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Provider Utilization of an Electronic Health Record Diagnostic and Statistical Manual V Criteria Evaluation Tool for Individuals with Attention Deficit Hyperactivity Disorder

A dissertation submitted in partial satisfaction of the requirement for the degree of Doctor of Nursing Practice

by

Kamala Gipson-McElroy

2020

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2020

ABSTRACT OF THE DISSERTATION

Provider Utilization of an Electronic Health Record Diagnostic
and Statistical Manual V Criteria Evaluation Tool for Individuals
with Attention Deficit Hyperactivity Disorder

by

Kamala Kennetria Gipson-McElroy
Doctor of Nursing Practice
University of California, Los Angeles, 2020
Professor Nancy A. Pike, Chair

Abstract

Introduction. Attention Deficit Hyperactivity Disorder (ADHD) is the most common neurobehavioral condition in children. Current guidelines recommend that *Diagnostic and Statistical Manual of Mental Disorders* Fifth Edition (DSM-V) criteria be used prior to diagnosis of ADHD. However, many providers are still using DSM-IV with the potential for inaccurate diagnosis. The use of a standardized electronic health record (EHR) template for ADHD that will serve as a reminder for providers to use DSM-V criteria. The objective of the project was to compare utilization of the DSM-V EHR evaluation tool with current documentation practice for screening ADHD. The project examined consistencies in ADHD screening documentation and

conducted comparisons between different providers: physician (MD), advanced practice registered nurse (APRN), and physician assistant (PA) in relationship to screening for ADHD.

Methods. Pre- and post-intervention design was used to evaluate documentation practices. Ten providers were given education on DSM-V criteria and instructions for screening template use. Providers' documentation practices were collected at 3 months before DSM-V EHR template implementation (October 1- December 31, 2019) and 2 months after (January 16 – March 1, 2019). Demographic and clinical data of children both pre- and post-implementation were also collected from the EHR. Provider demographics were obtained from a pre-implementation survey. Descriptive statistics and Chi-square were used to characterize variable distributions and t-tests evaluated group comparisons between provider groups.

Results. Provider (5 MDs and 5APRN/PAs) documentation practices were screened for children pre (n=57) and post (n=55) implementation. Children had a mean age of 9 ± 3.7, predominantly males (75%), Hispanic (85%), and all children were covered by public insurance (100%). Some children (20-30%) required referral in both groups for further evaluation by a child psychiatrist. There was no statistical differences pre- and post-intervention related to DSM-V template use in ADHD screening. However, there were statistical differences between provider type with the APRN/PAs screening more frequently using the DSM-V template (n=4) than MDs (n= 0) (p=.009).

Conclusion. Providers did not consistently use the DSM-V EHR template to screen children for ADHD. Future studies are needed to evaluate barriers to using the template, including practice preferences, openness to change, and other factors that may affect use of the EHR template.

The dissertation of Kamala Kennetria Gipson-McElroy is approved.

Catherine Louise Carpenter

Mary Rezk-Hanna

Eufemia Jacob

Nancy A. Pike, Committee Chair

University of California, Los Angeles

2020

DEDICATION

To my parents, “Johnny and Jessye.”

May this achievement be a realization of your wildest dreams,

as only parents have for their children.

To my husband, Corey.

This would not have been possible without your endless love, encouragement and sacrifice that created the space for me to complete this project. I love you.

To my children, Mackenzie and Christian.

You will always be my greatest achievement.

May your standard always be excellence. I love you.

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PUBLICATIONS AND PRESENTATIONS

Kamala Gipson-McElroy, Haynes, K., Mulugeta, N., & Phan, C. "Development of a Reference Tool for Novice Craniofacial Providers". American Cleft Palate Association Annual Meeting. April 8, 2016.

Kamala Gipson-McElroy & Mulugeta, N. "The Nurse Practitioner Role in Safe and Effective Early Cleft Lip and Nasal Repair". American Cleft Palate Association Annual Meeting. April 8, 2016.

Introduction

Clinical decision support (CDS) is a process that provides information to assist the user in decision making for evaluation and treatment. CDS ensures the timely gathering of information that is relevant to the patient and within the provider's workflow (Osheroff et al., 2017). The goal of CDS is to make accessible, the most informative data, to the key person, in the correct format, through the most direct channel, and at the right point in the workflow to improve health and health care decisions and outcomes (Osheroff et al., 2017). The purpose of the proposed project is two-fold: *first,* to use the CDS framework to develop an electronic version of the Diagnostic and Statistical Manual of Mental Disorders Fifth edition (DSM-V) for Attention Deficit Hyperactivity Disorder (ADHD) screening, that are embedded into the electronic health record (EHR). *Second,* to evaluate its utilization in a pediatric primary care community clinic in Los Angeles.

Problem Statement

ADHD the most commonly diagnosed pediatric neurobehavioral condition, is characterized by a persistent period of marked hyperactivity, inattention, distractibility and/or impulsivity (Center of Disease Control and Prevention (CDC), 2016). Currently, in the United States, approximately 5.4 million children (8.4%) have a clinical diagnosis of ADHD (Danielson et al., 2018) with a reported five percent increase per year (Center of Disease Control and Prevention [CDC], 2016). The diagnosis of ADHD is most prevalent in males (13.3%), children between the ages of 12-17 (11.8%), African-American ethnicity (12.7%) and correlates with family income less than 200% of the federal poverty threshold (CDC, 2016; Pastor, Reuben, Duran & Hawkins, 2015). Furthermore, ADHD has been associated with a greater frequency of

chronic school absenteeism than children with Autism and intellectual delays combined (Black & Zablotsky, 2018; CDC, 2015; Pastor, Reuben, Duran & Hawkins, 2015).

ADHD is a clinical diagnosis with no definitive diagnostic testing. The diagnosis can be a challenge for most providers since behavioral determinants of ADHD may not be attributed to the condition only (Chan, Hopkins, Perrin, Herrerias & Homer, 2005). Thus, the American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM–V) and the American Academy of Pediatrics (AAP) established ADHD clinical practice guidelines to assist providers with the diagnosis and management of ADHD (APA DSM-V, 2013; Wolraich et al., 2011). The AAP recommends that the DSM-V criteria be met prior to diagnosing ADHD (AAP, 2011). Despite the guidelines (2013), many providers are still using the DSM-IV criteria, which can contribute to inaccurate diagnosis and fragmented ADHD management (Guevara et al., 2005). Unfortunately, current clinical practice does not offer a standardized and succinct option to document DSM-V criteria when considering a diagnosis of ADHD.

The project proposes to develop a CDS or electronic version of the ADHD DSM-V criteria embedded into an EHR template in a pediatric primary care clinic. The goal is to increase provider utilization and documentation of specific DSM-V criteria for screening and diagnosis of ADHD.

PICO Question

The project is designed to address the question**,** among pediatric primary care providers of patients with suspected ADHD, will incorporation of the DSM-V criteria evaluation tool for ADHD in the EHR, increase providers' diagnosis or documentation of ADHD screening using DSM-V criteria compared to current practice?

Evidence-Based Practice Framework

The IOWA Model is a widely used framework for implementing evidence–based practice (EBP) that promotes quality care and guides this proposed project (Titler et al., 1994). The IOWA model considers the entire healthcare system from the provider, to the patient, and to the infrastructure using research to guide clinical practice decisions (Titler et al., 1994). The model is a stepwise process for identifying a clinical problem with an evidence-based intervention to improve patient care, and promote institutional change (Brown, 2014; Gawlinski & Rutledge, 2008; Iowa Model Collaborative, 2017). Because of its usefulness in establishing EBP (Titler et al., 1994), the IOWA model will guide the proposed project. The seven-steps of the IOWA model (Doody & Doody, 2011) guided the translation of research into practice to:

1) Identify a priority clinical problem where EBP change might serve as a solution,

2) Develop a team consisting of members that evaluated and implemented EBP,

3) Retrieve relevant research related to the desired practice change,

4) Critique of the evidence related to the desired practice change,

5) Develop an EBP,

6) Implement the EBP, and

7) Evaluate the value and contribution of the evidence into practice.

In addition, three-decision points were incorporated into the IOWA Model including: 1) assessment of the priority for the proposed clinical change, 2) determination of sufficient evidence to support the proposed clinical change, and 3) determination of whether the proposed clinical change was appropriate for adoption into the organization (Iowa Model Collaborative, 2017) (Figure 1).

Implementing the IOWA model will involve three phases. The first phase of the IOWA

model for this project is the identification of suboptimal utilization and documentation of DSM-V criteria as a priority clinical problem for a community pediatric primary care clinic (i.e., organization). Secondly, the pediatric primary care providers (led by a Pediatric Nurse Practitioner/DNP student) were identified to implement the practice change. Furthermore, the AAP ADHD clinical practice guidelines support the use of an electronic CDS tool based on the DSM-V criteria for screening and documenting ADHD. Two of the three decision points in the IOWA model were establishment of the clinical problem as an organization priority with research supporting the use of EHR for DSM-V criteria utilization and documentation for ADHD. The third decision point yet to be determined will be if the documentation change is appropriate for adoption into the organization.

Literature Search

A literature search was conducted in PubMed and The Cumulative Index of Nursing and Allied Health Literature (CINAHL) to identify articles relevant to ADHD diagnosis associated with DSM-V criteria and EHR use within the pediatric primary care setting. Database searches were limited to full-text, peer-reviewed articles in the English language, and excluded abstracts or case reports. Initially, a Boolean search strategy was implemented using the phrases "DSM-V, ADHD and EHR," "DSM-V, ADHD and Pediatrics," and "Decision support, DSM-5, and Pediatrics" yielded zero results. Search terms were modified to include "ADHD AND Electronic Health Record," "Decision Support AND ADHD AND Pediatric Primary Care," and "Childhood ADHD AND DSM-V criteria." The revised search yielded 114 articles. After duplicates were removed and selecting articles published within the last 10-years, 84 articles were identified, and abstracts screened. Articles not specific to the pediatric population and EHR use for ADHD among children, EHR use with mental health disorders (i.e. anxiety, bi-polar,

depression), and those conducted outside of United States were excluded. Finally, a total of nine articles relevant to ADHD and EHR use within the pediatric primary care settings were selected.

Critical Analysis of the Literature

This literature review identified four out of nine articles focused on CDS tools used in a variety of settings to improve provider utilization of APA and AAP diagnostic guidelines. Three studies were randomized control trials (RCT) (Carroll et al., 2013; Co et al., 2010; Oppenheimer, et al., 2019), and one was a feasibility study (Power et al., 2016). The remaining five studies were retrospective chart reviews focused on: evaluating provider EHR utilization with treatment adherence (Bierdermanm, et al., 2019), ADHD incidence (Daley et al., 2017), accuracy in ADHD classification (Gruschow, Yerys, Power, Durbin & Curry, 2019), symptom monitoring between parent and teachers (Michel et al., 2018), and variability in ADHD care at primary-care clinics (Epstein et al., 2014) (Table 1).

The selected RCT studies assessed the effectiveness of their CDS system in the EHR to improve screening, diagnosis and management of ADHD (Carroll et al., 2013, Co et al., 2010 & Oppenheimer et al., 2019). In all three studies, the intervention clinic groups reported higher quality care through increased ADHD diagnosis and prompt clinic visits related to care (Carroll et al., 2013, Co et al., 2010 & Oppenheimer et al., 2019). Some EHR-based tools had built in provider reminders or alerts to re-assess criteria compared to clinic sites without alerts (Co et al., 2010; Oppenheimer et al., 2019). These triggers or alerts built into the algorithms facilitated timely provider notification, prompting patient contact, and adjustments in treatment; thus, improving quality of care (Carroll et al., 2013, Co et al., 2010 & Oppenheimer et al., 2019).

The national guidelines related to diagnostic criteria for ADHD (e.g., DSM-IV vs. DSM-V) varied amongst studies. Two studies were conducted between the years of 2004 and 2010 (Co

et. al., 2010; Daley et. al., 2017) prior to the AAP updates (AAP, 2011) and therefore, the main outcomes of these studies (e.g. ADHD screening and diagnosis) are not reflective of the most recent recommendations for practice (DSM-V). The DSM-V has been determined to be more precise in diagnosing ADHD symptoms compared to the DSM-IV criteria (Epstein & Loren, 2013). One study was based on current AAP guidelines and DSM-V criteria for ADHD diagnosis (Gruschow, Yerys, Power, Durbin & Curry, 2019), had the goal of validating their EHR-based algorithm. This study identified a very low proportion of patients inaccurately diagnosed with ADHD resulting in a strong estimate of specificity for their tool using DSM-V criteria (Gruschow, Yerys, Power, Durbin & Curry, 2019). Four studies incorporated out-of-date DSM-IV criteria (Carroll et al., 2013; Co et al., 2010; Epstein et al., 2014; Daley et al., 2017). Other studies did not acknowledge how the diagnosis of ADHD was made and focused on provider utilization of the EHR-based decision tool (Biederman, et al., 2019; Michel et al., 2018; Oppenheimer, et al., 2019; Power et al., 2016).

Inconsistencies in EHR templates and built-in provider prompts or alerts were present across all studies. Four studies utilized distinct notifications within their respective EHR-based decision tool. Co and colleagues (2010) incorporated a clinician reminder to assess ADHD symptoms every three to six months, and the reminder was associated with an approximate 20% increase in the proportion of patients whom had a visit during the study period in which ADHD management was discussed. In an effort to screen patients suspected of having ADHD, one study utilized a three-question prescreen; and if positive, notified providers to the patient's potential risk for ADHD (Carroll et al., 2013). Michel and colleagues (2018) sought to support communication regarding patients' ADHD symptoms between providers, parents and teachers by electronically notifying providers when parents and teachers submitted scheduled ADHD

assessments into the EHR system. Oppenheimer et al (2019) embedded a notification into their EHR that was designed to detect potential adverse outcomes among children with ADHD and monitored remotely between doctor visits. Newly submitted forms prompted provider notification, patient contact and timely referrals or office visits for further evaluation; thus, providing faster response times and optimizing patient management and outcomes (Oppenheimer et al., 2019).

All studies were conducted in the United States, including three conducted at the same institution that assessed different aspects of monitoring, adherence, diagnosis, and instrument validation (Gruschow, Yerys, Power, Durbin & Curry, 2019; Michel et al., 2018; Power et al., 2016). A high degree of sensitivity 0.97 (95% CI: 0.96, 0.97), specificity 0.99 (95% CI: 0.90, 0.99) and positive predictive value from 0.98 (95% CI: 0.98, 0.99), to diagnosis ADHD among patients with symptoms suggestive of ADHD (Gruschow, Yerys, Power, Durbin & Curry, 2019). Study findings showed that the institution's EHR system could accurately classify ADHD, capture ADHD information, promptly communicate information between parents and teachers, and is feasible in assessing and monitoring treatment outcomes. These findings cannot be generalizable to all institution's EHR systems since these three studies were from the same institution (Gruschow, Yerys, Power, Durbin & Curry, 2019; Michel et al., 2018; Power et al., 2016).

This literature review identified overwhelming support for the use of EHR-base ADHD tools or templates to assist providers during office visits to screen and diagnose ADHD, and track symptoms related to pharmacologic and non-pharmacologic management.

Gaps in Knowledge

This review highlighted the need for studies to evaluate the use of DSM-V criteria embedded into a CDS tool to improve provider utilization and diagnostic accuracy. In addition, most reviewed studies did not address pertinent information about the providers (e.g., physicians, nurse practitioners, and physician assistants), years of experience, and additional psychiatric or mental health training. Provider type and experience could explain the variability in practice and clinical adherence to the new ADHD guideline. The EHR technology was limited to the general use of an ADHD template (not related to new DSM-V criteria), and the ability to identify newly diagnosed ADHD patients based on provider documentation. The proposed scholarly project will expand upon existing knowledge related to optimizing providers' use of EHR-based technology, by embedding DSM-V criteria into the template, and assessing utilization based on provider type and experience.

Methods

Project Design

The scholarly project is a phase I study using a pre- and post-intervention design. Data was extracted via the EHR in consecutive months during pre-intervention (October 1, 2019 – December 31, 2019 [three months]) and post-intervention (January 1, 2020 – March 1, 2020 [2 months]) to assess previous ADHD screening and diagnosis rates compared to post-EHR ADHD template start-up. Unfortunately, the 2019 coronavirus disease (COVID-19) pandemic cut short the post-intervention data collection by 1 month. The dates selected corresponded with the school year when the majority of suspected ADHD cases are identified by teachers/parents and seek primary care evaluations.

Sample and Setting

A convenience sample of 10 pediatric providers (five pediatricians, four pediatric nurse

practitioners, and one physician assistant was selected whose documentation practices were assessed across three pediatric primary care practices in South Los Angeles, Lynwood, and Compton. All providers underwent the intervention. These facilities are all federally qualified health organization serving primarily the uninsured or who have public insurance. All providers utilized the organization's EHR, eClinicalWorks (eCW) for documenting ADHD screening and diagnosis.

Inclusion/Exclusion Criteria

The eligibility criteria for selecting medical record review were patients: 1) ages 3 to 18 years, and 2) those who were screened and diagnosed with ADHD using CPT and billing codes (ICD-9 = 314.01; CPT = 96110). Exclusion criteria were patients: 1) diagnosed at another facility outside of the organization, 2) being followed by outside psychiatry, 3) have other psychiatric comorbidities (e.g. depression, anxiety, bipolar etc.), or 4) managed by a non-pediatric primary care provider (e.g. internal medicine).

Sample Size

One hundred and twelve patient encounters were identified in the EHR based on screening and diagnostic codes (CPT Code 96110; ICD-9 Code 314.01) after removal for duplicate patient visits.

Intervention

The intervention was two-fold with an educational component and the use of an EHR ADHD screening template.

Provider Education. A 30-minute in-service was conducted on the AAP clinical practice guidelines (Table 2) and use of the modified ADHD template that included new DSM-V criteria for ADHD developed by the PI at a monthly quality improvement meeting attended by all

providers. The PI educated all providers on how to use the EHR ADHD template for screening and diagnosis using the DSM-V criteria. Providers who were unable to attend the in-service sessions, were emailed and called to ensure their understanding of the use of the DSM-V EHR tool. Visual reminder cards for using the template were placed and located at all providers' workstations (Figure 2).

EHR ADHD Template. Based on the DSM-V criteria, this intervention is a standard tool for the classification of mental disorders, including ADHD. The DSM-V is a validated set of criteria with a sensitivity (100%), specificity (71.1%) and predictive value (85.1%) in the diagnosis of ADHD (Ghanizadeh, 2013). These criteria was embedded into the organization's EHR eCW ADHD template (Figure 3). The Vanderbilt ADHD Diagnostic Rating Scale is standard of care in the assessment of ADHD symptoms. This assessment tool is the gold standard for ADHD screening which includes forms for both a parent and teacher to complete based on behavior in two different environments (e.g., primarily home and school) and is currently used in the pediatric primary care clinic (Wolraich et al., 2003). The Vanderbilt is not scored until the teacher evaluation has been received. Therefore, the DSM-V criteria will be determined prior to the Vanderbilt screening which is the recommended method for classification of ADHD.

Data Collection

The study protocol was approved by the University of California, Los Angeles Institutional Review Board. At the end of the intervention in-service (January 9, 2020), all providers completed a demographic form to elicit data on age, gender, ethnicity, provider type, (e.g., physician, nurse practitioner, physician assistant), years of experience, years at the practice site and any additional pediatric psychiatric or mental health training (Appendix A). The PI obtained verbal permission from all providers to review their patient's records in the EHR. The

ADHD chart screenings and diagnosis findings for the project are anonymous and the evaluations were not punitive (e.g., in case some providers were identified as not documenting the use of DSM-V criteria). The proposed project had the support of the institution's lead pediatric provider who oversees all three primary care clinics.

The EHR ADHD template was initiated on January 16, 2020. Data extraction from the EHR occurred over three consecutive months before and two months after the intervention. Data collection consisted of patient demographic information (age at the screening, gender, ethnicity, insurance type) and ADHD screening / diagnosis (DSM-V criteria used, Vanderbilt completed by parent and teacher, was ADHD diagnosis made, current management, and other medical or behavioral conditions) (Appendix B).

Primary Outcomes

The primary outcome of the proposed project was the number of patients who receive ADHD assessment/screening utilizing DSM-V criteria to support the diagnosis. The secondary outcome includes provider documentation utilizing the EHR-based DSM-V criteria evaluation tool.

Data Analysis

Descriptive statistics (means, standard deviations and frequencies) were used to summarize distribution of demographic variables from the providers and clinical data for patients. Chi square was used to assess whether distribution of categorical variables (ethnicity, gender) exceeded expectation. A paired t-test was used to compare differences of pre- and post-intervention outcomes (e.g., number screened, and number diagnosed with ADHD). Statistical significance is two-sided at $p \leq 0.05$. The Statistical Package for Social Sciences (SPSS) version 25 (IBM; Somer, NY) was used for analysis.

Results

Documentation practices of ten providers were reviewed during a 5-month period (October 2019-March 2020) for consistencies with the use of the ADHD EHR screening template. During the pre-intervention period (October 2019-December 2019), 5295 pediatric primary care visits were examined for ADHD diagnosis or screening codes. After excluding for duplicate ADHD visits, 57 medical records were reviewed. During the post-intervention period (January 16, 2020-March 16, 2020), 7800 pediatric primary care visits were identified. After excluding for duplicate ADHD visits, 55 medical records were reviewed (Figure 4).

Among providers (five physicians [MD or DO] and five advance practice registered nurses [APRN] or physician assistant [PA], no statistically significant difference were found in documentation practices based on age, gender, ethnicity, years of experience, years at the organization, or additional mental health training (Table 3). The majority of providers were not using the template and using only narrative comments in their note which was recorded as incomplete. APRN / PAs (8%) were using the DSM-V template, compared to MD/DOs who were not using it (0%, p=.009). The Vanderbilt ADHD screening tool was utilized more by the MD/DO group (59%) compared to the APRN/PA group (33%), (p=0.043) (Table 4).

The pre- and post-intervention group characteristics showed no differences between groups based on age, gender, ethnicity, insurance, and visit type nor provider screened. The majority of children screened were on average 9 years of age, 80% male, 80% Hispanic, and 100% receiving public insurance (Table 5). Out of 31 patients screened post-implementation (56%), 29 (53%) had Vanderbilt screening, three (5%) had DSM-V EHR template screening; six were diagnosed with ADHD (Table 5). ADHD management consisted of 20-30% receiving combined medication and behavioral therapies and 40-50% being managed by an outside

provider (psychiatry) (Table 5). However, 49% pre-intervention and 29% post-intervention were either referred to psychiatry for a higher level of care (Tier I Institute) or parents refusing treatment. Collectively between groups, the most prevalent behavioral or medical comorbidities were autism (17%), developmental / learning delays (17%), overweight/obesity (16%), asthma / allergies (16%), post-traumatic stress disorder (PTSD) and depression (9%), conduct or oppositional defiant disorders (8%), and obstructive sleep apnea (OSA) (7%) (Table 5).

Discussion

Results from this project demonstrated the majority of providers, either MD/DO or APRN/PA, were not using the DSM-V EHR template to screen for ADHD. Though the overall provider use was low, the APRN/PAs utilized the DSM-V screening tool more often than the MD/DOs. Very few studies have compared provider type related to usage of EHR templates. However, one study showed similar findings using an EHR-based pediatric to adult transition planning template which was utilized more by nurses than physicians (Weimann, 2015). In this project, despite provider education on DSM-V criteria and the feasibility of the EHR template to assist in ADHD diagnosis, provider preferences persisted with using the Vanderbilt ADHD tool and referral for higher-level care (e.g. psychiatry). More effective pre-implementation provider query into barriers to usage and periodic system checks should be implemented in future EHR template projects (Lehmann et al., 2019 & Temple et al., 2019).

This project did not utilize an EHR "lock-out" mechanism, so providers could not opt-out of the template and mandate completion in order to sign the patient note. This could have potentially improved provider compliance with DSM-V screening criteria. A few studies have shown that this type of safeguard can prompt increased provider usage of EHR templates and ultimately improve patient outcomes (Loudon et al., 2015; Powers, 2018; Reyes-Portillo et al.,

2018). Furthermore, Ramirez et al. (2018) showed that an EHR "chart closure" hard stop implementation improved provider attention to alerts for the intensification of diabetes medication without significantly disrupting workflow and in a follow-up evaluation showed sustainability (Ramirez et al., 2020). These findings suggest EHR-based "chart closure" or "lock-out" mechanisms could be implemented in EHR-based ADHD DSM-V criteria tools to improve usage.

Degree of experience may have influenced the results observed. The majority of providers had two to three years' work experience, which may account for the lack of template utilization. Although not specific to ADHD, one study examining the opinion of physicians regarding the use of EHR which found MDs with 4 years or greater EHR experience, felt that EHR allowed them to provide better patient care compared to those with less than 4 years of experience (Jamoom, Heisey-Grove, Yang & Scanlon, 2016). In this project, the feasibility of using the DSM-V screening tool template, for diagnosis of ADHD was established in a small number of children. This raises concern for diagnostic accuracy and potential for inappropriate medical management or referral when not using the most current practice DSM-V criteria (Bastra et al., 2014; Manos et al., 2017). With the shortage of mental health providers and the delay in timely appointments, primary care providers need to be screening and diagnosing ADHD according to national guidelines in the outpatient setting to expedite treatment and optimize home and academic performance (Jansen, 2019).

This project also identified both behavioral and medical comorbidities in an ethnically diverse, underserved population in Los Angeles that may have implications for primary care practice in the management of children suspected or diagnosed with ADHD. The most prominent behavioral issues were autism, developmental/learning delays, depression/post-

traumatic stress disorder and medical comorbidities were overweight / obesity, OSA, and asthma / allergies. ADHD and autism signs and symptoms are linked together in addition to learning delays that arise from other behavioral / psychological disorders and developmental or learning delays. A comprehensive approach to assessment should be considered when making clinical judgements when screening children suspected of ADHD (Hinshaw, 2017).

The medical comorbidities of being overweight or obese has been associated with the impulsivity and inattention that can characterize ADHD causing increased caloric intake that can contribute to the problem (Cortese, Moreira-Maia, St Fleur, Morcillo-Peñalver, Rohde et al., 2016; Fuemmeler, Sheng, Schechter, Do, Zucker et al., 2020). Obesity and OSA may be related and lifestyle changes (nutritional guidance) or treatment for OSA should be considered before medications are used for ADHD (Sedky, Bennett & Carvalho, 2014). Furthermore, children with asthma and ADHD were found to have higher levels of hyperactivity, externalizing behaviors and anxiety than children who had ADHD alone (Borkschuk, Rodweller & Salorio, 2018). Thus, the combination of ADHD and asthma may present challenges to the child and provider related to treatment compliance to optimize functional outcomes. In this project, these comorbidities identified may reflect the underserved, inner city, Hispanic and African American children who are already at risk for behavioral issues, obesity, OSA and asthma and could potentially be separate from ADHD.

Limitations

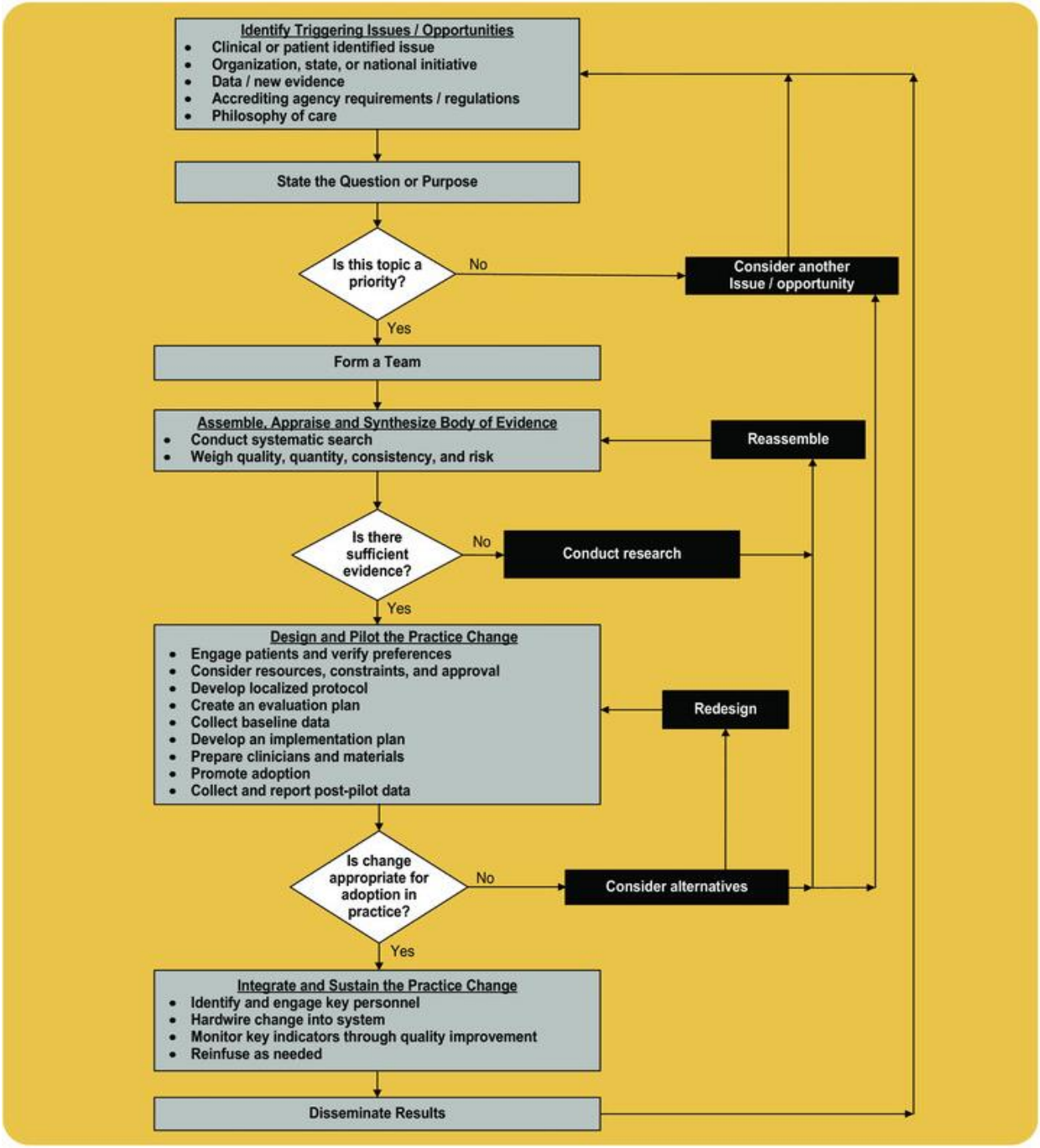
This scholarly project should be viewed in light of some limitations. The project was carried out amid the novel COVID-19 viral-pandemic. As a result, the post-intervention period was cut short by one month in efforts to maximize safety and reduce potential virus exposure to patients and medical staff. Primary care visits were replaced with only urgent care visits limiting

routine screening. In addition, the pandemic also triggered school closures, which may have affected the teacher's ability for in-class behavioral assessment or concern for ADHD. This was a small sample of pediatric providers at three-federally qualified health centers within an institution. Medical records reflecting ADHD patients seen by family practice providers were not included and may have different documentation practices than pediatric providers. The results were bias based on provider practice preferences despite education on the need to use DSM-V criteria for screening ADHD and initial buy-in prior to implementation of the project. Future EHR documentation practice improvement projects need to evaluate barriers to usage by providers including practice preference and openness to change in order increase utilization of the template. In addition, the use of a "lock-out" mechanism can be embedded into the EHR to ensure provider completion of the DSM-V template.

Conclusion

The need for primary care providers to follow DSM-V clinical practice guidelines is imperative for accurate screening, diagnosis and early treatment. Findings from the present study indicate that primary care providers did not consistently use the DSM-V EHR template to screen children for ADHD. These findings highlight the need to explore insights on EHR "lock-out" mechanisms and template use check points during data collection to prompt early intervention if usage drops. Further studies are indicated to examine barriers and facilitators to healthcare provider's use of EHR templates to appropriately screen and diagnose children with ADHD.

Figure 1. The IOWA Model Revised: Evidence-Based Practice to Promote Excellence in Health Care



Iowa Model Collaborative. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing, 14*(3), 175-182. doi:10.1111/wvn.12223.

Figure 2. Workstation Screening Reminder

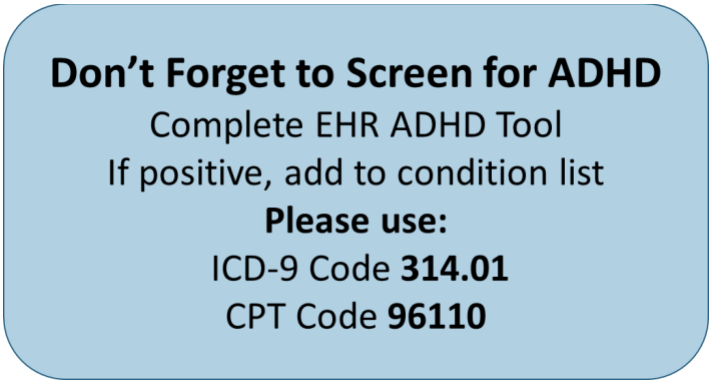


Figure 3. Sample EHR [eClinicalWorks] ADHD Template

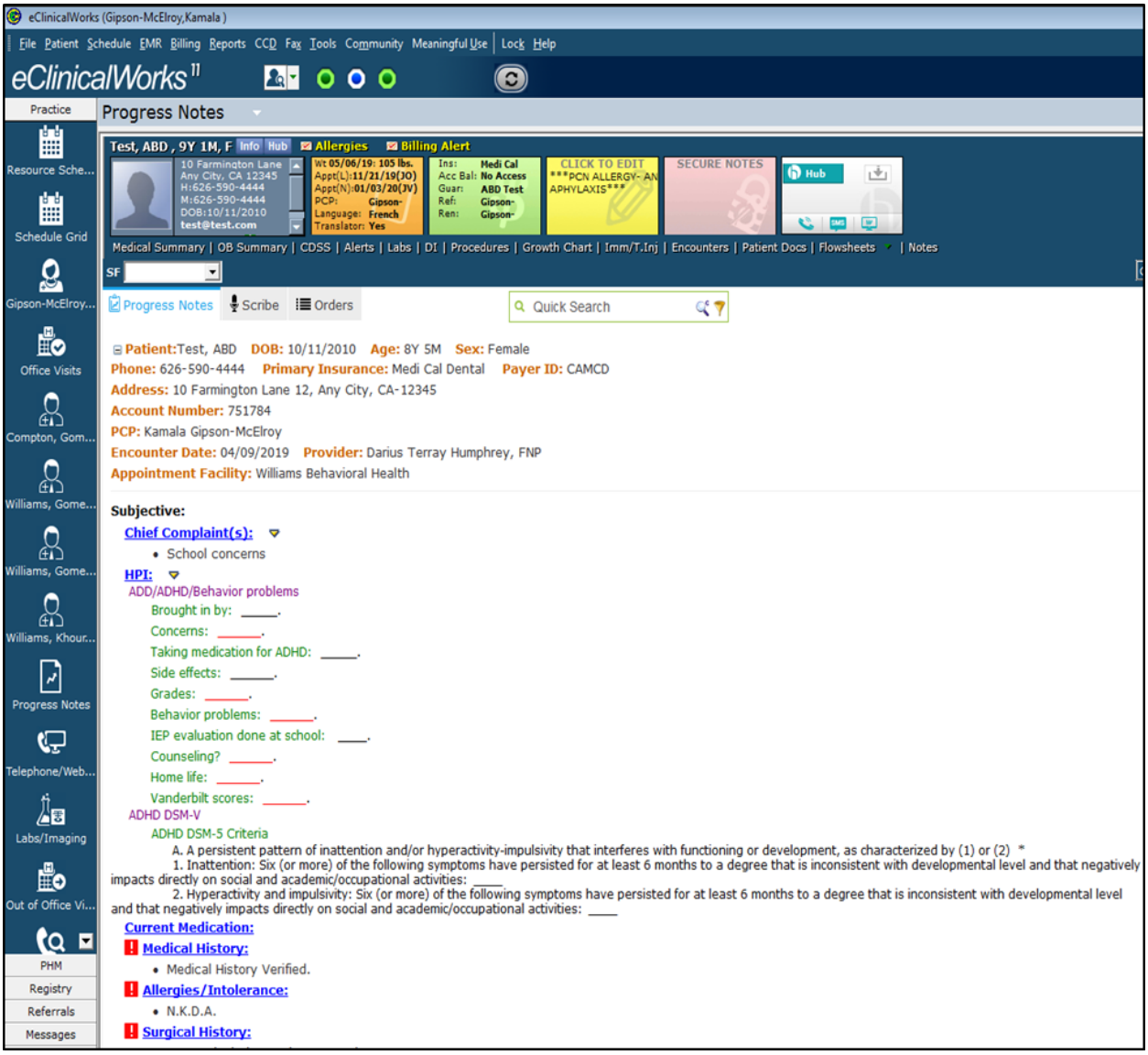


Figure 4. Chart Review Flow Diagram

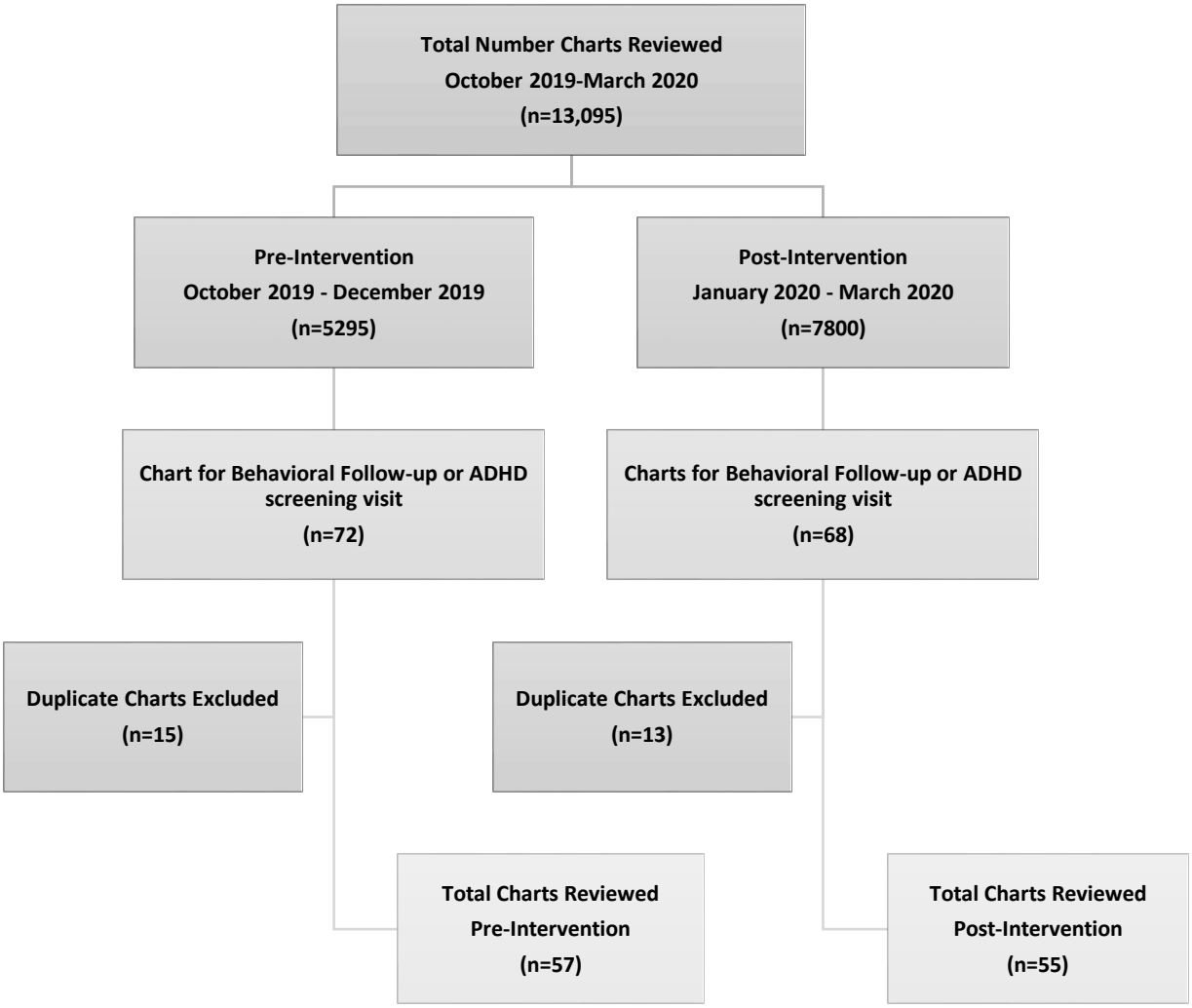


Table 1. Literature Review Table of Evidence

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Biederman, J., Fried, R., DiSalvo, M., Storch, B., Pulli, A., Woodworth, K. Y., …Perlis, R. H (2019). Evidence of low adherence to stimulant medication among children and youths with ADHD: An electronic health records study. *Psychiatry Services*, *70*(10), 874-880. DOI: 10.1176/appi.ps.201800515.	To evaluate rates and correlates of adherence to stimulant medication among children and adolescents by using data derived from the electronic medical record (EMR)	n= 2206; Ages 4–17 years who had been prescribed a stimulant. Conducted at Massachusetts General Hospital between January 1, 2015, to December 31, 2016 when EPIC EMR was implemented.	Patient index prescription defined as the first time stimulant prescribed. Prescription refills and medication adherence were measured by the index prescription type and when prescription was refilled. **Statistical Analysis:** Logistic regression imputation methods for economic status, area-under-the-curve (AUC) statistic to examine how characteristics predicted medication adherence.	2,206 children with prescriptions for stimulant medication. Confirmed ADHD diagnosis in 1,355 (61%). Only 46% (1,023) were adherent to stimulant treatment. Rates of adherence were worse among patients receiving care from a PCP than a psychiatrist in older female patient (AUC 0.57 – only modestly predict adherence better than chance.	Low adherence to stimulant treatment in ADHD affects all ages, both sexes, and all economic class strata. Improve medication adherence is needed in the primary care setting. Medication adherence maybe related to inaccurate ADHD diagnosis and management. **Limitations:** Confirmation of ADHD not considered despite new AAP guidelines prior to study in 2013.

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Carroll, A. E., Bauer, N. S., Dugan, T. M., Anand, V., Saha, C., & Downs, S. M. (2013). Use of a computerized decision aid for ADHD diagnosis: A randomized controlled trial. *Pediatrics*, *132*(3), e623–e629. DOI:10.1542/peds.2013-0933	To determine if implementation of ADHD diagnosis and treatment guidelines in a clinical decision support (CDS) system would result in better care and adherence to clinical care guidelines	n= 48; patients age 5-12 years, high Medicaid population. University of Indiana Medical Group-Primary Care Network (4-primary care practices) between 2010 and 2012.	Cluster randomized controlled trial Comparison of diagnosis and management after implementation of a CDS for ADHD and evaluated via chart reviews in intervention and control clinics. The ADHD template in Child Health Improvement through Computer Automation (CHICA) used by all providers. **Statistical Analysis:** Descriptive statistics for characteristics, Chi-square categorical and Wilcox rank-sum continuous variables. Logistic regression model used to compare dichotomous variables.	CDS module resulted in higher quality of care with respect to ADHD diagnosis. 21% increase in use of diagnostic assessment among intervention group (OR=8.0, 95% CI) and 12% in control group. No statistical significance in number of hyperactive symptoms at school (p=.075). Increase seen in the number of children with inattentive symptoms (p<0.5), and hyperactive symptoms at home (p<0.5).	Study showed introduction of CDS for ADHD improved the use of standardized rating scales ADHD core symptoms noted a diagnosis significant as it demonstrates the ability to improve the specificity of accurate reporting by parents and teachers. **Limitations:** Study conducted prior to updated AAP guidelines. ADHD template based on DSM-IV causing a limitation in diagnostic certainty.

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Co, J. P. T., Johnson, S. A., Poon, E. G., Fiskio, J., Rao, S. R., Van Cleave, J., Perrin, J. M., Timothy G. Ferris (2010) Electronic Health Record Decision Support and Quality of Care for Children With ADHD. *Pediatrics, 126* (2) 239-246; DOI: 10.1542/peds.2009-0710	To assess the effect of EHR decision support on physician management and documentation of care for children with ADHD.	N= 412 children, age 5 to 18, diagnosed with ADHD. 79 pediatricians in 12 pediatric primary care clinics that use the same EHR. Conducted between December 2006 and July 2007. Private and community clinics in eastern Massachusetts	Cluster randomized clinical trial of EHR-based CDS that included (1) clinician reminders to assess ADHD symptoms every 3 to 6 months, (2) ADHD note template with fields for symptoms, treatment effectiveness, and adverse effects. **Statistical Analysis:** Descriptive statistics and generalized estimating equations used to control for the clustering by providers.	Intervention sites showed improved ADHD care related visits during the study. ADHD template was used at 32% of visits and associated with improved documentation of symptoms (100% vs 61.3%), treatment effectiveness (96.6% vs 54.8%), and treatment adverse effects (96.6% vs 40.3%; p<.001 for each). ADHD reminders associated with 20% increase in visits that discussed of ADHD symptoms.	EHR tools increase the rate patients with ADHD have management of their condition and improve the quality of documentation. EHR use has potential for improving care for children with ADHD and other chronic conditions. **Limitations:** Study conducted prior to updated AAP guidelines in 2011. ADHD centered around DSM-IV causing a limitation in diagnostic certainty.

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Daley, M. F., Newton, D. A., DeBar, L., Newcomer, S. R., Pieper, L., Boscarino, J. A., … Bussing, R. (2017). Accuracy of Electronic Health Record–Derived Data for the Identification of Incident ADHD. *Journal of Attention Disorders, 21*(5), 416-425. DOI: 10.1177/1087054713520616	To assess the accuracy of her EHR derived diagnoses in identifying children with incident (i.e., newly diagnosed) ADHD.	n=7,362; age 3 to 9 year, with incident of ADHD from January 1, 2004 through December 31, 2010 10 large health care organizations (mix of urban, rural and community clinics) in Denver, CO.	Retrospective cohort study, random sample of 500 records reviewed to determine whether a diagnosis of ADHD was documented in the clinician notes using DSM-IV criteria. **Statistical Analysis:** Descriptive statistics for all variables of interest. Confirmation rates of diagnosis were weighted at 95% CI.	Incident ADHD was confirmed in clinician notes (71.5%) (95% CI = 56.5, 86.4) for age 3-5 year olds and (73.6%) (95% CI = 65.6, 81.6) for age 6-9-year-olds. 41.4% of incident ADHD index diagnosis were made in pediatric setting with 37.9% made in mental health clinics. Only 4.6% ADHD diagnosis made in the primary care setting	Manual chart reviews showed great variability in documentation of ADHD diagnosis. DSM-IV criteria rarely documented. **Limitations** Study design limits causation only an association. No control group without ADHD diagnosis. Identification of true ADHD cases was based on provider documentation ICD-9 codes.

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Epstein, J. N., Kelleher, K. J., Baum, R., Brinkman, W. B., Peugh, J., Gardner, W., . . . Langberg, J. (2014). Variability in ADHD care in community-based pediatrics. *Pediatrics, 134*, 1136-1143. DOI: 10.1542/peds.2014-1500.	To examine ADHD diagnosis and care variability in community-based pediatric practices.	n=1594; children's age not specified. 50 pediatric practices, 188 pediatric providers, no access to specialized mental health, in Central and Northern Ohio (August 2010-December 2012)	Retrospective chart review, random sample of charts Charts reviewed to assess pediatrician ADHD care practices. Pediatricians reported the percentage of their patients whose primary payer was Medicaid. **Statistical Analysis:** Descriptive statistics and multilevel modeling was used to estimate the percentage of variability in each ADHD care variable	DSM-IV criteria documented in 70.4% of patients. 93.4% on ADHD medication and 13% receiving psychosocial therapy. Combined therapy not evaluated. Parent- and teacher-rating scales were used during ADHD assessment but rarely used to monitor treatment response. Variability identified in ADHD care by pediatrician and practice site.	Variability in ADHD care at the patient level despite AAP guidelines. Quality of ADHD care in community-based pediatric settings need improvement. **Limitations:** Retrospective study design. Chart review did not include patient demographics, so relationship between patient-level data and quality of ADHD care could not be estimated. Out-of-date DSM-IV criteria utilized

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Gruschow, S. M., Yerys, B. E., Power, T. J., Durbin, D. R., & Curry, A. E. (2019). Validation of the Use of Electronic Health Records for Classification of ADHD Status. *Journal of Attention Disorders*, *23*(13), 1647–1655. DOI: 10.1177/1087054716672337	To validate an EHR based algorithm to classify ADHD status of pediatric patients.	n=2,030 reviewed with diagnosis of ADHD, n= 807 with non-ADHD The Children's Hospital of Philadelphia born between 1987-1995.	Retrospective cohort study Patients classified with ADHD in EHR by ICD-9 code 314.x via EPIC system and a random weighted sample with non-ADHD were reviewed to confirm the presence or absence of ADHD. **Statistical Analysis**: Researchers estimated sensitivity, specificity, positive predictive value and negative predictive value and exact 95% CI.	Depending on assumptions for inconclusive cases, sensitivity ranged 0.96 to 0.97 (95% CI = [0.95, 0.97]), specificity 0.98 to 0.99 [0.97, 0.99], and positive predictive value 0.83 to 0.98 [0.81, 0.99] Unable to use EHRs to confirm presence or absence of ADHD diagnosis, in 1 out of 4 patients with ICD-9 code 314.x.	Algorithms seeking to capture ADHD can do so with a high degree of sensitivity. Low proportion of patients without ADHD codes were in fact diagnosed with ADHD. **Limitations:** Study was not designed to identify if DSM criteria was utilized to diagnose ADHD. Single center EHR lack generalizable to all settings and providers. Variability in provider approach to ADHD best practice guidelines.

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Michel, J. J., Mayne, S., Grundmeier, R. W., Guevara, J. P., Blum, N. J., Power, T. J., … Fiks, A. G. (2018). Sharing of ADHD Information between Parents and Teachers Using an EHR-Linked Application. *Applied Clinical Informatics*, *9*(4), 892–904. doi:10.1055/s-0038-1676087	To adapt an existing EHR-linked system for ADHD symptom monitoring to support communication between parents and teachers and then to assess child characteristics associated with sharing of ADHD information	n= 590; school-age children with ADHD at 31 primary care sites affiliated with Children's Hospital of Philadelphia between January 25, 2017 to June 16, 2017.	Retrospective cohort study. ADHD Care Assistant CDS used across all primary care sites to improve parent and teacher sharing of information (e.g., surveys). Parents had to have accessed the system once during the study period. **Statistical Analysis**: Descriptive statistics for child characteristics, multivariable logistic regression used to estimate an association between child characteristics and parental sharing.	64% parents elected to share survey results with teachers at the first opportunity and 80% elected to share all possible information. Sharing at subsequent opportunities (89%). Parents viewed 16% of teacher submitted surveys and teachers only 30% of parent submitted surveys.	EHR-link promoted sharing of information between parent and teacher. This has not been widely integrated in ADHD care. Strategies are needed to improve viewing of shared information. **Limitations:** Sample represented a limited subset of all ADHD. Provider demographic information not included. Limited control over when and why clinicians chose to use the system.

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Oppenheimer, J.; Ojo, O.; Antonetty, A.; Chiujdea, M.; Garcia, S.; Weas, S.; Loddenkemper, T.; Fleegler, E.; Chan, E. (2019). Timely Interventions for Children with ADHD through Web-Based Monitoring Algorithms. *Diseases, 7*, 20. DOI:10.3390/diseases7010020	To evaluate an automated trigger algorithm designed to detect potentially adverse events in children with ADHD monitored remotely between visits.	n= 1738 parents of patients, no ages described, receiving ongoing care for ADHD and prescribed medications. 88 out of 113 providers agreed to participate. Department of Neurology at Boston Children's Hospital between October 1, 2014 and December 31, 2015.	Cluster randomized clinical trial EHR trigger algorithm (TriVox app) derived from parent-reported ADHD questionnaire used for care. Worse symptoms or side effects triggered an alert. Primary outcome is clinican response to alerts. Vanderbilt ADHD Parent Rating and Clinical Global Impressive-Severity and Improvement scales used. **Statistical Analysis:** Descriptive statistics to assess demographics between alert and non-alert groups, T-test and regression analysis between groups.	146 out of 1738 parent reports (8%) triggered alerts for 98 patients. 111 alerts (76%) required immediate review with 68 (61%) requiring contact. 46% (31/68) led to a change in care [medication adjustment (52%), scheduling an appt. (23%), and referral (23%]. Patients with alerts demonstrated worsened ADHD severity ($\beta = 5.8$, 95% CI: 3.5–8.1 [$p < 0.001$].	A trigger algorithm facilitated timely changes in the care in between face-to-face visits as measured by validated scales for ADHD severity. **Limitations:** Not randomized or blinded due to ethical concern. Minimal alert burden on clinicians due to low response rate. Did not assess patient outcomes or effects on medications.

Citation	Purpose	Sample/Setting	Study Design	Results	Discussion/ Limitations of findings
Power, T. J., Michel, J., Mayne, S., Miller, J., Blum, N. J., Grundmeier, R. W., … Fiks, A. G. (2016). Coordinating Systems of Care Using Health Information Technology: Development of the ADHD Care Assistant. *Advances in School Mental Health Promotion*, *9*(3-4), 201–218. DOI:10.1080/1754730X.2016.1199283	To examine the feasibility of the development and implementation of an EHR portal, known as the ADHD Care Assistant.	N= 279, 5 and 12 years of age, in the primary care network at Children's Hospital of Philadelphia 19 practices and 105 provider participated in the study between December 1, 2014 through July 31, 2015.	Feasibility study Providers were invited to participate in an educational intervention study designed to improve their use of evidence-based practices for managing ADHD Feasibility information obtained by extracting data from EHR for study providers and their patients with ADHD for whom the ADHD Care Assistant had been activated **Statistical Analysis:** bivariate ordinal logistic regression models for each characteristic that accounted for the clustering of observations within practices.	70 (67%) activated the Care Assistant for at least one patient during the 8-month project period. Care Assist use was lower in practices with higher Medicaid Across practices, 32% of providers activated Care Assistant for at least 5 patients and 15% activated it for 10 or more patients 279 parents complete Vanderbilt screenings (55%) and 165 teachers (33%).	The study showed the feasibility of an electronic system to collect parents and teachers information that is useful in decisions about ADHD; directly linked to the EHR, providers could have rapid access. **Limitations:** Findings are limited to the subset of practices / providers limits generalizability.

Table 2. Provider Education on DSM-V Criteria

DSM-V Criteria (ADHD) (Inattentive):

Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or with other activities.

Often has trouble holding attention on tasks or play activities.

Often does not seem to listen when spoken to directly.

Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., loses focus, side-tracked).

Often has trouble organizing tasks and activities.

Often avoids, dislikes, or is reluctant to do tasks that require mental effort over a long period of time (such as schoolwork or homework).

Often loses things necessary for tasks and activities (e.g. school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones).

Is often easily distracted.

Is often forgetful in daily activities.

DSM-V Criteria (ADHD) (Hyperactivity/Impulsivity)

Often fidgets with or taps hands or feet, or squirms in seat.

Often leaves seat in situations when remaining seated is expected.

Often runs about or climbs in situations where it is not appropriate (adolescents or adults may be limited to feeling restless).

Often unable to play or take part in leisure activities quietly.

Is often "on the go" acting as if "driven by a motor".

Often talks excessively.

Often blurts out an answer before a question has been completed.

Often has trouble waiting his/her turn.

Often interrupts or intrudes on others (e.g., butts into conversations or games).

Table 3. Provider Demographics (n=10)

	MD / DO (n=5)	**APRN / PA (n=5)**
Age (years)		
Mean ± SD	34 ± 2.9	36 ± 10
Range	31-38	27-52
Gender		
Female	4 (80%)	5 (100%)
Male	1 (20%)	--
Ethnicity		
White	1 (20%)	1 (20%)
African American	0 (0%)	3 (60%)
Asian	3 (60%)	0 (0%)
Other	1 (20%)	1 (20%)
Years of Experience		
Mean ± SD	3.1 ± 1.1	7.2 ± 7.5
Range	1-5	2-20
Years in Current Position		
Mean ± SD	2.3 ± 1.7	2.6 ± 0.9
Range	0.5-5	2-4
Employment Status n (%)		
Full-time	5 (100%)	3 (60%)
Part-time	0 (0%)	2 (40%)
Additional Mental Health Training		
Yes	1 (20%)	--
No	4 (80%)	--

Categorical variable = Chi Square, Continuous variables = Independent T-Test

Table 4. Provider Specific Use of DSM-V Criteria and Vanderbilt Completion (n=112)

	MD / DO	**APRN / PA**	**P Value**
	n=77	**n=35**	
DSM-V Criteria Used			**.009***
Yes	0 (0%)	4 (8%)	
No	16 (21%)	8 (17%)	
Incomplete	61 (79%)	23 (75%)	
Vanderbilt Completed			**.043***
Yes	40 (59%)	11 (33%)	
No	37 (39%)	24 (67%)	

*Categorical variable = Chi Square

Table 5. Pre- and Post-Intervention Patient Demographics

	Pre-Intervention (n=57)	**Post-Intervention (n= 55)**
Age (years)	9.4 ± 3.7	8.7±3.6
Gender		
Female	11 (20%)	13 (24%)
Male	46 (80%)	42 (76%)
Ethnicity n (%)		
White	1 (2 %)	0 (0%)
Hispanic	50 (88%)	45 (82%)
African American	6 (10%)	10 (18%)
Insurance Type		
Public	57 (100%)	55 (100%)
Patient Visit		
ADHD / Behavior Follow-Up	19 (33%)	24 (44%)
ADHD Screen at Routine Visit	38 (67%)	31 (56%)
Provider Screening		
MD / DO	39 (68%)	38 (69%)
APRN / PA	18 (32%)	17 (31%)
DSM-V Criteria Used		
Yes	1 (2%)	3 (5%)
No	13 (23%)	11 (20%)
Incomplete	43 (75%)	41 (75%)
Vanderbilt Completed		
Yes	22 (39%)	29 (53%)
No	35 (61%)	26 (47%)
ADHD Diagnosis Completed at Visit		
Yes	6 (11%)	6 (11%)
No	9 (16%)	10 (18%)
Diagnosis Already Established	42 (74%)	39 (71%)
Current Management		
Medication	6 (10%)	5 (9%)
Behavioral	9 (16%)	10 (18%)
Combination	11 (20%)	28 (33%)
None	3 (5%)	6 (11%)
Other [Refused Referral	28 (49%)	16 (29%)
Other Medical Conditions		
Overweight / Obesity	5 (9%)	4 (7%)
Asthma / Allergies	5 (9%)	4 (7%)
OSA / Tonsillar Hypertrophy	3 (6%)	1 (2%)
Seizure Disorders	2 (4%)	--
Other	5 (9%)	1 (2%)
None	36 (63%)	45 (82%)

Table 5 continued

	Pre-Intervention (n=57)	**Post-Intervention (n= 55)**
Other Behavioral / Mental Health		
Autism		
Learning Delays	7 (12%)	3 (5%)
Developmental Delays	5 (9%)	3 (5%)
Conduct or Oppositional Disorders	2 (4%)	0 (0%)
Other [PTSD, Depression, Trauma]	2 (4%)	2 (4%)
None	3 (5%)	2 (4%)
	38 (66%)	45 (82%)

MD/DO=physician; APRN = advanced practice registered nurse; PA=Physician assistant; OSA=obstructive sleep apnea; PTSD=post-traumatic stress disorder.

Appendix A. Provider Demographic Data Collection Form

1. Age _____
2. Gender: Male [ ], Female [ ]
3. Ethnicity: White [ ], Hispanic [ ], African American [ ], Asian [ ], Other : _____
4. Type of Provider: Physician [ ], PNP [ ], Physician Assistant [ ]
5. Years of Clinical Practice Experience _____
6. Years at Current Organization _____
7. Any additional training or certification is psychiatric / mental health. Yes [ ], No [ ]

Appendix B. Patient Electronic Health Record Data Collection Form

1. Age _____(at screened or diagnosed)
2. Gender: Male [ ] Female [ ]
3. Ethnicity: White [ ], Hispanic [ ], African American [ ], Asian [ ], Other : _____
4. Insurance: Public [ ], Private [ ], Uninsured / Self-pay [ ]
5. DSM-V Criteria Used for Screening: Yes [ ], No [ ], or Incomplete [ ]
6. Vanderbilt Completed: Yes [ ], No [ ], or incomplete [ ]
7. Current Management: [ ] Medication, [ ] Behavioral Therapy, [ ] Other _____
8. Other Medical or Behavioral Conditions: _____
9. Diagnosis made: [ ] Yes [ ] No [ ] Ongoing diagnosis

References

American Association of Colleges of Nursing (2006). The essentials of doctoral education for advance nursing practice. https://www.aacnnursing.org/Portals/42/Publications/DNPEssentials.pdf

American Academy of Pediatrics Subcommittee on Attention-Deficit/Hyperactivity Disorder, Steering Committee on Quality Improvement and Management, (2011). ADHD: Clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics, 128* (5), 1007-1022. https://doi.org/10.1542/peds.2019-2528

American Psychiatric Association (2013): Diagnostic and statistical manual of mental disorders (5th Ed). Arlington, VA: Author, 2013.

Austerman, J. (2015). ADHD and behavioral disorders: Assessment, management, and an update from DSM-5. *Cleveland Clinical Journal of Medicine, 82* (11), 2-7. DOI:10.3949/ccjm.82.s1.01

Barbaresi, W. J., Colligan, R. C., Weaver, A. L., Voigt, R. G., Killian, J. M. & Katusic, S. K. (2013). Mortality, ADHD, and psychosocial adversity in adults with childhood ADHD: A prospective study. *Pediatrics, 131*(4), 637-644. https://doi.org/10.1542/peds.2012-2354

Batstra, L., Nieweg, E. H., Pijl, S., Van Tol, D. G. & Hadders-Algra, M. (2014) Childhood ADHD: A stepped diagnosis approach. *Journal Psychiatry Practice*. *20*(3):169-77. DOI:10.1097/01.pra.0000450316.68494.20

Brown, N. M., Brown, S. N., Briggs, R. D., Germán, M., Belamarich, P. F. & Oyeku, S. O. (2017). Associations between adverse childhood experiences and ADHD diagnosis and severity, *Academic Pediatrics, 17*(4), 349-355. DOI:10.1016/j.acap.2016.08.013.

Brown, C. (2014). The Iowa Model of Evidence-Based Practice to Promote Quality Care: An illustrated example in Oncology Nursing. *Clinical Journal of Oncology Nursing, 18*(2), 157-159. doi:10.1188/14.CJON.

Biederman, J., Petty, C. R., Woodworth, K. Y., Lomedico, A., Hyder, L. L., & Faraone, S. V. (2012). Adult outcome of attention-deficit/hyperactivity disorder: a controlled 16-year follow-up study. *Journal of Clinical Psychiatry, 73*(7), 941-950. DOI:10.4088/JCP.11m07529.

Borschuk, A. P., Rodweller, C. & Salorio, C. F. (2018). The influence of comorbid asthma on the severity of symptoms in children with attention-deficit hyperactivity disorder. *Journal of Asthma*. *55*(1), 66-72. DOI: https://doi.org/10.1542/peds.2017-2475VVV

.Carroll, A. E., Bauer, N. S., Dugan, T. M., Anand, V., Saha, C., & Downs, S. M. (2013). Use of a computerized decision aid for ADHD diagnosis: A randomized controlled trial. *Pediatrics*, *132*(3), 623–629. DOI: 10.1542/peds.2013-0933

Co, J. P. T., Johnson, S. A., Poon, E. G., Fiskio, J., Rao, S. R., Van Cleave, J., Perrin, J.M. & Ferris, T. G. (2010). Electronic health record decision support and quality of care for children with ADHD. *Pediatrics, 126* (2) 239-246; DOI: https://doi.org/10.1542/peds.2009-0710

Cortese, S., Moreira-Maia, C. R., St. Fleur, D., Morcillo-Peñalver, C., Rohde, L. A. & Faraone, S. V. (2016). Association between ADHD and obesity: A systematic review and meta-analysis. *American Journal of Psychiatry*. *173*(1):34-43. https://doi.org/10.1176/appi.ajp.2015.15020266

Danielson, M. L.; Bitsko, R. H., Ghandour, R. M., Holbrook, J. R., Kogan, M. D. & Blumberg, S. J. (2018). Prevalence of Parent-Reported ADHD Diagnosis and Associated Treatment

among U.S. Children and Adolescents. *Journal of Clinical Child and Adolescent Psychology, 47*(2), 199-212. https://doi.org/10.1080/15374416.2017.1417860

Daley, M. F., Newton, D. A., De Bar, L., Newcomer, S. R., Pieper, L., Boscarino, J. A., Toh, S., Palowski, P., Nordin, J. D., Nakasato, C., Herrinton, L. J. & Bussing (2017). Accuracy of electronic health record–derived data for the identification of incident ADHD. *Journal of Attention Disorders, 21*(5), 416–425. https://doi.org/10.1177%2F1087054713520616

Epstein, J. N., & Loren, R. E. (2013). Changes in the Definition of ADHD in DSM-5: Subtle but Important. *Neuropsychiatry*, *3*(5), 455–458. https://doi.org/10.2217/npy.13.59

Epstein, J. N., Kelleher, K. J., Baum, R., Brinkman, W. B., Peugh, J., Gardner, W., Lichtenstein, P. & Langberg, J. (2014). Variability in ADHD care in community-based pediatrics. *Pediatrics, 134*(6), 1136-1143. https://doi.org/10.1542/peds.2014-1500

Feldman, H. M., & Reiff, M. I. (2014). Attention deficit-hyperactivity disorder in children and adolescents. *New England Journal of Medicine, 370*(9), 838-846 https://doi.org/10.1056/NEJMcp1307215

Fuemmeler, B. F., Sheng, Y., Schechter, J. C., Do, E., Zucker, N., Majors, A., Maguire, R., Murphy, S. K., Hoyo, C. & Kollins, S. H. (2020). February 10, 2020. Associations between attention deficit hyperactivity disorder symptoms and eating behaviors in early childhood. *Pediatric Obesity*. 1-10 https://doi.org/10.1111/ijpo.12631

Ghanizadeh, A. (2013). Agreement between diagnostic and statistical manual of mental disorders, fourth edition, and the proposed DSM-V attention deficit hyperactivity disorder diagnostic criteria: an exploratory study. *Comprehensive Psychiatry. 54*(1), 7-1. https://doi.org/10.1016/j.comppsych.2012.06.001

Gruschow, S. M., Yerys, B. E., Power, T. J., Durbin, D. R., & Curry, A. E. (2016). Validation of the Use of Electronic Health Records for Classification of ADHD Status. *Journal of attention disorders*, *23*(13), 1647–1655. https://doi.org/10.1177/1087054716672337

Hinshaw, S. (2018). Attention deficit hyperactivity disorder (ADHD): Controversy, developmental mechanisms, and multiple levels of analysis. *Annual Review of Clinical Psychology. 14*(1), 291-316. https://doi.org/10.1146/annurev-clinpsy-050817-084917

Hoagwood, K., Kelleher, K., Feil, M. & Comer, D. (2000). Treatment and services for children with attention deficit hyperactivity disorder: A national perspective. *Journal of the American Academy of Child & Adolescent Psychiatry, 39*(2), 198-206. https://doi.org/10.1097/00004583-200002000-00020

Iowa Model Collaborative, Buckwalter, K. C., Cullen, L., Hanrahan, K., Kleiber, C., McCarthy, A., Rakel, B., Steelman, V., Tripp-Reimer, T. & Tucker, S. (2017) Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing, 141* (5), 175-182. https://doi.org/10.1111/wvn.12223

Jamoom, E. W., Heisey-Grove, D., Yang, N., & Scanlon, P. (2016). Physician opinions about EHR use by EHR experience and by whether the practice had optimized its EHR use. *Journal of health & medical informatics, 7*(4), 1-19. https://doi.org/10.4172/21577420.1000240

Jansen, M. (2019) Use of guidelines to diagnose and treat childhood ADHD. *The Nurse Practitioner*. *44*(7), 37-42. DOI:10.1097/01.NPR.0000559845.76249.48

Lehmann, C. U., Kirkendall, E. S., Temple, M. W., Sisk, B., Krams, L. & Schneider, J. H. (2019). Use of electronic health records in pediatric office settings. *Pediatrics. 144* (2) https://doi.org/10.1542/peds.144.2_MeetingAbstract.27

Loudon, H., Nentin, F. & Silverman, M.E. (2016). Using clinical decision support as a means of Implementing a universal postpartum depression screening program. *Archives of Women's Mental Health* 19, 501–505. https://doi.org/10.1007/s00737-015-0596-y

Manos, M. J, Giuliano, K. & Geyer, E. (2017). ADHD: Over-diagnosed and overtreated, or misdiagnosed and mistreated? *Cleveland Clinical Journal of Medicine. 84*(11), 873-880. https://doi.org/10.3949/ccjm.84a.15051

Olson, B.G., Rosenbaum, P. F., Dosa, N.P. & Roizen, N. J. (2005). Improving guideline adherence for the diagnosis of ADHD in an ambulatory pediatric setting. *Ambulatory Pediatrics, 5*(3), 138–142. https://doi.org/10.1367/A04-047R.1

Osheroff, J., Teich, J. M., Middleton, B. F., Steen, E. B., Wright, A. & Detmer, D. E. (2007) A roadmap for national action on clinical decision support. *Journal of American Medicine Informatics Association, 14*(3), 141–145. https://doi.org/10.1197/jamia.M2334.

Oppenheimer, J., Ojo, O., Antonetty, A., Chiujdea, M.; Garcia, S., Weas, S., Loddenkemper, T., Fleegler, E. & Chan, E. (2019). Timely Interventions for Children with ADHD through Web-Based Monitoring Algorithms. *Diseases, 7*(1), 1-12. https://doi.org/10.3390/diseases7010020.

Pastor, P. N., Reuben, C. A., Duran, C. R. & Hawkins, L. D. Association between diagnosed ADHD and selected characteristics among children aged 4–17 years: United States, 2011–2013. NCHS data brief, no 201. Hyattsville, MD: National Center for Health Statistics. 2015.

Powers, E. M., Shiffman, R. N., Melnick, E. R., Hickner, A. & Sharifi, M. (2018) Efficacy and unintended consequences of hard-stop alerts in electronic health record systems: A

systematic review. *Journal of the American Medical Informatics Association*, *25*(11), 1556–1566, https://doi.org/10.1093/jamia/ocy112

Ramirez, M., Maranon, R., Fu, J., Chon, J. S., Chen, K., Mangion, C. M., Moreno, G. & Bell, D. (2018) Primary care provider adherence to an alert for intensification of diabetes blood pressure medications before and after the addition of a "chart closure" hard stop. *Journal of the American Medical Informatics Association*, 25(9), 1167-1174, https://doi.org/10.1093/jamia/ocy073.

Ramirez, M, Chen, K, Follett, R. W., Mangione, C. M. , Moreno, G. & Bell, D. S. (2020) Impact of a "chart closure" hard stop alert on prescribing for elevated blood pressures among patients with diabetes: Quasi-experimental study. *Journal of Medical Internet Research Medical Informatics*, *8*(4), 16421. https://doi.org/10.2196/16421

Rogers, D. M. (1983). *Diffusion of innovations.* 3rd Edition, The Free Press, New York, NY: The Free Press.

Rushton, J. L., Fant, K. E. & Clark, S. J. (2004) Use of practice guidelines in the primary care of children with attention-deficit/hyperactivity disorder. *Pediatrics, 114*(1), 23-28. https://doi.org/10.1542/peds.114.1.e23

Sedky, K., Bennett, D. S. & Carvalho, K. S. (2104). Attention deficit hyperactivity disorder and sleep disordered breathing in pediatric populations: a meta-analysis. *Sleep Medicine Review*. *18*(4), 349-356. https://doi.org/10.1016/j.smrv.2013.12.003

Temple, M. W., Sisk, B., Krams, L. A., Schneider, J. H., Kirkendall, E. S., Lehmann, C. U. (2019) Trends in use of electronic health records in pediatric office settings. *Journal of Pediatrics.* 206, 164-171. https://doi.org/10.1016/j.jpeds.2018.10.039

Titler, M. G., Kleiber, C., Steelman, V., Goode, C., Rakel, B., Barry-Walker, J. & …

Buckwalter, K. (1994). Infusing research into practice to promote quality care. *Nursing Research, 43*(5), 307–313.

Vreeman, R.C., Madsen, K.A., Vreeman, D. J., Carroll, A. E. & Downs, S. M. (2006) Compliance with guidelines for ADHD: a pilot study of an evaluation tool. *The Journal of Pediatrics, 149*(4), 568–571.

Wiemann, C. M, Hergenroeder A, C, Bartley, K. A, Sanchez-Fournier, B., Hilliard, M. E., Warren, L. J., Graham, S. C. (2015). Integrating an EMR-based transition planning tool for CYSHCN at a Children's Hospital: A quality improvement project to increase provider use and satisfaction. *Journal of Pediatric Nursing*. *30* (5), 776-787 https://doi.org/10.1016/j.pedn.2015.05.024

Wolraich, M. L., Lambert, W., Doffing, M. A., Bickman, L., Simmons, T. & Worley, K. (2003). Psychometric properties of the Vanderbilt ADHD diagnostic parent rating scale in a referred population, *Journal of Pediatric Psychology*, *28* (8), 559-568. https://doi.org/10.1093/jpepsy/jsg046