should be "yes" except for 2, 5, and 12, which were reversed and a "no" is the expected answer. Keeping that in mind, a quick scan of the responses should show all responses "yes" except "no" to 2, 5, and 12. Any "yes" or "no" answer outside those would need to be followed up on. Very few of the providers actually knew the screen in its entirety, and none appeared to be aware of which questions were expected to be "yes" or "no". When the process was on paper, the nurses would score the screen and use a yellow highlighter to mark the "wrong" answers on the paper screen, so providers did not actually have to know the scoring or details beyond looking at those highlighted questions. Some of the providers thought scanning the questions for "yes" or "no" in the wrong place was too much, but consensus was that given the limitation on highlighting the answers in the EHR, the process put into place to scan the results would be the best way to determine which to follow up on at this time. Throughout the 17 weeks post-implementation, the providers were able to determine the incorrect answers to follow up on, as evidenced by chart review, and no further complaints were fielded.

The only real challenge arose the first day of implementation, and was raised by the front desk secretary. Apparently, the secretary had made the assumption that the department-specific paper form, which was developed by the department and not meant to be a part of the medical record, would also be replaced by a tablet form. This had never been the plan, since all the

discussion had been solely about the M-CHAT screening on the tablet. The receptionist

verbalized that she was certain that parents would be upset at having to fill out forms on both the

tablet and paper, and demonstrated visible frustration. She was told by the chair that if a parent

is upset at the prospect of completing both paper and tablet forms, she may offer just the tablet

option. The team member was carefully supported, while also advised that she may be

projecting her views onto parents, and that it is important to keep an open mind and remain

objective.   Trying to lighten the moment while respecting her view was difficult but important.

Presentation is very important, and if the person handing out the tablet (and clipboard) shows

that they are not on board with the process, the parent's perspective may be changed. After some

discussion, the receptionist reluctantly agreed to proceed. Rounds were performed with the

receptionist that week and beyond, and the receptionist reported that parents were not refusing

filling out both as she had expected.

   The charge capture process received close monitoring throughout the implementation,

since there was not a specific change established from before the tablets were introduced.

Unfortunately, the D-H IS team did not yet have the time to dedicate to automating the charge

capture to drop once the screen was uploaded into the EHR via the tablet interface, so the process

would remain a manual one for the time being. Knowing that the pre-implementation charge

capture completion rates were poor, it was decided to work on reminders and engagement in the

process as a way to improve the charge capture completions until it could be automated by the

build team.

After the first two weeks of at-elbow support, email communication was consistently rendered on a weekly basis with the chair, department manager, and the clinical and administrative supervisors, sharing data retrieved from the chart reviews and overall checking in. Data shared included the total number of eligible children screened, and the aggregate and percentages for complete documentation, charge capture, and any missed screens. A plan was formed with the chair for her to follow up in person on any missed charge captures and missing provider notes, and therefore provider initials, appointment dates/times, and specifics on what was missing was included. Run charts were created and maintained to track progress and determine if changes were needed. At the mid-point of the implementation phase, at week 6, a simple before-after bar graph was shared with the chair and department to visualize the improvement made thus far. The chart reviews allowed for formative feedback to providers regarding missing documentation and nurses for missing charge capture.

The chart reviews clearly showed that there was one provider who presented as a "special cause variable". This provider was well known as one who does not follow the rest of the department, and therefore it was not surprising that he had missed documentation while others had not. Unfortunately, he did not use a template for his notes, and declined to have templates created for him. The department chair personally reached out to him with feedback when it was noted he missed documentation. The chart reviews and run charts show that his notes have improved over time.

Study of the Interventions

　　The run chart was chosen as a tool to 1) track the process over time, 2) show whether a change in the process is needed, and 3) indicate if any change made was successful. According to Ramsey (2015), run charts may provide time-specific information on whether the process distribution is stable, as well as if there is potential special cause variation in the process. The run charts created for each of the data measured were updated and assessed weekly. Changes made were marked and subsequent data reviewed for potential runs. Runs below the median were evident around the mid-point of the project, and a short run above the median following a change in process.

　　A simple before-after bar graph was made at the mid-point of the project as a visual for the department to show improvement at that point. The bar graph cannot, however, show improvement over time so has limited utility for a process improvement project. It was helpful to the department, however, as a quick and easy visual to show positive results for their efforts.

　　Finally, a control chart was created in an effort to detect special cause variation. Since the data is not sub-grouped, an individual control chart was chosen. An excel template created by New York University (NYU) was utilized, using +/- 3 standard deviations from the mean as the control limits. It should be noted, however, that the data used for the control chart consisted of only 17 points (weeks), not the recommended minimum of 20 (Ramsey, 2015), but this number was verified with Dr. Ramsey to be acceptable.

Measures

In order to measure the outcomes of this DNP Project, a data abstraction tool was adapted

from Agency for Healthcare Research and Quality (AHRQ) templates. According to Vassar and

Holzman (2013), the failure to use standardized data abstraction form, and the failure to create a

procedure for data abstraction are two common errors committed when performing a

retrospective chart review. The data abstraction tool shown in Figure 5 was completed for each

chart reviewed, and the aggregate results compared with the numbers obtained from the reporting

capability in the EHR.

Pt. ID	Inclusion: Is Child between 16-30 mo? 0=No 1=Yes	Inclusion: Was visit a well-child visit? 0=No 1=Yes	Data: Was M-CHAT scanned? 0=No 1=Yes	Data: Is the result/plan in note? 0=No 1=Yes	Data: Was M-CHAT billed? 0=No 1=Yes	Exclusion: Does child already have a dx of ASD?	Exclusion: Does child already have 2 completed screens?

Figure 5. Data abstraction tool

The reports retrieved from the EHR included the following search parameters: 1) dates of

service January 1, 2018 through March 31, 2018 2) all D-H Nashua pediatrics providers, 3) all

children between 16 and 26 months of age, presenting for 4) a well-child visit (CPT 99382 or

99392, ICD-10 Z00.121 or Z00.129), and 5) presence of CPT code 96110 as yes/no. The date of

abstraction was for the three months preceding the implementation, and for four months

following implementation.

The data retrieved from manual chart reviews included verification that 1) the visit was a well-child visit (ICD-10 code Z00.121 or Z00.129), 2) the child had not already received two M-CHAT screens, and 3) the screen was actually performed.

Each eligible child's medical record was also reviewed for "completeness" of documentation, including 1) the presence, or absence, of the M-CHAT (scanned into the chart for pre-project chart reviews), and 2) the presence, or absence, of provider documentation, including 2a) the result of the M-CHAT, and 2b) the plan regarding the result of the M-CHAT. The data obtained from the reporting capability in the EHR was compared against the data obtained through manual chart review for quality control.

Analysis

Quantitative data was obtained by chart reviews and EHR reporting and tracked as aggregate data. The data was separated into the categories being tracked, and kept as raw data as well as converted into a mean, expressed as a percentage specific to the element tracked. Qualitative data was acquired from departmental meetings and rounding, as well as weekly (and as needed) communication with the departmental chair, who kept a very close pulse on the process. The chair's feedback was verified against the student's feedback to ensure responses correlated, in case some providers and staff might not provide negative feedback to the project lead.

A run chart was created and updated weekly from the data retrieved. The run chart is utilized as a visual aid to track progress and how the tracked data change over time. A review of the run charts created for this project showed a downward trend in one measure just after the

midpoint of the project, which necessitated an intervention. Following the midpoint change, thee

run chart then showed that the intervention, or change in process, that had been put into place

was successful. Run charts may assist in determining whether a process is stable, and if special

cause variation is influencing the process. For this project, a control chart was also created to

better show whether there is special cause variation or just common cause. The control charts

were created towards the end of the 17 weeks of data collection, when the process was thought to

be stable. An individuals chart was chosen since there was no subgrouping of data needed.

Control limits were set as three times the standard deviation, and upper specification limit was

set at the goal of 100%, with lower specification limit set at the baseline data mean retrieved

from the pre-implementation chart reviews.

Ethical Considerations

The D-H Internal Review Board (IRB) determined that this is a non-research, QI project.

UNH IRB was not required. (Appendix A)

All participants were protected by the Health Insurance Portability and Accountability

Act of 1996 (HIPAA) which protects the privacy of patients' health information (Modifications

to the HIPAA Privacy, Security, Enforcement, and Breach Notification Rules, 2013).

Additionally, the DNP student and team who conducted this project followed the Standards of

Care for practice in a primary care office. All information that has and will be collected as part of

evaluating the impact of this project will be aggregated data from the project participants and

will not include any potential patient identifiers. The risk to patients participating in this project

is no different from the risks of patients receiving screening utilizing the paper M-CHAT. The list

of participants and their identifying numbers were kept on an encrypted, password protected

laptop belonging to the DNP student. Only the DNP student has the laptop password.

Results

Evolution Over Time With Modifications

The run charts for each element, and for all three elements combined, were analyzed

weekly. Beginning around week 10 a distinct downward in the charge capture element began

showing (chart 3), which was also noted in the combined run chart, as shown in chart 4. At that

time, there was a run of three to four data points below the median, indicating a change in

process needed. A slight change in process specific to the charge capture process was put in

place around week 13, and a positive run resulted over the following weeks, indicating the

process change was successful (chart 3). The run chart for the presence of the screen in the EHR,

as shown in chart 1, reveals only one data point below 100%, which occurred the week of the

EHR upgrade, when the first iPad would not work properly and the screen was completed on

paper and not scanned. The run chart for provider documentation, as shown in chart 2, indicates

a random variation, with intermittent dips below the median (of 100%).
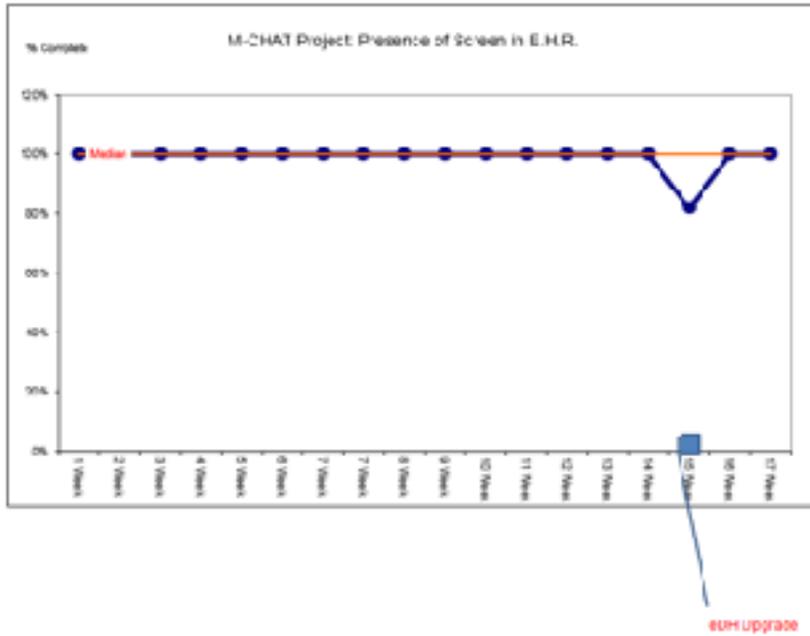
Chart 1. Run chart for presence of screen in the EHR
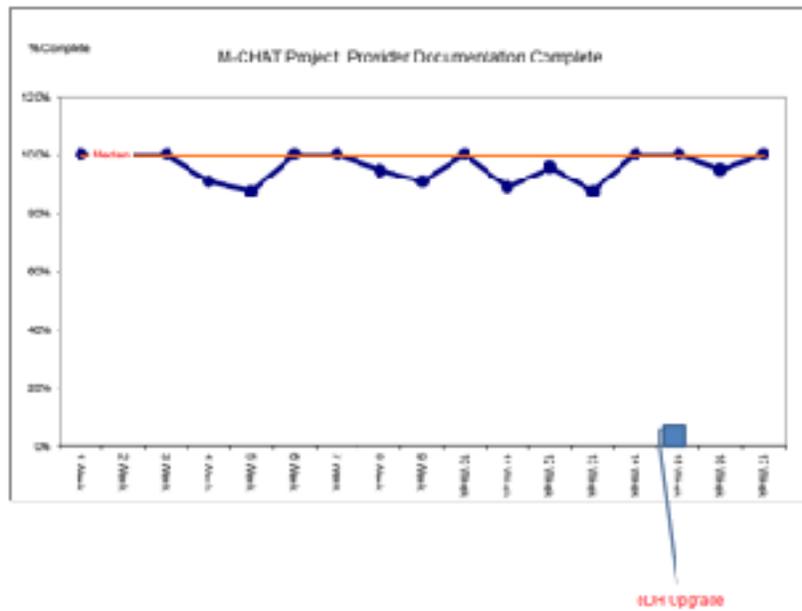
Chart 2. Run chart for provider documentation complete

Chart 3. Run chart for charge capture complete

Chart 4. Run chart for all elements complete

Variation in the process was further investigated with control charts. The control charts

for each element, as well as all elements combined, as shown in charts 5, 6, and 7, showed that

100% of the points fell between the control limits, demonstrating an in-control process for each

of the elements charted. Raw data for each control chart may be found in Appendix B.
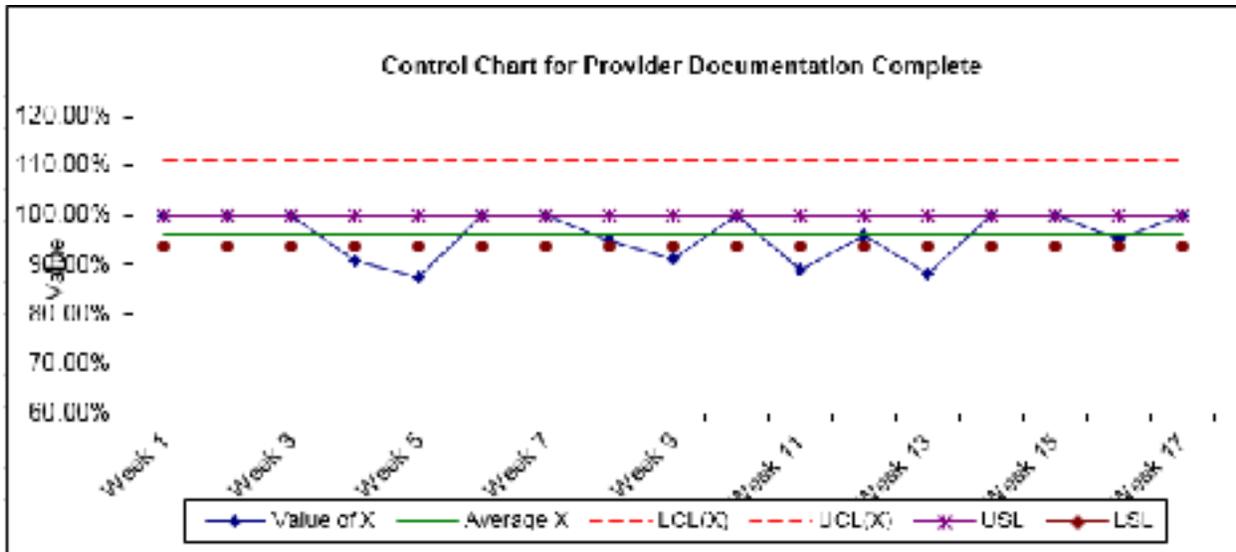
Chart 5. Control chart for provider documentation complete
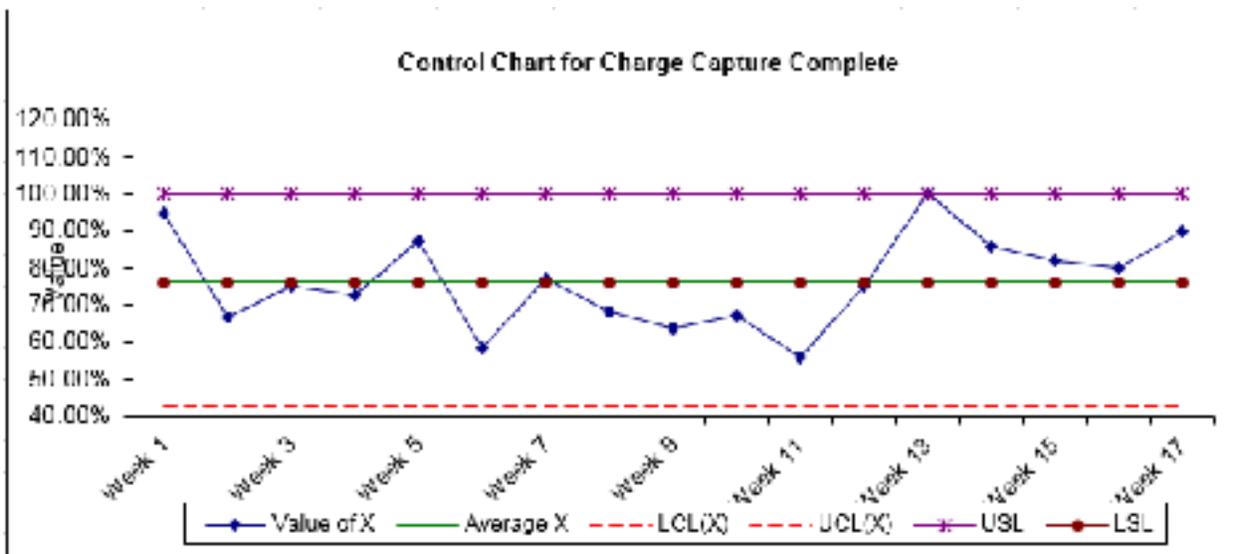
Chart 6. Control chart for charge capture complete
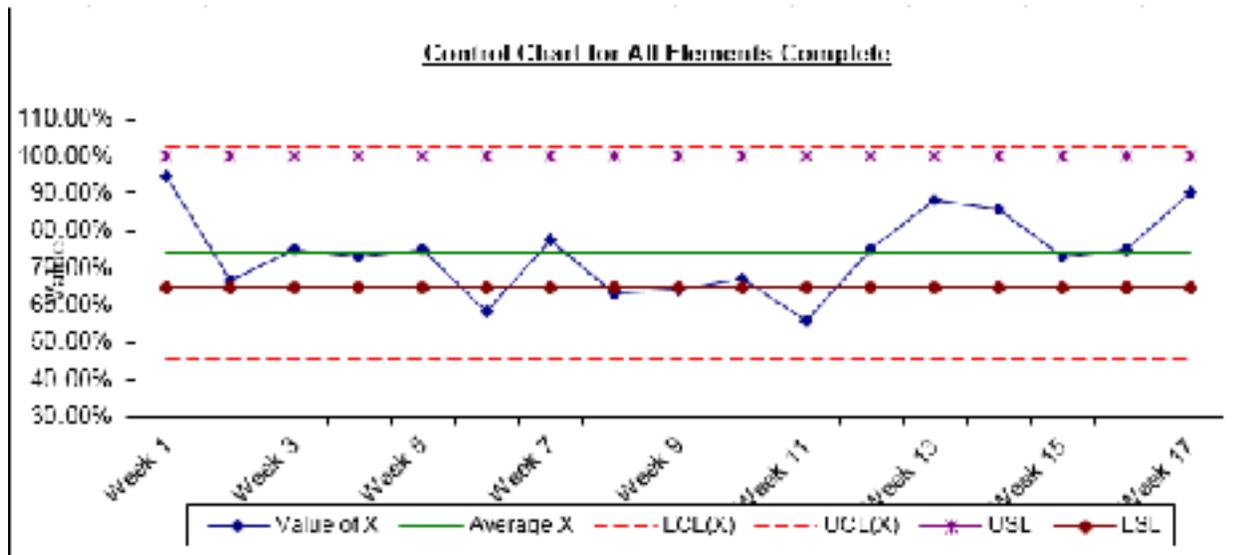
Chart 7. Control chart for all elements complete

Details of the Process Measures and Outcome

As a result of this process improvement, the percentage of screening all eligible children presenting to D-H Nashua Pediatrics for well-child visits at 18 and 24 months for ASD has increased. The formal definition of complete screening for this project, which includes the presence of 1) provider documentation of the screen, results, and plan, 2) the screen in the EHR, and 3) charge capture completed, increased from 64.7% to 73.9%, as shown in Figure 6, following implementation of the project. T-testing shows this is statistically significant (t=31.6105, df=16, p=0.05). A "looser" definition of screening, considering the presence of either the completed screen in the EHR and/or provider documentation of the screening, was also looked at and that result rose from 97.4% to 99.6%, which is also statistically significant using a t-test calculation (t=41.3321m df=16, p=0.05).
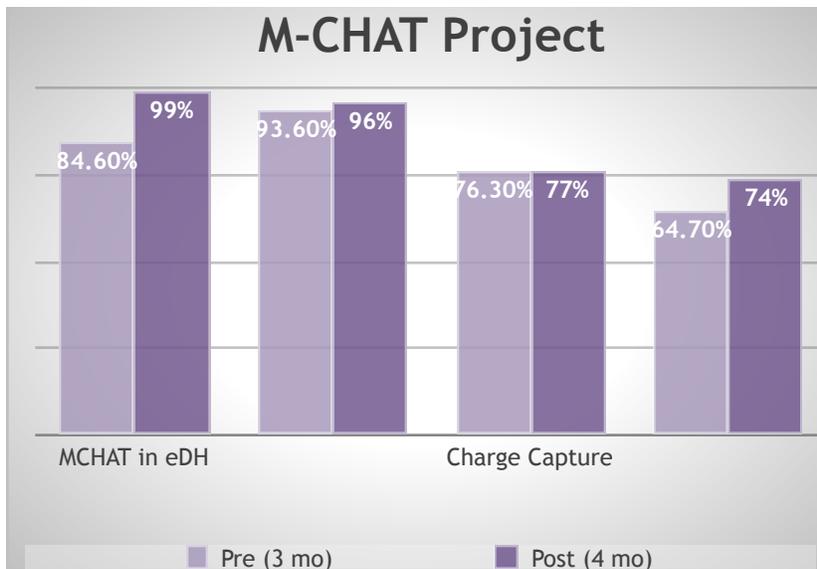
Figure 6. Before-after bar graph

Elements 1, 2, and 3 were also charted individually, to track progress of each component, given the intervention needed to add a change to each element differed. For example, if provider documentation showed a downward trend, or a negative run on the run chart, the intervention would be focused on providers. Should the charge capture show a downward trend, the focus of the intervention would be mostly on nursing, and not include providers. Lastly, should the presence of the screen show a concern, the follow up would be largely with front desk staff or the IS team.

The results of the pre (n=156) and post (n=280) chart reviews illustrated in Figure 6 show:

- Provider documentation increased from 93.6% to 96%

- Presence of the screen in the EHR increased from 84.6% to 98.9%

- Charge capture completion remained unchanged at 76.5% (prior 76.3%)

There was only one child of the 280 reviewed in the 17 weeks post-implementation for whom the screen was not completed at all. This was evidenced by none of the 3 elements present in the chart review. Chart review of the three month span prior to the project implementation revealed that four children missed screening out of 156.

Discussion

Overall the results were very positive. The charge capture result is disappointing, but not altogether unexpected. Since the IS team could not automate that process, it remained a manual one performed by very busy nurses for whom rooming and immunizations took up the majority of their time. At the inception of this project there was an initial concern that the charge capture rate may be negatively affected by removing the paper screen, which might have been serving as a reminder for charge capture. Focusing on reminders and visual cues in the schedule worked for the first few weeks of the project, however the department was experiencing staffing issues, and chart reviews showed that the majority of missed charge captures were actually coming from nurses who were floating to pediatrics from other offices, per diem nurses, or new nurses. Given the constant staffing changes and flux that did not have an expected end date, the unknown date of the automation of charge capture, and the results of the run chart, a visual cue in the form of a colored mark on the paperwork the nurses receive upon rooming was implemented (with positive results shown on the run chart). This addition to the process was effective, as evidenced by a run of data points above the median for charge capture completion.

The project had two unexpected benefits. The first benefit was that the department

moved to the updated version of the M-CHAT, the M-CHAT-R/F.   The validation of the revised

version showed a reduction in the initial false-positive rate, from 9.15% to 7.17%, while

maintaining statistically unchanged positive predictive value (PPV), and increasing the detection

of ASD from 45 out of 10000 to 67 of 1000 screened ($\chi 2$ [1, $n = 35\,060$] = 8.63; $P = .003$),

compared with the previous version of the M-CHAT (Robins, et al., 2014). The second benefit

was that since the new tablet-based screening process has been deemed a success by the

department, the process is now being used as a scaffold to start screening for teenage depression

and substance abuse with another validated and AAP-endorsed tool. The department may also

add additional recommended screens and questionnaires to the current process, further improving

the quality of care.

Summary

This project was able to demonstrate that even a relatively successful process may be

improved upon by using scientific methodology and informatics. While the goal of screening

100% of eligible children for ASD using the M-CHAT R/F was not attained, there was a

statistically significant increase in the percentage of children screened of 9.2% (64.7% to

73.9%). The data show that the quality as measured by the completeness of documentation also

increased, with provider documentation of the screen and plan increasing by 2.4%. The presence

of the actual parent-completed questionnaire in the EHR increasing by 14.3%, which was

significant (t=295.4084, df=16, p=0.05).

A particular strength of the project was the minimal cost involved, since the equipment

and programming time was able to be provided in the operational budget. In addition, since the

iPads are already in use, adding other screens to the iPad using the same process as the M-CHAT

will not cost anything additional (with the exception of time to build the parameters in the EHR).

Another strength of the project, as previously outlined, is that the project will act as a scaffold for

other screening questionnaires that the department plans to introduce, so it serves as a process

upon which other quality improvements will be added.

Interpretation

The results of this project were similar to the results of a project by Brooks, Haynes,

Smith, McFadden, and Robins (2016), which showed that ASD screening results were improved

by moving from a paper to electronic screening modality. By improving screening rates and

reducing potential missed screens, more children with potential ASD may be found and referred

for formal testing earlier. Early identification and intervention has been shown to improve

outcomes for children with autism, including an improved quality of life of the child and family,

and reduced economic burden to the family and society.

Conclusions

Despite the AAP's strong recommendation for all children to be screened for ASD using a

validated tool, at 18 and 24-month well-child visits, it is not being done consistently. The vast

majority of providers, such as the providers at D-H Nashua Pediatrics, have the best intention to

screen 100% of children, but the current processes that are in place to screen children at most

primary care offices are not effective enough to achieve such a goal. This project has shown that

by using process improvement methodologies, statistics, inter-professional collaboration, leadership ability, and nursing informatics application, the variables and potential errors may be removed from an ineffective and inefficient process to improve both screening rates and the completion of the provider documentation of the screening. Moving the screening for ASD, using the M-CHAT, from paper to electronic modality using a tablet has helped to reduce human and process variables that negatively affect reaching the goal of screening all children for ASD. The process also streamlines the workflows in the office, removing the extra time necessary to manually score the screen, enter the result, and scan the paper into the EHR. The additional screenings may also increase revenue for the department by increasing the number of screens performed that may be submitted to insurance for payment. Most importantly, this automated process has demonstrated an effective reduction in missed screens, and therefore a reduction in subsequent delays in treatment should the child who missed the screening have ASD or a delay that needed prompt intervention

Funding

There was no funding for this project. All non-student time and equipment was provided as operational time or materials by the DHMC organization.

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Appendix A

Trustees of Dartmouth College · Dartmouth-Hitchcock Medical Center
COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS

Howard Hughes, PhD, Chair CPHS A
Daniel O'Rourke, MD, Chair CPHS B and D
Jack van Hoff, MD, Chair CPHS C

63 South Main Street · HB 6254 · Hanover, NH 03755
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NOT HUMAN SUBJECTS RESEARCH

May 22, 2018

Jessica Testes
DHMC

CPHS #:	STUDY00031077	Action:	Not Human Subjects Research
Principal Investigator:	Jessica Testes	Action Date:	5/22/2018
Submission Type:	Initial Study		
Review Type	IRB Review Not Required		
Funding:	None		
Title of Study:	Automating the process of screening for ASD with the M-CHAT		
Documents Reviewed:	• not_research_application.docx		
	• D-H Center for Nursing Excellence DNP Project Proposal (002).docx		
	• NIH certificate		

Comments: 45 CFR 46.102(d) Research means a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge.

Note: This project is a quality activity without a research component.

The CPHS has determined that the proposed activity is not research involving human subjects under the purview of the CPHS. While CPHS review and approval is not required, it is your responsibility as Principal Investigator to ensure that all other appropriate institutional approvals are obtained.

This determination applies only to the activities described in the CPHS submission and does not apply should any changes be made. If changes are being considered and there are questions about whether CPHS review is needed, please submit a study modification to the CPHS for a determination. You can create a modification by navigating to the active study and clicking Create Modification / CR.

Sincerely,

Rachel D. Bribeault, CIP
Human Research Analyst
Committee for the Protection of Human Subjects
cc: Jessica Testes

Page 1 of 1

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May 21, 2018

Dear Jessica

The UNH Department of Nursing Quality Review committee has reviewed your DNP proposal Titled: "Using Informatics to Improve Autism Screening in a Pediatric Primary Care Practice." Based on the SQUIRE 2.0 guidelines for determination of quality improvement and research activities, the proposal meets the standards for a quality improvement project. The Quality Review committee determined that this project does not constitute research, and therefore does not need review by the UNH Institutional Review Board for the Protection of Human Subjects, and there are no potential conflicts of interest (financial, professional, or institutional). You may implement your project as proposed.

Good Luck,

Pamela P DiNapoli PhD, RN.CNL

Assistant Professor and Graduate Programs Coordinator

247 Hewitt Hall

Durham NH 03824

cc. J. Samuels

J. Dufresne

Appendix B

Metric Name: Provider Documentation

Sample number	Value of X	Average X	MR	Average MR	UCL(MR)	LCL(X)	UCL(X)	USL	LSL
Week 1	100.00%	0.9600588		0.06		0.808771	1.111346	1	93.60%
Week 2	100.00%	0.9600588	0	0.06	0.19	0.808771	1.111346	1	93.60%
Week 3	100%	0.9600588	0	0.06	0.19	0.808771	1.111346	1	93.60%
Week 4	90.90%	0.9600588	0.09	0.06	0.19	0.808771	1.111346	1	93.60%
Week 5	87.50%	0.9600588	0.03	0.06	0.19	0.808771	1.111346	1	93.60%
Week 6	100.00%	0.9600588	0.13	0.06	0.19	0.808771	1.111346	1	93.60%
Week 7	100.00%	0.9600588	0	0.06	0.19	0.808771	1.111346	1	93.60%
Week 8	94.70%	0.9600588	0.05	0.06	0.19	0.808771	1.111346	1	93.60%
Week 9	91%	0.9600588	0.04	0.06	0.19	0.808771	1.111346	1	93.60%
Week 10	100%	0.9600588	0.09	0.06	0.19	0.808771	1.111346	1	93.60%
Week 11	89%	0.9600588	0.11	0.06	0.19	0.808771	1.111346	1	93.60%
Week 12	90%	0.9600588	0.07	0.06	0.19	0.808771	1.111346	1	93.60%
Week 13	88%	0.9600588	0.08	0.06	0.19	0.808771	1.111346	1	93.60%
Week 14	100.00%	0.9600588	0.12	0.06	0.19	0.808771	1.111346	1	93.60%
Week 15	100.00%	0.9600588	0	0.06	0.19	0.808771	1.111346	1	93.60%
Week 16	95.00%	0.9600588	0.05	0.06	0.19	0.808771	1.111346	1	93.60%
Week 17	100%	0.9600588	0.05	0.06	0.19	0.808771	1.111346	1	93.60%

Metric Name: Charge Capture Complete

Sample number	Value of X	Average X	MR	Average MR	UCL(MR)	LCL(X)	UCL(X)	USL	LSL
Week 1	94.70%	0.7647547		0.13		0.427443	1.102086	1	76.30%
Week 2	66.70%	0.7647547	0.28	0.13	0.41	0.427443	1.102086	1	76.30%
Week 3	75%	0.7647547	0.08	0.13	0.41	0.427443	1.102086	1	76.30%
Week 4	72.70%	0.7647547	0.02	0.13	0.41	0.427443	1.102086	1	76.30%
Week 5	87.50%	0.7647547	0.15	0.13	0.41	0.427443	1.102086	1	76.30%
Week 6	58.30%	0.7647547	0.29	0.13	0.41	0.427443	1.102086	1	76.30%
Week 7	77.30%	0.7647547	0.19	0.13	0.41	0.427443	1.102086	1	76.30%
Week 8	68.40%	0.7647547	0.09	0.13	0.41	0.427443	1.102086	1	76.30%
Week 9	64%	0.7647547	0.04	0.13	0.41	0.427443	1.102086	1	76.30%
Week 10	67%	0.7647547	0.03	0.13	0.41	0.427443	1.102086	1	76.30%
Week 11	56%	0.7647547	0.11	0.13	0.41	0.427443	1.102086	1	76.30%
Week 12	75%	0.7647547	0.19	0.13	0.41	0.427443	1.102086	1	76.30%
Week 13	100%	0.7647547	0.25	0.13	0.41	0.427443	1.102086	1	76.30%
Week 14	85.70%	0.7647547	0.14	0.13	0.41	0.427443	1.102086	1	76.30%
Week 15	81.30%	0.7647547	0.04	0.13	0.41	0.427443	1.102086	1	76.30%
Week 16	80.00%	0.7647547	0.02	0.13	0.41	0.427443	1.102086	1	76.30%
Week 17	90%	0.7647547	0.1	0.13	0.41	0.427443	1.102086	1	76.30%

Sample number	Metric Name: All Elements Complete Value of X	Average X	MR	Average MR	UCL(MR)	LCL(X)	UCL(X)	USL	LSL
Week 1	94.70%	0.739		0.11		0.456209	1.021791	1	64.70%
Week 2	65.70%	0.739	0.28	0.11	0.35	0.456209	1.021791	1	64.70%
Week 3	75%	0.739	0.08	0.11	0.35	0.456209	1.021791	1	64.70%
Week 4	72.70%	0.739	0.02	0.11	0.35	0.456209	1.021791	1	64.70%
Week 5	75.00%	0.739	0.02	0.11	0.35	0.456209	1.021791	1	64.70%
Week 6	68.30%	0.739	0.17	0.11	0.35	0.456209	1.021791	1	64.70%
Week 7	77.30%	0.739	0.19	0.11	0.35	0.456209	1.021791	1	64.70%
Week 8	63.20%	0.739	0.14	0.11	0.35	0.456209	1.021791	1	64.70%
Week 9	64%	0.739	0.01	0.11	0.35	0.456209	1.021791	1	64.70%
Week 10	67%	0.739	0.03	0.11	0.35	0.456209	1.021791	1	64.70%
Week 11	56%	0.739	0.11	0.11	0.35	0.456209	1.021791	1	64.70%
Week 12	75%	0.739	0.19	0.11	0.35	0.456209	1.021791	1	64.70%
Week 13	88%	0.739	0.13	0.11	0.35	0.456209	1.021791	1	64.70%
Week 14	85.70%	0.739	0.02	0.11	0.35	0.456209	1.021791	1	64.70%
Week 15	72.70%	0.739	0.13	0.11	0.35	0.456209	1.021791	1	64.70%
Week 16	75.00%	0.739	0.02	0.11	0.35	0.456209	1.021791	1	64.70%
Week 17	90%	0.739	0.15	0.11	0.35	0.456209	1.021791	1	64.70%