

**ORIGINAL RESEARCH**

# Prompting Primary Care Providers about Increased Patient Risk As a Result of Family History: Does It Work?

Philip Zazove, MD, Melissa A. Plegue, MA, Wendy R. Uhlmann, MS,  
and Mack T. Ruffin IV, MD

**Background:** Electronic health records have the potential to facilitate family history use by primary care physicians (PCPs) to provide personalized care. The objective of this study was to determine whether automated, at-the-visit tailored prompts about family history risk change PCP behavior.

**Methods:** Automated, tailored prompts highlighting familial risk for heart disease, stroke, diabetes, and breast, colorectal, or ovarian cancer were implemented during 2011 to 2012. Medical records of a cohort of community-based primary care patients, aged 35 to 65 years, who previously participated in our Family Healthware study and had a moderate or strong familial risk for any of the 6 diseases were subsequently reviewed. The main outcome measures were PCP response to the prompts, adding family history risk to problem summary lists, and patient screening status for each disease.

**Results:** The 492 eligible patients had 847 visits during the study period; 152 visits had no documentation of response to a family history prompt. Of the remaining 695 visits, physician responses were reviewed family history (n = 372, 53.5%), discussed family history (n = 159, 22.9%), not addressed (n = 155, 22.3%), and reviewed family history and ordered tests/referrals (n = 5, 0.7%). There was no significant change in problem summary list documentation of risk status or screening interventions for any of the 6 diseases.

**Conclusions:** No change occurred upon instituting simple, at-the-visit family history prompts geared to improve PCPs' ability to identify patients at high risk for 6 common conditions. The results are both surprising and disappointing. Further studies should examine physicians' perception of the utility of prompts for family history risk. (J Am Board Fam Med 2015;28:334–342.)

**Keywords:** Genetics, Primary Health Care, Reminder Systems

A major goal of primary care is to identify at-risk patients who may benefit from early interventions with various diseases. Family histories could help primary care physicians (PCPs) more effectively identify patients at risk for developing common chronic

conditions such as heart disease, diabetes, and some types of cancer<sup>1–8</sup> because both genetic and environmental components of disease are captured.<sup>9</sup> Identifying at-risk individuals could facilitate preventive care and surveillance and potentially reduce morbidity and mortality.<sup>1,2,4</sup> Family history is, however, often not done in primary care or is done poorly.<sup>1,10–17</sup>

Several reasons for limited family history use exist, including time, complexity, accuracy, and perceived lack of utility.<sup>10,18–20</sup> Patients often do not know their family history<sup>14</sup> or PCPs lack the knowledge to take a good family history, ascertain patients at increased risk, and intervene accordingly.<sup>1,13–17</sup> One study found that discussions of family history occurred during only 51% of new and 22% of established patient visits, and these averaged <2.5 minutes.<sup>10</sup>

This article was externally peer reviewed.

Submitted 12 May 2014; revised 26 August 2014; accepted 11 September 2014.

From the Department of Family Medicine (PZ, MAP, MTR), the Division of Molecular Medicine and Genetics, Department of Internal Medicine (WRU), and the Department of Human Genetics (WRU), University of Michigan, Ann Arbor.

**Funding:** This study was supported by Blue Cross Blue Shield Foundation of Michigan (grant no 1672.PIRAP).

**Conflict of interest:** none declared.

**Corresponding author:** Philip Zazove, MD, Department of Family Medicine, University of Michigan, 1018 Fuller St, Ann Arbor, MI, 48104 (E-mail: pzaz@umich.edu).

There have been efforts to increase the use of family history information. The surgeon general launched the Family History Initiative in 2004, creating an online tool ([www.hhs.gov/familyhistory](http://www.hhs.gov/familyhistory)) for patients to collect and print family history information to share with relatives and physicians. Several primary care organizations, including the American Academy of Family Physicians,<sup>21</sup> the American Academy of Pediatrics,<sup>22</sup> and the US Preventive Services Task Force,<sup>23</sup> encourage the use of family history.

Although family history information allows physicians to recommend prevention and screening tailored to each patient's level of familial predisposition,<sup>24,25</sup> there exists little evidence that this improves patient outcomes.<sup>11,12</sup> One randomized trial of a computer decision support for familial breast and colon cancer demonstrated more referrals to genetic clinics than usual care, with referrals significantly more consistent with guidelines.<sup>26</sup> A recent National Institutes of Health State-of-the-Science conference concluded that more research is needed.<sup>11</sup>

We do know that primary care practices are very complex.<sup>27,28</sup> PCPs have multiple demands on their time during clinic hours, ranging from acute patient needs to meeting required quality metrics, plus much "after-hours" work,<sup>29</sup> making it difficult for them to effectively implement new interventions, regardless of their importance.<sup>27,30–32</sup> This, in addition to the aforementioned low awareness and understanding of how to use family history data, helps to explain in part the poor performance of PCPs in this arena.

The widespread adoption of electronic health records (EHRs) provides an opportunity for PCPs to better use family history information. Clinical reminder systems do improve the management of chronic diseases.<sup>33,34</sup> EHR algorithms can use inputted family history to determine a risk score and then prompt PCPs to address various conditions among patients with high-risk family histories. Nevertheless, as already mentioned, there are many barriers to the adoption and use of these systems, including difficulty integrating into, or disruption of, workflow.<sup>35</sup> As Zafar<sup>36</sup> pointed out: "[information technology (IT)] solutions will almost always be distracting and be abandoned unless specific attention is paid to re-engineering workflows or integrating IT solutions into existing workflows!" The Committee on Engaging the Computer Science Research Community in Health Care Informatics of the National Research Council has iden-

tified "organizational systems-level research into the design of health care systems processes and workflow" as 1 of 3 critical areas in need of health IT research.<sup>37</sup> Moreover, using family history for screening differs from interventions for preexisting chronic diseases. This study was designed to determine whether tailored prompts to PCPs increased the effective use of family history information in decision making.

## Methods

This was a prospective, real-time intervention study of how family physicians in 5 University of Michigan-affiliated clinics would respond to validated family history data from 800 patients that were presented at the time of any visit of those patients. The family history data used were from the Family Healthware study, which has been described elsewhere.<sup>38–42</sup> Eligible patients were 35 to 65 years old, spoke English, were not pregnant, and had no coronary heart disease, stroke, diabetes mellitus, or any cancer (except nonmelanoma skin cancer). The Family Healthware data used in this study had been collected via an interactive, online tool that collects and records personal and family history (maternal and paternal first- and second-degree relatives) for 6 common diseases (coronary heart disease, stroke [cerebrovascular accident], diabetes, and colorectal, breast, and ovarian cancer[s]) and ages at onset; algorithms were used to generate a 3-tiered family history-based risk assessment for each disease.<sup>43</sup> The risk categories, validated by focus groups and epidemiologic studies, included the following<sup>44</sup>:

- **Weak:** no family history or a late-onset disease in only one second-degree relative
- **Moderate:** one first-degree relative with late-onset disease or 2 second-degree relatives from the same lineage with late-onset disease
- **Strong:** a first-degree relative with early onset disease, multiple relatives affected, or a hereditary syndrome identified

For most common chronic diseases, a moderate familial risk has a 2-fold increase risk over a weak familial risk, and a strong familial risk has at least a 3-fold increase.<sup>25</sup>

This study, approved by the University of Michigan Institutional Review Board, was conducted

from July 1, 2011, through June 30, 2012, and included all 800 patients participating in the Family Healthware study for whom we had family history risk assessments. Family medicine physicians received an automated prompt when they saw any of these patients who had a moderate or strong family history risk for 1 or more of the 6 diseases. The prompts identified which disease(s) the patient was at moderate or strong risk for and identified which family members contributed to the risk. Other nonfamilial risk factors such as smoking were already in the EHR. The physicians had 10 years of experience with both an EHR and a clinical prompting system for preventive services and chronic disease management.<sup>45</sup> In addition, they normally received regular reports of responses to all prompts stratified by individual PCPs, teams of PCPs, and clinics.

The family history prompts for this study followed the standard format and categories used for other prompts, though definitions varied slightly depending on the clinical issue. They required PCPs to check one of the following responses:

- **Service provided:** Family history was reviewed with the patient.
- **Ordered service:** Family history was reviewed with the patient and a test/referral was ordered as a result.
- **Patient declined:** You (the PCP) brought up family history but the patient declined to discuss.
- **Not a candidate:** Family history was incorrect or the summary attachment was not provided.
- **Discussed:** You (the PCP and the patient) discussed the family history but no decision was made. You (the PCP) did not order any tests or referrals and want to be prompted again.
- **Not addressed or doctor decided against:** You did *not* bring up family history.

The prompts were not repeated at subsequent visits if the clinician checked service provided, ordered service, or not a candidate. The discussion duration was not assessed.

The prompt definitions were reviewed at separate faculty meetings, 2 months apart, before the study began. Feedback from the first meeting was used to improve wording for the prompt response actions, category definitions, and report format. At the second meeting, the improved format was presented, with general acceptance.

The data for this study were obtained via manual chart audits for every visit at which a family history prompt occurred. Trained auditors reviewed the visit notes, test orders, and referrals to determine whether family history was discussed, whether family history of a disease was added to the problem summary list (PSL), and whether ordered tests/referrals were related to family history prompts. This information was linked to the original Family Healthware study data, which included procedure dates for interventions such as occult stool blood cards, exercise stress tests, mammograms, blood pressure, cervical cytology, and various blood tests such as lipid profiles.

### **Statistical Methods**

The study was a postintervention evaluation and analyzed whether electronic prompts changed behaviors by looking at whether (1) PSL updates occurred, (2) prompts resulted in discussion and/or tests/referrals/screening being ordered/discussed, and (3) screening for each disease was current when a patient was at high risk (ie, patients with family history at-risk prompts were up to date with recommended screening tests for the high-risk condition). Descriptive statistics of these 3 interventions were calculated for all patients seen during the study period, as well as for PCP-related data (eg, number of prompts). Changes to the PSL were analyzed by comparing dates of PSL entries with visit dates to ascertain whether prompting affected PSL entries for patients at higher (moderate or strong) risk for each of the 6 diseases studied.

Physician responses to prompts were investigated via the physician's self-recorded response (ie, what they did in response to the prompt) and actions taken (ordering/performing tests, discussing screening, or referring to a specialist). The physician's recorded response was compared with visit type (health maintenance exam [HME], chronic, or acute) using the Fisher exact test. Actions taken at any visit for each patient were compared with family history risk for the 6 diseases individually as well as the disease(s) for which a patient was at elevated risk (cancer only, noncancer only, both, or none) to determine whether prompts increased testing/referrals to clarify the patient's risk. For female-specific interventions, only women were used in the analysis. All comparisons were performed using  $\chi^2$  tests.

Whether screening was current for heart disease (lipids within 3 years), breast cancer (mammogram

**Table 1. Demographics and High Risk Conditions for Subjects**

Variable	n (%)
Sex	
Female	320 (65.0)
Male	172 (35.0)
Age, years	
Mean (SD)	49.7 (8.0)
Range	35–65
Race	
White	454 (92.3)
Black	15 (3.0)
Other or multiple races	23 (4.7)
Conditions with increased risk	
Heart disease	339 (68.9)
Stroke	295 (60.0)
Diabetes	236 (48.0)
Breast cancer*	87 (27.2)
Colon cancer	75 (15.2)
Ovarian cancer*	36 (11.3)
Diseases at elevated risk, n	
0	17 (3.5)
1	137 (27.8)
2	150 (30.5)
3	134 (27.2)
4	43 (8.7)
5	9 (1.8)
6	2 (0.4)

Data are n (%) unless otherwise indicated.

\*Numbers and percentages are based on the female subset only. SD, standard deviation.

or complete breast examination within 2 years), colon cancer (colonoscopy within 10 years, flexible sigmoidoscopy within 5 years, or fecal occult blood test within 1 year), and diabetes (screening within 2 years) was assessed for all patients. Screening status was compared with age, family history risk status for corresponding diseases, and whether PCPs ordered/performed testing/screening during the visit using  $\chi^2$  tests. Patients also were stratified by disease risk status, and screening status and ordering/performing tests were compared using  $\chi^2$  tests.

## Results

Of the 800 patients with information about their family history, 492 were seen during the study period. Demographic characteristics are summarized in Table 1. These 492 patients had 847 visits: 695 visits had provider response information and 152 had no response to the family history prompt.

Of the 695 visits, 28.3% were for an HME, 38.3% were for chronic conditions, and 33.5% were for acute conditions.

### Frequency of Visits/Provider

Eighty-nine providers received at least one prompt during the year (patients could have a prompt at every visit if clinicians did not respond to them); the number of prompts per physician per year ranged from 1 to 42; the average was 7.8 prompts/year (standard deviation,  $\pm 8.2$ ). These 89 providers had between 1 and 36 unique patients with at least 1 family history risk prompt, with a mean of 6.4 (standard deviation,  $\pm 6.5$ ).

### PSL Documentation

During the study period there was no overall change in listing the family history risk on the PSL for any of the 6 conditions (Table 2). Few new PSL entries were made, and most of those happened before the physicians would have been prompted.

### Provider Responses

Table 3 shows the frequency of each type of provider response (last column). Five visits did not have valid visit type information and were excluded. The most common response was “service provided” (53.5%). The rest of Table 3 shows that physicians’ recorded responses and visit types were related ( $P < .001$ ), with substantially more “discussed” prompts during acute visits and fewer during HME visits. The same held true for “doctor decided against.” However, there were more “service

**Table 2. Number and Type of Changes in the Problem Summary List**

Condition for Which a Family History Risk Existed	Patients at Elevated Risk (n)	Visits (n)	PSL Entries of Elevated Risk (n)		
			Before Visits	At or After Visit	Total
Heart disease	339	577	0	0	0
Diabetes	236	418	0	0	0
Stroke	295	515	1	2	3
Colon cancer	75	124	1	0	1
Breast cancer*	87	139	13	1	14
Ovarian cancer*	36	60	0	0	0

\*Women only.

PSL, problem summary list.

**Table 3. Comparison of Provider Responses to Family History Prompt By Visit Type\***

Provider Response	Visit Type			Total (n = 690) <sup>†</sup>
	HME (n = 195)	Chronic (n = 264)	Acute (n = 231)	
Discussed	28 (14.4)	61 (23.1)	69 (29.9)	158 (22.9)
Doctor decided against	9 (4.6)	58 (22.0)	86 (37.2)	153 (22.2)
Not a candidate	2 (1.0)	1 (0.4)	1 (0.4)	4 (0.6)
Ordered service	2 (1.0)	3 (1.1)	0 (0.0)	5 (0.7)
Service provided	154 (79.0)	141 (53.4)	75 (32.5)	370 (53.6)

Data are n (%).

\**P* value < .001, Fisher exact test (applies to the entire table).

<sup>†</sup>Five observations were missing visit type information and are not included here.

HME, health maintenance exam.

provided” or “family history reviewed” responses during HME visits and fewer during acute visits.

### Procedures/Tests Ordered

Table 4 shows distribution of the family history prompts generated during the study based on risk status. There were few associations of generated prompts with ordering or providing appropriate tests. Cardiac stress tests were ordered more for patients with a family history of heart disease (*P* = .037). Of the 11 patients with cardiac stress tests ordered, 8 were at high risk for heart disease only or heart disease plus another condition, and the remaining 3 patients were at risk for other diseases but not heart disease, and no stress tests were ordered for patients who were not at risk. During HME visits, complete breast exams were more likely for women at risk for both cancer and non-cancer diseases (*P* = .006), and 89.6% of those women received the examination during the visit versus 56.2% of women at risk for only cancer diseases, 75.6% who were at risk for only noncancer diseases, and 0% who were not at risk; we accounted for age (ie, >50 vs <50 years old) in this analysis. During visits for the management of chronic conditions, those at risk for noncancer conditions (heart attacks, strokes, and diabetes) were more likely to discuss cardiac screening (17.1%; *P* = .03) than those at risk for only cancer (0%), those at risk for both cancer and noncancer conditions (6.3%), and those not at risk for any disease (0%). Glucose testing (25% vs 9.1%; *P* = .009), lipid testing (25% vs 9.1%; *P* = .006), and HME

recommended/ordered (37.5% vs 8.3%; *P* = .034) were more common among those not at risk for any condition than those with cancer condition risks.

### Referrals

Physicians were not more likely to refer higher-risk patients for genetic counseling, weight-loss programs, exercise programs, smoking cessation, or a specialist consult (eg, gastroenterologist, oncologist).

### Screening Status

We looked at the relationship of lipid screening (if done within the past 3 years), breast cancer screening (if done within the past 2 years), and colorectal cancer screening (if done within the appropriate screening guidelines). We did not find any relationship between the patients’ screening status for any of these conditions and a family history of risk for that condition.

For diabetes screening, patients were categorized as having screening within 2 years (*n* = 137) or ≥2 years ago (*n* = 225); 130 patients with no diabetes testing were excluded from the analysis. There was no significant relationship between screening status and diabetes risk status alone. Glucose testing was, however, performed more often during visits for those with no diabetes testing within 2 years compared with those who had test-

**Table 4. Distribution of Patient Prompts by Risk Status**

	Cancer Risk Only	Noncancer Risk Only	Both Cancer and Noncancer Risk	
			Both Cancer and Noncancer Risk	Not at Risk
Disease type risk status	29	325	120	17
Disease-specific risk status	Specified Disease Risk Only	Other Disease Risk Only	Both Specified and Other Disease Risk	Not at Risk
Diabetes	39	239	196	17
Heart disease	45	136	293	17
Stroke	30	179	265	17
Colon cancer	7	399	68	17
Breast cancer*	13	231	74	1
Ovarian cancer*	3	282	33	1

\*Women only.

ing (18.7% vs 9.5%;  $P = .018$ ) and, when stratified by familial risk, those with increased risk for diabetes had increased glucose testing when not current (19.1% vs 7.7%;  $P = .048$ ).

## Discussion

Overall there was no evident effect of instituting simple at-the-visit family history prompts to improve a PCP's ability to identify patients at risk for 6 common conditions, even though they had none of the diseases at the time of the study. There was no increase in PSL documentation of the increased risk and an almost total lack of discussion, testing, or referrals for pertinent patients based on our chart reviews. In fact, most of the at-risk conditions were not listed on the PSL as the patient being at risk for that condition. Our results are both surprising and disappointing, particularly considering the increasingly widespread use of EHRs with automated prompts and increased focus on quality metrics. However, these findings do not mean the conditions identified by our prompts are not being addressed. We see several possible explanations.

First, physicians may perceive little benefit of listing family history risks on the PSL. Early during the EHR transition with our University of Michigan family medicine group, we encountered a similar problem with PSL documentation for chronic diseases (eg, diabetes). Once clinicians experienced the benefit of listing these in the PSL (allowing the EHR to prompt at visits regarding appropriate interventions and allowing the practice to evaluate panels of patients with diseases), the PSL became more comprehensive and up to date. In part, this probably reflects that, with the increasing emphasis on evidence-based practice for a now-sizeable number of conditions and the metrics that accompany this, physicians appropriately give lower priority to interventions that have yet to show improvements in patient outcomes, no matter how promising. This is not totally the situation, however, because we know of conditions for which interventions have been shown to be useful if detected early (eg, hearing loss<sup>46</sup>) but these effective interventions are not being done by PCPs. Rather, the sizeable number of conditions for which PCPs are being asked to screen for and follow-up on and the complexity of primary care, far in excess of the time available to do what is requested, may be the reason for perceived lack of benefit.<sup>27</sup>

Until recently there existed no widespread algorithms for when a patient's PSL lists a family risk for a particular disease. This may explain why clinicians do not update the PSL with this history. Now, a strong risk for heart disease might generate a prompt to consider aspirin therapy. Some PCPs may remain unaware of the benefits of prompts to patient care. More likely, they have not yet seen a benefit in adding family history to PSL, given the extra time it takes in already busy clinics. The PSL is mainly a list of problems, whereas family history is a risk, not a medical condition. As more benefit of listing at-risk family histories is identified, we suspect more clinicians will do so.

Second, all 6 conditions are mostly multifactorial. The increased genetic predisposition based on family history is only one of many factors that determine whether a patient develops a disease. Most patients in primary care have positive family histories, putting them at risk for at least one, and often multiple, conditions. Thus family history may be considered just one of multiple risk factors and not worth addressing with testing or was already addressed in other ways or via previous discussion, even though we prompted for only higher-risk patients.

Third, it is possible that physicians felt they were already doing appropriate interventions and no additional testing/discussion was needed. We cannot verify this because we did not survey physicians regarding why they did or did not respond to prompts. Many of the interventions are standard of care depending on patients' age or sex; this may explain the lack of any response. Moreover, screening rates were generally high, suggesting that physicians were already considering patients' family histories or other information (eg, age, sex). This may be the case since patient-centered medical homes emphasize having other team members (eg, medical assistants) initially respond to prompts under a physician's supervision, which increases the likelihood that appropriate interventions get done.

Fourth, we did not survey the physicians. It is possible that for some at-risk patients, physicians did take additional histories and decided the patients were not at risk for specific conditions. This would not, however, explain the lack of difference between physicians who responded that they discussed the disease versus those who did not. Fifth, individual physicians saw our family history prompts infrequently, perhaps one every other month, on average. This is much less frequent than many prompts

(eg, diabetes-related prompts), which occurred several times per day. Thus physicians may have deemed the family history prompts relatively unimportant.

Sixth, our population may not be indicative of other populations. For instance, we had a relatively low prevalence of minority groups in our study. Last, but not least, many PCPs remain uncomfortable with and lack knowledge about genetics,<sup>16</sup> how to take family histories,<sup>17</sup> and how a positive family history affects a patient's risk for a condition. This occurs in part because they see few patients with clear-cut genetic disorders and many patients with multifactorial etiologies. This may create a relative disinterest in genetic risk factors versus more highly publicized risk factors (eg, smoking, obesity, high cholesterol).

Our study has some limitations. The physicians were already being prompted for multiple diseases; the new prompts may have been ignored because of prompt fatigue, which has been described elsewhere.<sup>45</sup> Our study was conducted using academic physicians, who may have knowledge of family history risks and practice styles different from those of private practitioners, and our findings may not apply to nonacademic settings. Moreover, the almost 500 at-risk patients were spread over 5 clinics and 89 providers throughout the year. Our definitions of prompt responses, though discussed with faculty before implementation, were slightly different from the usual definitions; physicians may have been confused by which response to use because of the infrequency of family history prompts.

## Conclusion

We found that prompting academic family physicians about patients with family histories showing risk for 6 common conditions did not seem to increase the identification or screening of these patients. Other experts reached a similar conclusion after examining and debating the value of family history.<sup>11</sup> One study did show that automated collection of family history can identify more patients at risk for heart disease, but it did not go on to demonstrate improved patient care outcomes from the availability of such information.<sup>47</sup> More studies that examine the clinical utility of family history, including the best way to engage PCPs in using this information are needed before we begin to use automated prompts and alerts for high-risk family histories.

## References

1. Frezzo TM, Rubinstein WS, Dunham D, Ormond KE. The genetic family history as a risk assessment tool in internal medicine. *Genet Med* 2003;5:84–91.
2. Guttmacher AE, Collins FS, Carmona RH. The family history—more important than ever. *N Engl J Med* 2004;351:2333–6.
3. Reid GT, Walter FM, Brisbane JM, Emery JD. Family history questionnaires designed for clinical use: a systematic review. *Public Health Genomics* 2009;12:73–83.
4. Yoon PW, Scheuner MT, Peterson-Oehlke KL, Gwinn M, Faucett A, Khoury MJ. Can family history be used as a tool for public health and preventive medicine? *Genet Med* 2002;4:304–10.
5. Yoon PW, Chen B, Faucett A, et al. Public health impact of genetic tests at the end of the 20th century. *Genet Med* 2001;3:405–10.
6. Khoury MJ, Gwinn M. What role for public health in genetics and vice versa? *Community Genet* 2006; 9:282, author reply 3.
7. Williams RR, Hunt SC, Heiss G, et al. Usefulness of cardiovascular family history data for population-based preventive medicine and medical research (the Health Family Tree Study and the NHLBI Family Heart Study). *Am J Cardiol* 2001;87:129–35.
8. Walter FM, Prevost AT, Birt L, et al. Development and evaluation of a brief self-completed family history screening tool for common chronic disease prevention in primary care. *Br J Gen Pract* 2013;63: e393–400.
9. Khoury MJ. Genetics and genomics in practice: the continuum from genetic disease to genetic information in health and disease. *Genet Med* 2003;5:261–8.
10. Acheson LS, Wiesner GL, Zyzanski SJ, Goodwin MA, Stange KC. Family history-taking in community family practice: implications for genetic screening. *Genet Med* 2000;2:180–5.
11. Berg AO, Baird MA, Botkin JR, et al. National Institutes of Health State-of-the-Science Conference Statement: Family History and Improving Health. *Ann Intern Med* 2009;151:872–7.
12. Wilson BJ, Qureshi N, Santaguida P, et al. Systematic review: family history in risk assessment for common diseases. *Ann Intern Med* 2009;151: 878–85.
13. Hayflick SJ, Eiff MP, Carpenter L, Steinberger J. Primary care physicians' utilization and perceptions of genetics services. *Genet Med* 1998;1:13–21.
14. Rich EC, Burke W, Heaton CJ, et al. Reconsidering the family history in primary care. *J Gen Intern Med* 2004;19:273–80.
15. Suther S, Goodson P. Barriers to the provision of genetic services by primary care physicians: a systematic review of the literature. *Genet Med* 2003;5: 70–6.

16. Wood ME, Stockdale A, Flynn BS. Interviews with primary care physicians regarding taking and interpreting the cancer family history. *Fam Pract* 2008; 25:334–40.
17. Powell KP, Christianson CA, Hahn SE, et al. Collection of family health history for assessment of chronic disease risk in primary care. *N C Med J* 2013;74:279–86.
18. Rogers J, Durkin M. The semi-structured genogram interview: I. Protocol, II. Evaluation. *Fam Syst Med* 1984;2:176–88.
19. Waters I, Watson W, Wetzel W. Genograms. Practical tools for family physicians. *Can Fam Physician* 1994;40:282–7.
20. Wood ME, Flynn BS, Stockdale A. Primary care physician management, referral, and relations with specialists concerning patients at risk for cancer due to family history. *Public Health Genomics* 2013;16: 75–82.
21. Carmona RH, Wattendorf DJ. Personalizing prevention: the U.S. Surgeon General's Family History Initiative. *Am Fam Physician* 2005;71:36, 39.
22. Green RF. Summary of workgroup meeting on use of family history information in pediatric primary care and public health. *Pediatrics* 2007;120(Suppl 2):S87–100.
23. U.S. Preventive Services Task Force. BRCA-related cancer: risk assessment, genetic counseling, and genetic testing. December 2013. Available from: <http://www.uspreventiveservicestaskforce.org/uspstf/uspstfbrgen.htm>. Accessed March 5, 2014.
24. Yoon PW, Scheuner MT, Khoury MJ. Research priorities for evaluating family history in the prevention of common chronic diseases. *Am J Prev Med* 2003;24:128–35.
25. Scheuner MT, Wang SJ, Raffel LJ, Larabell SK, Rotter JL. Family history: a comprehensive genetic risk assessment method for the chronic conditions of adulthood. *Am J Med Genet* 1997;71:315–24.
26. Emery J, Morris H, Goodchild R, et al. The GRAIDS Trial: a cluster randomised controlled trial of computer decision support for the management of familial cancer risk in primary care. *Br J Cancer* 2007;97:486–93.
27. Katerndahl D, Wood R, Jaen CR. Family medicine outpatient encounters are more complex than those of cardiology and psychiatry. *J Am Board Fam Med* 2011;24:6–15.
28. Shargorodsky J, Curhan SG, Curhan GC, Eavey R. Change in prevalence of hearing loss in US adolescents. *JAMA* 2010;304:772–8.
29. Doerr E, Galpin K, Jones-Taylor C, et al. Between-visit workload in primary care. *J Gen Intern Med* 2010;25:1289–92.
30. Ellis B. Complexity in practice: understanding primary care as a complex adaptive system. *Inform Prim Care* 2010;18:135–40.
31. Maciosek MV, Coffield AB, Edwards NM, Flottesmesch TJ, Goodman MJ, Solberg LI. Priorities among effective clinical preventive services: results of a systematic review and analysis. *Am J Prev Med* 2006;31:52–61.
32. Nutting PA, Baier M, Werner JJ, Cutter G, Conry C, Stewart L. Competing demands in the office visit: what influences mammography recommendations? *J Am Board Fam Pract* 2001;14:352–61.
33. Hunt DL, Haynes RB, Hanna SE, Smith K. Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. *JAMA* 1998;280: 1339–46.
34. Shiffman RN, Liaw Y, Brandt CA, Corb GJ. Computer-based guideline implementation systems: a systematic review of functionality and effectiveness. *J Am Med Inform Assoc* 1999;6:104–14.
35. Patterson ES, Doebbeling BN, Fung CH, Miliello L, Anders S, Asch SM. Identifying barriers to the effective use of clinical reminders: bootstrapping multiple methods. *J Biomed Inform* 2005;38: 189–99.
36. Zafar A. Getting started with health IT implementation. Paper presented at: AHRQ National Resource Center for Health Information Technology; December 1, 2005; Rockville, Maryland.
37. Stead WW, Lin H; National Research Council Committee on Engaging the Computer Science Research Community in Health Care Informatics. Computational technology for effective health care: immediate steps and strategic directions. Washington, DC: National Academies Press; 2009.
38. O'Neill SM, Rubinstein WS, Wang C, et al. Familial risk for common diseases in primary care: the Family Healthware Impact Trial. *Am J Prev Med* 2009;36: 506–14.
39. Acheson LS, Wang C, Zyzanski SJ, et al. Family history and perceptions about risk and prevention for chronic diseases in primary care: a report from the Family Healthware Impact Trial. *Genet Med* 2010; 12:212–8.
40. Wang C, O'Neill SM, Rothrock N, et al. Comparison of risk perceptions and beliefs across common chronic diseases. *Prev Med* 2009;48:197–202.
41. Rubinstein WS, Acheson LS, O'Neill SM, et al. Clinical utility of family history for cancer screening and referral in primary care: a report from the Family Healthware Impact Trial. *Genet Med* 2011;13: 956–65.
42. Ruffin MT 4th, Nease DE Jr, Sen A, et al; Family History Impact Trial (FHITr) Group. Effect of preventive messages tailored to family history on health behaviors: the Family Healthware Impact Trial. *Ann Fam Med* 2011;9:3–11.
43. Yoon PW, Scheuner MT, Jorgensen C, Khoury MJ. Developing Family Healthware, a family history



- screening tool to prevent common chronic diseases. *Prev Chronic Dis* 2009;6:A33.
44. Facio FM, Feero WG, Linn A, Oden N, Manickam K, Biesecker LG. Validation of My Family Health Portrait for six common heritable conditions. *Genet Med* 2010;12:370–5.
  45. Nease DE Jr, Green LA. ClinfoTracker: a generalizable prompting tool for primary care. *J Am Board Fam Pract* 2003;16:115–23.
  46. Chou R, Dana T, Bougatsos C, Fleming C, Beil T. Screening adults aged 50 years or older for hearing loss: a review of the evidence for the U.S. preventive services task force. *Ann Intern Med* 2011;154:347–55.
  47. Qureshi N, Armstrong S, Dhiman P, et al. Effect of adding systematic family history enquiry to cardiovascular disease risk assessment in primary care: a matched-pair, cluster randomized trial. *Ann Intern Med* 2012;156:253–62.