

The influence of task environment and health literacy on the quality of parent-reported ADHD data

S. C. Porter¹; C-Y Guo²; J. Molino³; S. L. Toomey⁴; E. Chan⁵

¹ Division of Paediatric Emergency Medicine, The Hospital for Sick Children, Department of Paediatrics, University of Toronto, Toronto Canada;

² Institute of Public Health, National Yang Ming University, Taipei, Taiwan;

³ Department of Health Policy and Management, Boston University School of Public Health, Boston MA;

⁴ Division of General Pediatrics, Children's Hospital Boston, Boston MA;

⁵ Division of Developmental Medicine, Children's Hospital Boston, Boston MA

Keywords

Attention deficit disorder with hyperactivity, information science, data collection, quality assurance, patient-provider communications

Summary

Objectives: To determine 1) the extent to which paper-based and computer-based environments influence the sufficiency of parents' report of child behaviors and the accuracy of data on current medications, and 2) the impact of parents' health literacy on the quality of information produced.

Methods: We completed a randomized controlled trial of data entry tasks with parents of children with Attention Deficit Hyperactivity Disorder (ADHD). Parents completed the NICHQ Vanderbilt ADHD screen and a report of current ADHD medications on paper or using a computer application designed to facilitate data entry. Literacy was assessed by the Test of Functional Health Literacy in Adults (TOFHLA). Primary outcomes included sufficient data to screen for ADHD subtypes and accurate report of total daily dose of prescribed ADHD medications.

Results: Of 271 parents screened, 194/271 were eligible and 182 were randomized. Data from 180 parents were analyzed. 5.6% parents had inadequate/marginal TOFHLA scores. Using the computer, parents provided more sufficient and accurate data compared to paper (sufficiency for ADHD screening, paper vs. computer: 87.8% vs. 93.3%, $P = 0.20$; accuracy of medication report: 14.3% vs. 69.4%; $p < 0.0001$). Parents with adequate literacy had increased odds of reporting sufficient and accurate data (sufficiency for ADHD screening: OR 8.0, 95% CI 2.0–32.1; accuracy of medication report: OR 4.4, 95% CI 0.5–37.4). In adjusted models, the computer task environment remained a significant predictor of accurate medication report (OR 18.7, 95% CI 7.5–46.9).

Conclusions: Structured, computer-based data entry by parents may improve the quality of specific types of information needed for ADHD care. Health literacy affects parents' ability to share valid information.

Correspondence to:

Eugenia Chan MD, MPH
Division of Developmental Medicine,
Children's Hospital Boston
300 Longwood Avenue
Boston, MA 02115
Phone: 617-355-3070
Fax: 617-730-4660
email: eugenia.chan@childrens.harvard.edu

Appl Clin Inf 2012; 3: 24–37

doi:10.4338/ACI-2011-10-RA-0062

received: November 4, 2011

accepted: January 11, 2012

published: January 18, 2012

Citation: Porter SC, Guo C-Y, Molino J, Toomey SL, Chan E. The influence of task environment and health literacy on the quality of parent-reported ADHD data.

Appl Clin Inf 2012; 3: 24–37

<http://dx.doi.org/10.4338/ACI-2011-10-RA-0062>

1. Background

Effective disease management that improves a child's Attention Deficit Hyperactivity Disorder (ADHD) requires timely and accurate information exchange between pediatric health providers and parents of affected children [1–3]. Parental health literacy is integral to the successful transfer of information and represents a key construct in the study of patient-centered care for childhood ADHD [4–7].

The classic model of office-based and paper-driven information exchange with the physician as the locus of control often fails to gather data needed for ADHD care [8, 9]. For example, only two-thirds of pediatricians report almost always obtaining parent or teacher ADHD rating scales for initial evaluation [10], and interventions to improve ADHD care have required additional personnel to manage the information exchange workflow [11]. Healthcare systems increasingly rely on technology and electronic media to organize and deliver care while simultaneously expecting patients to assume more responsibility for chronic disease management [12]. In childhood ADHD, technology-based initiatives and research to date have focused primarily on providers as the end-users for information technology [13–15].

To better understand factors relevant to parents' successful entry of information needed for ADHD management, we designed a clinical trial to explore the quality of information produced by parents working in paper-based and computer-based environments. Exploring health literacy as a parent-specific variable and its impact across task environments was a key element of this research effort.

2. Objectives

The specific aims of this project were to determine:

1. the extent to which paper-based and computer-based environments influence the sufficiency of parents' report of child ADHD symptoms and the accuracy of data on current medications, and
2. the impact of parents' health literacy on the quality of information produced across task environments.

3. Methods

3.1 Overview

From 2007–2009, we completed an un-blinded randomized controlled trial of data entry tasks using paper-based and computer-based environments to investigate the quality of information produced by parents [16]. Parents of children with ADHD were randomized based on their score on the Test of Functional Health Literacy in Adults (TOFHLA) to provide information on their children's current ADHD symptoms and prescribed medications.

3.2 Participants

We recruited English-speaking and Spanish-speaking parents of school-aged children with ADHD. Parents were eligible if they confirmed that: the child was between 5 and 12 years of age, a physician had diagnosed the child with ADHD, the child resided primarily with them, the parent was the person who managed the child's health, and the child was currently taking, or within the past 4 months had taken, prescription medication to treat ADHD. Exclusion criteria included report of any of the following diagnoses for the child: autism, pervasive developmental disorder, Asperger's disorder, bipolar disorder, or mental retardation.

Recruitment efforts across the greater Boston metropolitan area included newspaper advertisements, letters sent by pediatric practices, emails to parent support groups and list-serves, and marketing at community-based organizations. To facilitate recruitment of parents with lower literacy, plain-language materials were developed and personal contact with parents was emphasized during outreach.

3.3 Consent and Randomization

Parents were screened and completed a process of consent that included: viewing of a video explaining the study, discussion with research staff, and review of a one page plain language document describing the study and privacy laws.

Prior to randomization, a parent completed the full TOFHLA [17]. Parents were assigned to a “lower literate” (inadequate/marginal score) group and a “literate” (adequate score) group. Based on this group assignment, each parent was randomized through a mixture of permuted blocks to a “computer first” or a “paper first” series of data entry tasks.

3.4 Study procedures

Study procedures were completed at a location chosen by the parent, with the intention that most parents would prefer to complete tasks in a familiar environment (home or a nearby location). In theory, the site where health data tasks related to chronic disease management are completed would mimic these familiar environments.

3.4.1 Primary study procedures

Parents randomized to paper first received an envelope containing three forms with written instructions. The parent was told – “these forms are ones similar to what a doctor’s office might send you and ask that you fill out. Please open the envelope and fill out the forms as best you can.” Forms included the NICHQ Vanderbilt parent assessment form [18, 19], a medication side effects inventory (adapted from the San Diego ADHD Project with verbal permission from Laurel Leslie MD), and an open-ended, free-text request for information on current medications. Forms were completed either in English or Spanish according to the language the parent stated they used in health communication. All forms were printed in black and white on 8.5 x 11 inch paper. The research assistant observed the parents’ effort but did not provide interpretation of content.

Parents randomized to computer first were introduced to a laptop computer which was running the ADHD data entry application [20]. The research assistant supervised the parent in completing a log in procedure that brought up the introductory screen for the ADHD application. At this point, the parent was instructed to follow the directions on-screen and complete the work on their own. The content of computer-based tasks mirrored the content of the paper-based forms but the structure and workflow on the computer were designed to provide a guided experience that facilitated comprehension and task completion, but did not force parents to complete all items. For items from the NICHQ Vanderbilt, the questions and response options were identical in both task environments. For report of medications, the ADHD application used a nested navigational structure to present information on medications where the first task was finding and selecting the medication name, followed by other attributes for the drug. The research assistant observed the parents’ effort with the computer but did not interpret content nor give technical assistance.

Subsequently, all parents in both groups completed a series of surveys on demographics, technology-specific experience, prior use of health-related forms, and information about their child’s ADHD care. The final step was a structured, in-person review of all current prescription bottles containing medications to treat the child’s ADHD. This structured interview produced the gold standard determination of current ADHD medications including an examination of the prescription label/bottle and a discussion with the parent as to the actual daily dose and frequency of the medication.

3.4.2 Data processing and abstraction work

The paper forms filled out by the parents were abstracted and transferred to structured forms by a trained research assistant. The abstracted data and original forms for each subject were reviewed for accuracy by a two-person expert panel composed of a developmental-behavioral pediatrician (EC) and a clinical informatician (SCP). For the Vanderbilt form, abstraction included a raw rating that described how each answer appeared, as well as a clarified answer that interpreted the parent’s raw response according to how it would be used in clinical practice.

For the medication history form, the abstraction of parents' written documentation identified the number of medications reported and the presence/absence of specific attributes of each medication (name, formulation, strength, dose, frequency).

Data for report on behavior and current medications generated by parents' computer-based work were stored as text files.

3.5 Outcomes and definitions

We measured two primary outcomes for data quality for each subject:

1. sufficient data to allow for a positive or negative screen for inattentive or hyperactive subtypes of ADHD; and
2. an accurate report of the daily dose exposure for medication(s) used to treat ADHD as determined by the gold standard interview.

Sufficiency for screening of ADHD subtypes depended on the number of positive, missing, and/or indeterminate responses on performance and symptom items on the NICHQ Vanderbilt. ▶ Appendix A discusses how this definition and the definitions for subtypes were codified.

Accurate report of a daily dose exposure for a given medication required that a medication name be specified correctly and that the total daily dose in milligrams could be calculated based solely on the information provided by the parent. Accuracy of parental report for medications was judged against information collected during the gold standard interview, which required the parent to have the bottle or label to confirm the name, strength, and concentration of the medication. Minor misspellings (few missing letters or letters out of order) on the paper form were not grounds to judge the data as inaccurate as long as the medication could be readily identified (e.g. "aderol" for "Adderall", but not "aderol" for "Adderall XR"). In another example, a parent who wrote "concerta 18 mg each day" would have provided enough information to determine the dose exposure amount. A parent who wrote "concerta 18 mg" would not have provided enough information to be accurate. This strict definition for accuracy was used purposefully as the goal of the research was to determine parents' independent capacity to provide medication data without the need for clinicians' inference or clarification.

3.6 Analyses

The primary unit of analysis was the parent. Analyses were completed using an intention-to-treat approach and primary outcomes were judged on available data.

3.6.1 Analysis of sufficiency and accuracy

The outcomes of sufficiency and accuracy were considered dichotomous and crude associations were tested with literacy modeled both categorically and as a continuous predictor. Task assignment (paper vs. computer) was tested as a dichotomous predictor. Odds ratios and 95% CI were calculated to measure the effect size.

For analysis of medication data, we restricted the primary outcome to drugs that may be prescribed for children with ADHD and related co-morbidities, and only considered those medications from the gold standard interview where a bottle or label was available for review. For a given subject, we eliminated from consideration any medications that were taken as needed since we could not calculate a total daily dose. As a secondary outcome, we restricted the analysis only to subjects who reported a single medication.

Finally, as a secondary outcome, we examined the effect of task environment among parents who provided *both* sufficient ADHD symptom data *and* accurate report of ADHD medication.

3.6.2 Sample size calculation

For parents using paper, we estimated that 80% would produce sufficient data to screen for ADHD subtypes, and that 60% would provide an accurate medication report. Presuming the computer would improve data completeness to 95% and medication accuracy to 80%, we calculated that a total

of 180 subjects (90 randomized to each arm) would provide greater than 80% power at an alpha level of 0.05 to detect this difference between proportions.

3.6.3 Multivariable modeling strategy

Two logistic regression models were built for each of the primary outcomes. The first multivariable model included both task environment and health literacy as predictors. The second model adjusted for additional covariates including years since child's diagnosis, parents' gender, educational level, race, comfort with computers, experience with paper health forms, preferred language, and comfort with ADHD terms.

All analyses were completed using SAS version 9.1. Tests with the significance level of 5% were considered.

4. Results

We recruited and enrolled parents of school-aged children with ADHD from December 2007 to February 2009. A total of 271 parents were screened, 194/271 (72%) were eligible, and 180/194 eligible subjects (93%) comprised the trial cohort for analysis. One participant in each group was excluded from analysis post-randomization as they were found to be ineligible. See ► Figure 1 for a full account of the screening and enrollment process.

4.1. Description of parental cohort

Parents in the enrolled cohort represented a diverse group of individuals on the basis of education, race, ethnicity and experience with ADHD. Overall, the majority of parents reported exposure to and comfort with computers including how to navigate the internet. ► Table 1 shows the distribution of parents' characteristics across the randomized groups.

4.2 Data sufficiency for parental report of ADHD symptoms

A total of 163/180 parents (90.5%) provided sufficient data to allow for a positive or negative ADHD screen using the Vanderbilt parental assessment form. Of 163 with sufficient data, 63 (44.8%) screened negative for both subtypes, 49 (30.1%) screened positive for both subtypes, 28 (17.2%) screened positive for the inattentive subtype only, and 13 (8.0%) screened positive for the hyperactive subtype only.

4.2.1 Impact of task environment on sufficiency of ADHD symptom data

Of 90 parents randomized to the paper environment, 79 (87.8%) provided sufficient data for ADHD screening. On the computer, 84/90 (93.3%) gave sufficient data for ADHD screening. Computer-based task completion increased the odds of data sufficiency (OR 1.9, 95% CI 0.7 – 5.5).

4.2.2 Impact of parents' health literacy on sufficiency of ADHD screening

Most of the 180 parental subjects were literate. Of the lower literate group (N = 10), 0/3 parents with inadequate TOFHLA scores provided sufficient data to screen for ADHD, and 6/7 parents (85.7%) with marginal TOFHLA scores provided sufficient data. Of 170 literate parents, 157 (92.3%) provided sufficient data for ADHD screening. Literate parents, as compared to lower literate parents, had significantly increased odds of sufficient data (OR 8.0, 95% CI 2.0–32.1). With literacy modeled as a continuous score, we found a small but significantly increased odds of sufficient data reported for every single integer increase in the TOFHLA score (OR 1.1, 95% CI 1.0–1.1; $p = 0.0004$).

4.2.3 Multivariable adjusted models

Health literacy remained a significant predictor of sufficiency in the two predictor model with task assignment (► Table 2). When other parental factors were added into the model, health literacy did not retain significance. Excluding education as a covariate in the adjusted model did not change the results (data not shown).

4.3 Accuracy of report for ADHD medication use

Parents reported a total of 40 discrete medications used to treat their children's ADHD, from zero (no medications used at time of study interview) to a maximum of five. ► Table 3 lists the ten most common medications reported by parents. Most parents reported only one medication used to treat their child's ADHD (114/180, 63%).

One hundred forty-nine of 180 parents contributed data to this primary outcome. Thirty one subjects were excluded from analysis as the only medication reported was not a prescription medication common to ADHD care.

4.3.1 Impact of task environment on accuracy of medication report

Of 149 subjects, 77 completed tasks on paper, and 72 were assigned to the computer. Overall accuracy was poor; 61/149 (40.9%) parents provided accurate information on daily dose exposure for medications. Eleven of 77 parents (14.3%) using paper were accurate compared to 50/72 (69.4%) using the computer.

Assignment to the computer significantly increased the odds of accurate medication report (OR 13.6, 95% CI 6.1 – 30.7).

4.3.2 Impact of parents' health literacy on accuracy of medication report

Of the 149 parental subjects in this analysis, 142 were literate. Only 1/7 (14.3%) lower literate parents provided accurate data on medications. Of 142 literate parents, 60 (42.2%) provided accurate information. Eleven (15.1%) of literate parents using paper were accurate compared to 49 (71.0%) using the computer.

Literate parents had increased but non-significant odds of accurately reporting information on medications (OR 4.4, 95% CI 0.5 – 37.4). With literacy modeled as a continuous score, we found a small but significantly increased odds of accuracy for every single integer increase in the TOFHLA score (OR 1.1, 95% CI 1.0–1.1; $p = 0.02$).

4.3.3 Multivariable adjusted models

Task environment demonstrated a large effect size and retained significance in all models (► Table 4). Literacy, although not statistically significant, did demonstrate increased odds favoring improved accuracy for literate parents. Excluding education as a covariate in the adjusted model did not change the results (data not shown).

4.3.4 Secondary outcome: Accurate report of a single medication

One hundred eight parents reported a single medication used to treat ADHD. Eight of 50 parents (16.0%) using paper provided accurate information compared to 46/58 (79.3%) using the computer. Parents using the computer had significantly increased odds of accurate report of clinically sufficient information compared to parents using paper (OR 20.1, 95% CI 7.5 – 54.0).

The association between parental health literacy and the accurate report of commonly used medications was examined. Of 101 literate parents, 53 (52.5%) were accurate in their report of commonly used medications. Of 7 lower literate parents, 1 (14.3%) was accurate. Literate parents had increased odds of accurate report of clinically sufficient information on common medications (OR 6.6, 95% CI 0.8 – 57.0).

4.4 Secondary outcome: parents whose report was both sufficient and accurate

Finally, we examined a combined outcome of sufficient ADHD symptom data and accurate medication report. Overall, only 60/159 (40.3%) of parents provided both sufficient and accurate information. Parents using the computer had a higher rate of sufficient and accurate report compared to parents using paper forms, 49/72 (68.1%) versus 11/77 (14.3%). Zero of four (0%) lower literate parents were sufficient and accurate using paper, and 1/3 (33%) lower literate parents were sufficient

and complete using the computer. Adjusting for literacy, use of the computer significantly increased the odds of sufficient and accurate report for parents (OR 13.2, 95% CI 5.8 – 29.8).

5. Discussion

High-quality ADHD care requires accurate and complete reports from parents about child symptoms and medication use in order to best titrate prescribed medications to their maximal benefit while minimizing side effects [1–3, 21, 22]. Results from this randomized trial illustrate how task environment and parents' health literacy influence the quality of information shared. The findings we report build upon previously published results of decreased task burden, including temporal load, for parents' report of child-specific data in computer environments, and are highly relevant to efforts to design patient-inclusive solutions to chronic disease management in primary care [16, 23].

Primary care practices are challenged by how to effectively create a mechanism to gather, process, interpret, and use data from parent-completed surveys about behavior, medications, and potential side effects [8, 9, 24–26]. A minority of parents in our study successfully gave both sufficient *and* accurate data on paper, casting doubt on the systemic effectiveness of a paper-based solution to data gathering that does not impose significant error-checking burden on the medical home.

Our home-based field test approximated the real-world setting of a parent, in advance of a health visit, being sent paper forms to complete or being asked to log onto a website. The computer-based environment demonstrated benefit to the outcomes of sufficiency and accuracy of data, although the size and significance of the computer environment was most notable in parents' report of medications. This is likely due to two factors:

1. for ADHD symptom screening, the computer prompted parents to complete unanswered questions, and
2. for medication reporting, the computer provided a structured process with drop-down menus pre-populated for appropriate responses across attributes for a given medication [16].

As our protocol did not directly compare the computer application to a structured paper form for the report of medications, we cannot state with certainty which is more important for accuracy: the task environment or the structured nature of the communication. Idealized information management in primary care must consider:

1. parents' capacity to independently complete information tasks, and
2. optimal channels and structures for communication that promote parents' accurate and complete reporting.

A recent analysis of the 2003 National Assessment of Adult Literacy noted that at least one in four parents have limited health literacy skills which constrain parents' ability to complete health forms [27]. Our results suggest that parents' health literacy is a key factor in "information disparities" across two inter-related aspects of data quality – completeness and accuracy. Lower quality of data generated by parents is not just a problem of additional work at the time of a single office visit to repeat and clarify information. Deficits in data quality impact the overall efficiency and effectiveness of a primary care practice's efforts to organize and deliver high-quality ADHD care.

A computer-based communication channel which embeds a structured and hierarchical approach to gathering information on medications from parents remains an incomplete solution to the demand for accurate data [28]. In our study, the structured computer environment, although markedly better than an unstructured paper form, resulted in only two-thirds of parents successfully providing accurate data on medications.

This study has limitations that deserve discussion. We cannot comment on quality of care or child-specific outcomes that occurred more distal in time as we did not measure events after the single episode of data entry. Similarly, we cannot interpret the clinical significance of screening "positive" or "negative" for an ADHD subtype despite a working clinical diagnosis of ADHD based on a single report outside the context of a child's symptom and treatment trajectory. Further, our data do not address questions of whether parents' success in communicating information changes over time with repeated interaction in the paper or computer environment. Our results do not ad-

dress the potential technology barrier of “logging in” to the computer, as our protocol facilitated this aspect of human-computer interaction.

Our definitions for sufficiency and accuracy view the parents’ information in isolation and from a clinical standard of “good enough or not.” We recognize that there are gradations to how problematic missing or inaccurate data is based on the number of items that generate uncertainty. Our measure of health literacy, the TOFHLA, addresses reading comprehension and numeracy but does not provide insight into parents’ written, expressive, and receptive skills with regard to literacy. The small numbers of parents who scored inadequate/marginal on the TOHFLA limit our analysis of literacy as a predictor, and may reflect possible selection bias despite extensive efforts to recruit lower-literate parents from community sites. Finally, because there is currently no standardized measure of computer literacy, we used self-rated “comfort with computers” as a proxy in our analyses.

6. Conclusions

Parents of children with ADHD share information that is more complete and accurate when completing data entry in a structured, computer-based environment compared to commonly used paper forms. Literacy is a relevant factor to the success of parents’ ability to share ADHD-specific data about their child. Parent-completed, computer-based data entry has the potential to improve the quality of information needed for optimal decision-making in ADHD care.

Clinical Relevance

Results from this randomized trial illustrate how task environment and parents’ health literacy influence the quality of information shared by parents of children with ADHD. The findings inform efforts to design patient-inclusive solutions for primary care management of chronic disease.

Conflict of Interest

The authors have no disclosures or conflicts of interest to report.

Human Subjects Protections

The study was performed in compliance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects. The Children’s Hospital Boston Committee on Clinical Investigation approved the study protocol and the trial was registered (Clinicaltrials.gov identifier NCT00543257).

Acknowledgements

The authors thank Ms Rosanna Batista and Ms Ana Fernandes for their efforts both in managing the clinical trial and in creating a successful partnership with parents of children with ADHD as part of the research effort. This work was wholly funded by grant R01LM009256 from the National Institutes of Health (Dr. Porter). An abstract reporting results included in this manuscript was presented in May 2010 at the Pediatric Academic Societies’ Annual Meeting, Vancouver, BC, Canada. At the time of the study, Dr. Porter was affiliated with the Division of Emergency Medicine and Children’s Hospital Informatics Program, Children’s Hospital Boston, and Dr. Guo and Ms. Molino were affiliated with the Clinical Research Program, Children’s Hospital Boston.

Appendix A: Algorithm to determine sufficiency of data for an ADHD subtype

Step 1: Classifying ADHD symptom ratings on the NICHQ Vanderbilt.

ADHD symptoms are rated as occurring 0 (never), 1 (occasionally), 2 (often), or 3 (very often). For unclear responses (e.g., 2 ratings codes are circled; a mark appears between 2 rating codes), we employed the following clarification algorithm:

- Responses that fell between codes 2 and 3 were interpreted as “indeterminate but positive”
- Responses that fell between codes 0 and 1 were interpreted as “indeterminate but negative”
- Responses that fell between codes 1 and 2 were considered truly indeterminate

A symptom was considered positive if the rating code was 2 (often), 3 (very often) or “indeterminate but positive”. A symptom was considered negative if the rating code was 0 (never), 1 (occasionally), or “indeterminate but negative”. A symptom was “indeterminate” if the response was missing or reinterpreted as truly indeterminate.

Step 2: Classifying performance item ratings on the NICHQ Vanderbilt.

Performance items are rated as 1 (excellent), 2 (above average), 3 (average), 4 (somewhat of a problem), or 5 (problematic). For unclear responses, we employed a similar algorithm to the above:

- Responses that fell between codes 4 and 5 were interpreted as “indeterminate but positive”
- Responses that fell between codes 1 and 3 were interpreted as “indeterminate but negative”
- Responses that fell between codes 3 and 4 were considered truly indeterminate

Performance items were considered positive if the rating code was 4, 5, or “indeterminate but positive”. Performance items were considered negative if the rating code was 1, 2, 3, or “indeterminate but negative”. Performance items were “indeterminate” if the response was missing or reinterpreted as truly indeterminate.

Step 3: Determining sufficiency for screening ADHD subtypes

Sufficient data to meet criteria (“screen positive”) for an ADHD subtype required (a) at least 6 of 9 ADHD symptoms in either the inattentive or the hyperactive-impulsive symptom cluster to be positive, *and* (b) at least one performance item to be positive. Sufficient data to determine that a child did not meet criteria for an ADHD subtype (“screen negative”) required that (a) the child did not “screen positive” for an ADHD subtype, and (b) none of the conditions for insufficient data (below) was met.

Among those who do not “screen positive,” insufficient data to determine screening status included any of the following conditions:

- At least one performance item code was indeterminate
- Greater than 3 indeterminate codes within any symptom cluster

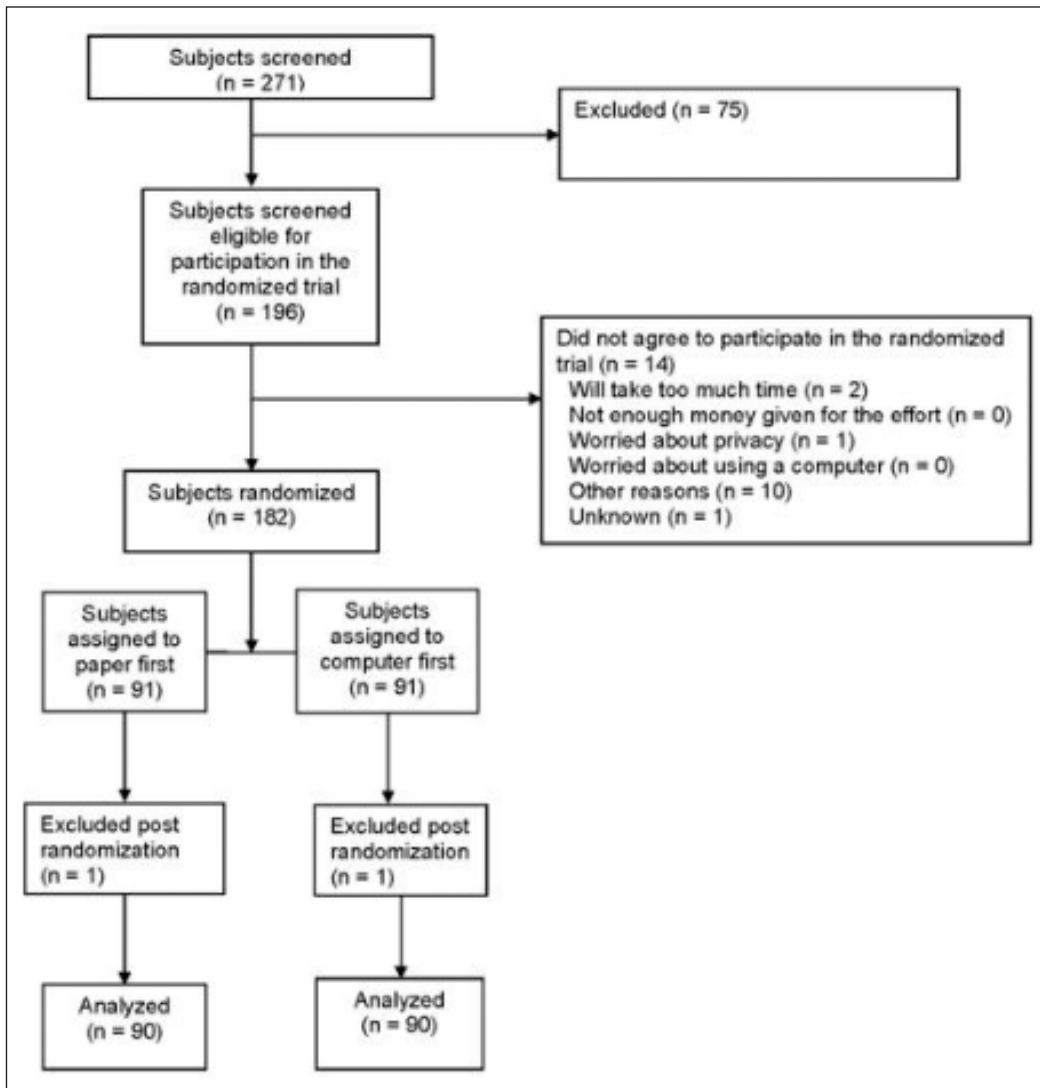


Fig. 1 Participant screening, enrolment, and randomization

Table 1 Characteristics for the analyzed cohort* (*No statistically significant differences)

		Paper		Computer	
N		90		90	
TOFHLA Score	Mean \pm SD	90.9 \pm 9.12		92.09 \pm 8.92	
		n	%	n	%
TOFHLA Category	Inadequate	1	1.1	2	2.2
	Marginal	4	4.4	3	3.3
	Adequate	85	94.4	85	94.4
Parent Gender	Male	4	4.4	7	7.8
	Female	86	95.6	83	92.2
Parent Race	White	42	46.7	48	53.3
	Non-white	48	53.3	42	46.7
	Black	25	27.8	25	27.8
	More than one race	9	10.0	2	2.2
	Other	14	15.6	15	16.7
Parent Ethnicity	Hispanic or Latino	10	11.1	10	11.1
	Not Hispanic or Latino	65	72.2	70	77.8
	Other,	15	16.7	10	11.1
Education Level	High school graduate, GED, or less	26	28.9	21	23.3
	Education beyond high school	64	71.1	69	76.7
Comfort with ADHD words	Very Uncomfortable/Uncomfortable/No opinion	20	22.2	30	33.3
	Comfortable/Very comfortable	70	77.8	60	66.7
Paper ADHD form experience	Yes	80	88.9	80	88.9
	No	10	11.1	10	11.1
Comfort with Technology	Very Uncomfortable/Uncomfortable/No opinion	28	31.1	23	25.6
	Very Comfortable/Comfortable	62	68.9	48	53.3
Years since Diagnosis	<1	21	23.3	23	25.6
	1–2	24	26.7	21	23.3
	3–4	30	33.3	27	30.0
	>5	15	16.7	19	21.1
Preferred language	English	87	96.7	86	95.6
	Spanish	3	3.3	4	4.4
Number of medications prescribed	None	6	6.7	8	8.9
	1	52	57.8	67	74.4
	2	30	33.3	12	13.3
	3	1	1.1	1	1.1
	4	1	1.1	2	2.2

Table 2 Multivariable logistic regression models examining the relationship between data sufficiency and the predictors of task environment and health literacy

Primary Predictor	Crude model with one predictor		Crude model with two predictors		Full model*	
	OR	95% CI	OR	95% CI	OR	95% CI
Task environment (computer vs. paper)	1.95	(0.69, 5.52)	2.04	(0.69, 6.02)	2.36	(0.70, 7.94)
Health literacy (literate vs. lower literate)	8.05	(2.01, 32.19)	8.39	(2.05, 34.34)	3.81	(0.52, 28.19)

*Adjusted for parents' gender, race, educational level, language, comfort with ADHD words, comfort with computers, experience with paper forms and time since child's ADHD diagnosis.

Table 3 List of twelve most commonly reported medications

Medication (brand)	Medication (generic)	Frequency
Concerta	Methylphenidate HCL	55
Adderall XR	Mixed amphetamine salts	30
Methylphenidate (generic)	Methylphenidate	24
Ritalin LA	Methylphenidate HCL	17
Focalin XR	Dexmethylphenidate HCL	15
Clonidine (generic)	Clonidine	15
Strattera	Atomoxetine HCL	14
Metadate CD	Methylphenidate HCL	11
Ritalin	Methylphenidate HCL	7
Adderall	Mixed amphetamine salts	6
Daytrana	Methylphenidate HCL (dermal)	4
Mixed amphetamine salts (generic)	Mixed amphetamine salts	3

Table 4 Multivariable logistic regression model examining the relationship between medication accuracy and the predictors of task environment and health literacy accuracy

Primary Predictor	Crude model with one predictor		Crude model with two predictors		Full model*	
	OR	95% CI	OR	95% CI	OR	95% CI
Task environment (computer vs. paper)	13.64	(6.06, 30.71)	14.10	(6.20, 32.05)	18.70	(7.47, 46.85)
Health literacy (literate vs. lower literate)	4.39	(0.52, 37.42)	5.90	(0.58, 60.65)	1.14	(0.35, 1.24)

*Adjusted for parents' gender, race, educational level, language, comfort with ADHD words, comfort with computers, experience with paper forms and time since child's ADHD diagnosis.

References

1. Committee on Quality Improvement, Subcommittee on ADHD. Clinical practice guideline: Diagnosis and evaluation of the child with attention-deficit/hyperactivity disorder. *Pediatrics* 2000; 105(5): 1158–1170.
2. Committee on Quality Improvement, Subcommittee on ADHD. Clinical practice guideline: Treatment of the school-aged child with attention-deficit/hyperactivity disorder. *Pediatrics* 2001; 108(4): 1033–1044.
3. Gephardt H. Where we are, and how we can succeed, at treating ADHD. *Contemporary Pediatrics* 2003; 20: 77.
4. Committee on Health Literacy. Health literacy: A prescription to end confusion. Washington, DC; 2004.
5. Rothman RL, Yin HS, Mulvaney S, Co JPT, Homer C, Lannon C. Health literacy and quality: Focus on chronic illness care and patient safety. *Pediatrics* 2009; 124 (Suppl. 3): S315–S326.
6. Sanders LM, Shaw JS, Guez G, Baur C, Rudd R. Health literacy and child health promotion: Implications for research, clinical care, and public policy. *Pediatrics* 2009; 124 (Suppl. 3): S306–S314.
7. Wolf MS, Davis TC, Parker RM. Editorial: the emerging field of health literacy research. *American Journal of Health Behavior* 2007; 31: S3–S5.
8. Rushton JL, Fant KE, Clark SJ. Use of practice guidelines in the primary care of children with attention-deficit/hyperactivity disorder. *Pediatrics* 2004; 114(1): e23–e28.
9. Epstein JN, Langberg JM, Lichtenstein PK, Mainwaring BA, Luzader CP, Stark LJ. Community-wide intervention to improve the attention-deficit/hyperactivity disorder assessment and treatment practices of community physicians. *Pediatrics* 2008; 122(1): 19–27.
10. Wolraich ML, Bard DE, Stein MT, Rushton JL, O'Connor KG. Pediatricians' attitudes and practices on ADHD before and after the development of ADHD pediatric practice guidelines. *Journal of Attention Disorders*. 2010; 13(6): 563–572.
11. Leslie LK, Weckerly J, Plemmons D, Landsverk J, Eastman S. Implementing the American Academy of Pediatrics attention-deficit/hyperactivity disorder diagnostic guidelines in primary care settings. *Pediatrics* 2004; 114(1): 129–140.
12. Breen G, Wan TTH, Zhang NJ, Marathe SS, Seblega BK, Paek SC. Improving doctor-patient communication: examining innovative modalities vis-a-vis effective patient-centric care management technology. *Journal of Medical Systems* 2009; 33(2): 155–162.
13. Groshek M. Clinical information system (CIS) baselets help standardize evaluation of ADHD in the KP Colorado region. *The Permanente Journal* 2002; 6(4): 65–68.
14. Lozano P. Using hand-held technologies to reduce errors in ADHD care. *AHRQ*; 2001.
15. Co JPT, Johnson SA, Poon EG, Fiskio J, Rao SR, Cleave JV, et al. Electronic health record decision support and quality of care for children with ADHD. *Pediatrics* 2010; 126(2): 239–246.
16. Porter CS, Guo C-Y, Bacic J, Chan E. Health literacy and task environment influence parents' burden for data entry on child-specific health information: Randomized controlled trial. *J Med Internet Res* 2011; 13(1): e13.
17. Parker RM, Baker DW, Williams MV, Nurss JR. The test of functional health literacy in adults: a new instrument for measuring patients' literacy skills. *J Gen Intern Med* 1995; 10(10): 537–541.
18. Wolraich ML, Lambert W, Doffing MA, Bickman L, Simmons T, Worley K. Psychometric properties of the Vanderbilt ADHD diagnostic parent rating scale in a referred population. *Journal of Pediatric Psychology* 2003; 28(8): 559–568.
19. Caring for children with ADHD: A resource toolkit for clinicians. Elk Grove Village, IL: American Academy of Pediatrics; 2002.
20. Sox CM, Gribbons WM, Loring BA, Mandl KD, Batista R, Porter SC. Patient-centered design of an information management module for a personally controlled health record. *Journal of Medical Internet Research* 2010; 12(3): e36–e.
21. Biederman J, Faraone SV, Monuteaux MC, Grossbard JR. How informative are parent reports of attention-deficit/hyperactivity disorder symptoms for assessing outcome in clinical trials of long-acting treatments? A pooled analysis of parents and teachers reports. *Pediatrics* 2004; 113(6): 1667–1671.
22. Brown RT, Amler RW, Freeman WS, Perrin JM, Stein MT, Feldman HM, et al. Treatment of attention-deficit/hyperactivity disorder: Overview of the evidence. *Pediatrics* 2005; 115(6): e749–e757.
23. Unertl KM, Weinger MB, Johnson KB, Lorenzi NM. Describing and modeling workflow and information flow in chronic disease care. *Journal of the American Medical Informatics Association* 2009; 16(6): 826–836.
24. Power TJ, Mautone JA, Manz PH, Frye L, Blum NJ. Managing attention-deficit/hyperactivity disorder in primary care: A systematic analysis of roles and challenges. *Pediatrics* 2008; 121(1): e65–e72.
25. Singh H, Naik AD, Rao R, Petersen LA. Reducing diagnostic errors through effective communication: harnessing the power of information technology. *Journal of General Internal Medicine* 2008; 23(4): 489–494.

26. Singh H, Thomas EJ, Khan MM, Petersen LA. Identifying diagnostic errors in primary care using an electronic screening algorithm. *Arch Intern Med* 2007; 167(3): 302–308.
27. Yin HS, Johnson M, Mendelsohn AL, Abrams MA, Sanders LM, Dreyer BP. The health literacy of parents in the United States: A nationally representative study. *Pediatrics* 2009; 124 (Suppl. 3): S289-S298.
28. Porter SC, Kohane IS, Goldmann DA. Parents as partners in obtaining the medication history. *Journal of the American Medical Informatics Association* 2005; 12(3): 299–305.