

**The Institute for Family Health
Final Report Subcontract 0020808-406807-1**

ATTACHMENT 1

**Evaluating MedlinePlus Connect:
A Quantitative Analysis**

EXECUTIVE SUMMARY

In February 2011, the Institute for Family Health implemented live web links from its patient portal (MyChartMyHealth) to the National Library of Medicine's information resource MedlinePlus Connect. In this descriptive project, we examined adoption and usage of MedlinePlus Connect over the 1st year of use, as well as demographic and clinical characteristics of early adopters. Of the 13,115 patients with active MyChartMyHealth accounts, 4,788 (36.5%) explored one or more MedlinePlus Connect links. Usage rose to 1200 clicks per month in the first month, and remained relatively steady between 1200 and 1400 clicks per month for the entire year. A very wide variety of search terms were used, with the top 20 search terms representing only about 31% of clicks. Compared to all MyChartMyHealth users, patients who used MedlinePlus Connect were slightly more likely to be women, less likely to be white, more likely to be Hispanic, less likely to have private insurance and more likely to have Medicaid, and more likely to be speakers of English. They had more chronic conditions on average, and specifically were more likely to have depression, asthma, diabetes, or chronic hepatitis than non-MedlinePlus Connect users. Patients could click on search terms only if they appeared in their medical record, and as a result, relationships were evident between patient characteristics and their choices of search terms. We conclude that the technology is being used regularly, is relatively usable for a large proportion of patients, and is being disproportionately used by those with the greatest information needs, namely, those with more medical conditions.

BACKGROUND

Electronic patient portals offer potential benefits to patients by giving them access to their own medical data, health education materials, and electronic communication with their provider organization. However, patient portals pose significant health literacy challenges to many patients, as they typically contain medical terminology (such as diagnosis codes derived from ICD-9 codes) and data requiring medical knowledge to interpret (such as laboratory values).

To address these challenges, the Institute for Family Health, Epic Systems Inc., and the National Library of Medicine partnered to develop technology that would allow direct hyperlinks between the Epic patient portal and MEDLINEplus, the National Library of Medicine's free patient education resource. These links allow patients to click on specific items of interest within their portal record, including disease names and medications, and be taken directly to relevant information from MEDLINEplus. Disease names appear as a hyperlink within the patient portal, whereas for medications, a separate link labeled "for more information about your medication" is displayed. The links are available in both the English and Spanish versions of MyChart.

In February 2011, the Institute for Family Health implemented the live web links in the MEDLINEplus Connect project.

OBJECTIVES

This descriptive project was intended to examine adoption of the new MEDLINEplus Connect (MPC) over the first year of use, as well as demographic and clinical characteristics of early adopters. We sought to:

- A. Track adoption and use of MedlinePlus Connect over its first year;
- B. Identify the most commonly accessed MedlinePlus Connect search terms;
- C. Compare MedlinePlus Connect users, MedlinePlus Connect nonusers, and non-portal users in terms of sociodemographic and clinical characteristics;
- D. Identify relationships between MedlinePlus Connect search term selection and sociodemographic and clinical characteristics of users.

METHODS

All active adult patients, defined as patients with a clinical visit to an IFH site within the previous one year, were eligible for this retrospective cohort study. Deidentified reports of socio-demographics and portal usage data were generated from the Epic database and analyzed in SAS version 9.2 (Cary, NC). Our analysis focused on MedlinePlus Connect usage over time and the characteristics of users: age, gender, race, ethnicity, insurance status, primary language, and comorbid illnesses. Age was summarized using mean and standard deviation; t-tests were performed for between-group differences. All other variables were analyzed using frequency distributions and chi-square tests. Similar analyses were performed for the characteristics of users who searched for the top 20 search terms. Statistical significance was assessed at the $\alpha = 0.05$ level and analyses were not corrected for multiple comparisons. The project was approved by the IRBs of Weill Cornell Medical College and the Institute for Family Health.

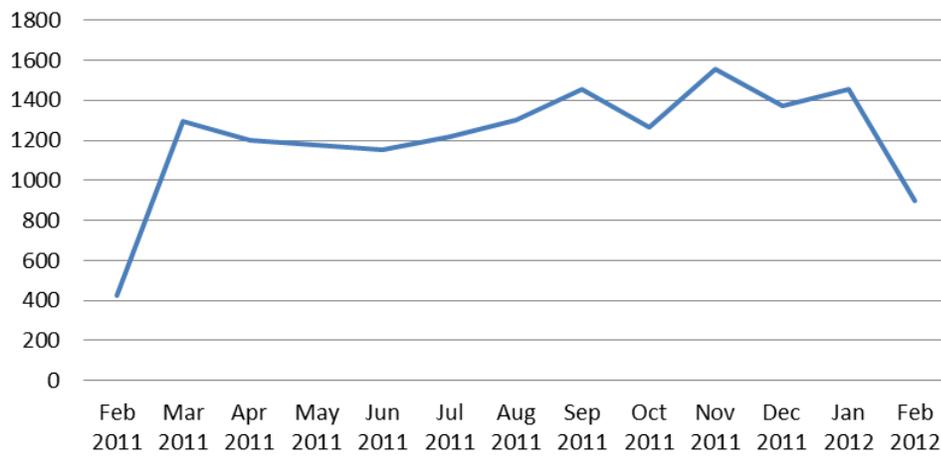
RESULTS

There were 64,142 active patients in this data set; 13,115 had active MyChartMyHealth accounts, and 4,788 of these (36.5%) explored one or more MedlinePlus Connect links.

SECTION A. Adoption and use of MedlinePlus Connect over the 1st year

Adoption of the new technology has remained relatively steady at 1200 to 1500 clicks per month. (The apparent decline in February 2012 is an artifact of the fact that data is available only for part of the month of February.)

Figure 1. MedlinePlus Connect click rates over time



SECTION B. Most commonly accessed MedlinePlus Connect search terms

Patients clicked on an extremely large number of different terms. The top 20 terms (Table 1 and Figure 1) accounted for only 31% of all clicks. The most common search terms reflect common exams and health conditions in the IFH population.

Table 1: Top 20 search terms in 2011-12

Rank	Search term	N	%
1	ROUTINE+PHYSICAL+EXAM&info	1152	7.54
2	ROUTINE+MEDICAL+EXAM&infor	1034	6.77
3	OBESITY&informationRecipi	467	3.06
4	HIGH+CHOLESTEROL&informati	218	1.43
5	MANAGING+BIRTH+CONTROL&inf	172	1.13
6	MOOD+PROBLEM&informationR	170	1.11
7	BIRTH+CONTROL&informationR	169	1.11
9	MENTAL+HEALTH+PROBLEM&informat	143	0.94
10	HIGH+BLOOD+PRESSURE&inform	132	0.86
11	HYPERTENSION+%28HIGH+BLOOD	121	0.79
12	ABNORMAL+PAP+SMEAR&inform	111	0.73
13	HIGH+CHOLESTEROL+OR+TRIGLY	110	0.72
14	ANXIETY+PROBLEM&informati	106	0.69
15	CHILD+PHYSICAL&information	95	0.62
16	PRENATAL+CARE&informationR	90	0.59
17	GYNECOLOGIC+EXAM&informat	80	0.52
18	ANXIETY+STATE&information	75	0.49
19	TOBACCO+USE&informationRec	75	0.49
20	TOBACCO+USE+DISORDER&infor	74	0.48

**An additional search term was number 8 in popularity; it was "EN" and was determined to be an artifact of the way URLs were stored in the database.*

SECTION C. Sociodemographic and clinical characteristics of MedlinePlus Connect users, MedlinePlus Connect nonusers, and non-portal users

As we can see from Table 2 on the next page, MedlinePlus Connect users differ from non- MedlinePlus Connect users. (In interpreting these results, it should be kept in mind that the sample size is very large, which leads to very small p values even in cases where the differences are not very important.) Patients who used MedlinePlus Connect were slightly more likely to be women, less likely to be white, more likely to be Hispanic, less likely to have private insurance and more likely to have Medicaid, and more likely to be speakers of English. They had more chronic conditions on average, and specifically were more likely to have depression, asthma, diabetes, or chronic hepatitis than non- MedlinePlus Connect users.

The final 3 columns demonstrate the differences between MyChartMyHealth users and nonusers. MyChartMyHealth users tend to be slightly older, are more likely to be women, are more likely to be white, are more likely to have private insurance, and have slightly fewer chronic conditions. These are broadly in line with results we have previously reported in the *Journal of General Internal Medicine* (Ancker, Barrón, Rockoff, et al. *Journal of General Internal Medicine* 2011), although it is encouraging to note that the racial and socioeconomic disparities in this table are smaller than those reported in 2011.

Table 2: MedlinePlus Connect (MPC) users, MPC nonusers, and all MyChartMyHealth users

Characteristic	MyChart MyHealth users who never used MPC	MyChart MyHealth users who used MPC	P	All MyChart MyHealth users	Non-MyChart MyHealth users	P
N	8327	4788		13115	51027	
Mean age	40.5	39.2	<0.0001	40.1	43.2	<0.0001
Women, n (%)	5555 (67)	3314 (69)	0.0003	8869 (67)	31061 (61)	<0.0001
Race, n (%)			<0.0001			<0.0001
white	3912 (47)	1873 (39)		5785 (44)	20947 (41)	
black	1515 (18)	1051 (22)		2566 (20)	11716 (23)	
unknown	973 (12)	573 (12)		1546 (12)	6091 (12)	
all other races	1927 (23)	1291 (27)		3218 (25)	12273 (24)	
Ethnicity, n (%)			<0.0001			0.0036
Hispanic/Latino	1843 (22)	1242 (26)		3085 (24)	11921 (23)	
not Hispanic/Latino	4919 (59)	2804 (59)		7723 (59)	30714 (60)	
unknown	1565 (19)	742 (16)		2307 (18)	8392 (16)	
Insurance status, n (%)			<0.0001			<0.0001
Uninsured + self-pay	824 (10)	492 (10)		1316 (10)	8171 (16)	
Private	3958 (48)	2146 (45)		6104 (47)	14585 (29)	
Medicaid (ffs+mgd care)	2051 (25)	1381 (29)		3432 (26)	15950 (31)	
Dual-eligible	14 (0)	6 (0)		20 (0)	262 (0.5)	
Medicare (ffs+mgd care)	856 (10)	381 (8)		1237 (9)	7665 (15)	
All others	334 (4)	196 (4)		530 (4)	1734 (3)	
Unknown	290 (3)	186 (4)		476 (4)	2660 (5)	
Preferred language, n (%)			<0.0001			<0.0001
English	7336 (88)	4362 (91)		11698 (89)	41743 (82)	
Spanish	260 (3)	125 (3)		385 (3)	4290 (8)	
missing	711 (9)	289 (6)		1000 (7.6)	4720 (9)	
all other languages	20 (0)	12 (0)		32 (0)	274 (1)	
Number of clinical encounters, mean		3.1		3.1		
Number of chronic conditions, mean	0.86	0.96	<0.0001	0.89	0.85	0.0015
Individual chronic conditions, n (%)						
hyperlipidemia	1406 (17)	819 (17)	0.74	2225 (17)	7824 (15)	<0.0001
hypertension	1382 (17)	819 (17)	0.45	2201 (17)	9711 (19)	<0.0001
depression	1372 (16.5)	976 (20)	<0.0001	2348 (18)	7892 (15)	<0.0001
asthma	949 (11)	620 (13)	0.008	1569 (12)	50321 (10)	<0.0001
diabetes	665 (8)	450 (9)	0.005	1115 (8.5)	5219 (10)	<0.0001
HIV	173 (2.1)	110 (2.3)	0.4	283 (2)	1060 (2)	0.57
chronic hepatitis	154 (1.9)	125 (2.6)	0.004	279 (2)	1388 (2.7)	0.0001
alcoholism	159 (2.0)	107 (2.2)	0.20	266 (2)	1249 (2.5)	0.0005
drug dependency	207 (2.5)	134 (2.8)	0.28	341 (3)	1946 (4)	<0.0001

Section D. Relationships between MedlinePlus Connect search term selection and sociodemographic and clinical characteristics of users

Patients could search only on terms that appear within their medical record. As a result, as is demonstrated in Table 3 on the next page, MedlinePlus Connect searches were strongly associated with clinical characteristics of the patients. For example, 100% of those who searched for "prenatal care," "abnormal Pap smear," and "managing birth control" were women. One hundred percent of those who searched for "mental health problem" had a diagnosis of depression, and 100% of those who searched for "hypertension and high blood pressure" had hypertension. Search terms such as "obesity" were also associated with patients with hyperlipidemia and diabetes. Patients searching for "mood problem," "high blood pressure" or "hypertension", and "anxiety problem" had noticeably more clinical encounters than other patients, suggesting closer medical supervision of their conditions. In addition to these obvious clinical correlations, there were also associations between search terms and demographic characteristics. Latino patients represented only about 24% of MyChartMyHealth users, but 40% or more of those who searched for the terms "obesity" and "managing birth control." By contrast, whites were overrepresented among those who searched for terms related to mental health issues.

Table 3: Characteristics of patients who accessed specific search terms

Characteristics of patients who clicked that word	"Routine physical exam" (rank 1)	"Routine medical exam" (rank 2)	"Obesity" (rank 3)
n of patients	808	752	341
Mean age (SD)	36.1 (12.6)	34.9 (12.0)	37.3 (12.6)
Proportion women	68%	67%	76%
Proportion whites	33.8%	30%	22%
Proportion Hispanic/Latino	27.5%	27%	40%
Proportion			
Uninsured + self-pay	11%	14%	9%
Private	49%	46%	41%
Medicaid	29%	31%	35%
Dual-eligible	0%	0%	0%
Medicare	3%	3%	4%
All others	4%	3%	7%
Unknown	4%	3%	5%
Proportion with preferred language English	93%	91%	90%
Number of clinical encounters, mean	3.9	4.0	4.5
Number of chronic conditions, mean	0.60	0.54	0.9
Individual chronic conditions, n (%)			
hyperlipidemia	11%	9%	18%
hypertension	10%	8%	19%
depression	14%	12%	16%
asthma	9%	9%	15%
diabetes	5%	6%	10%
HIV	0.6%	0.5%	1.5%
chronic hepatitis	1%	2%	1%
alcoholism	1%	1%	0%
drug dependency	1.5%	1%	1%

Characteristics of patients who clicked that word	"High cholesterol" (rank 4)	"Managing birth control" (rank 5)	"Mood problem" (rank 6)	"Birth control" (rank 7)
n of patients	159	132	117	126
Mean age (SD)	49.2 (11.7)	27.2 (7.4)	38.2 (12.8)	28.1 (6.7)
Proportion women	50%	100%	71%	100%
Proportion whites	48%	18%	32%	26%
Proportion Hispanic/Latino	16%	40%	35%	36%
Proportion				
Uninsured + self-pay	3%	15%	9%	25%
Private	60%	34%	17%	31%
Medicaid	18%	39%	51%	33%
Dual-eligible	0%	0%	0%	0%
Medicare	13%	0%	15%	1%
All others	4%	4%	3%	6%
Unknown	3%	8%	3%	5%
Proportion with preferred language English	87%	89%	93%	93%
Number of clinical encounters, mean	4.6	4.5	5.7	4.7
Number of chronic conditions, mean	1.7	0.4	1.9	0.4
Individual chronic conditions, n (%)				
hyperlipidemia	86%	5%	20%	3%
hypertension	23%	2%	17%	1%
depression	20%	11%	93%	14%
asthma	13%	6%	16%	11%
diabetes	20%	2%	11%	1%
HIV	1%	0%	3%	0%
chronic hepatitis	3%	0%	1%	0%
alcoholism	0%	2%	9%	1%
drug dependency	1%	4%	9%	0%

Characteristics of patients who clicked that word	"Mental health problem" (rank 9)*	"High blood pressure" (rank 10)	"Hypertension and high blood pressure" (rank 11)
n of patients	106	104	96
Mean age (SD)	43.0 (13.3)	50.8 (11.4)	53.2 (13.5)
Proportion women	71%	51%	53%
Proportion whites	60%	38%	42%
Proportion Hispanic/Latino	25%	18%	19%
Proportion			
Uninsured + self-pay	15%	14%	4%
Private	34%	49%	53%
Medicaid	25%	22%	18%
Dual-eligible	0%	0%	0%
Medicare	13%	13%	19%
All others	8%	2%	3%
Unknown	5%	0%	3%
Proportion with preferred language English	90%	88%	84%
Number of clinical encounters, mean	4.5	6.1	5.7
Number of chronic conditions, mean	1.8	1.7	1.9
Individual chronic conditions, n (%)			
hyperlipidemia	13%	27%	38%
hypertension	20%	75%	100%
depression	100%	18%	9%
asthma	17%	14%	10%
diabetes	9%	24%	23%
HIV	2%	1%	2%
chronic hepatitis	1%	1%	1%
alcoholism	4%	2%	2%
drug dependency	4%	4%	1%

**An additional search term was number 8 in popularity; it was "EN" and was determined to be an artifact of the way URLs were stored in the database.*

Characteristics of patients who clicked that word	"Abnormal Pap smear" (rank 12)	"High cholesterol or triglycerides" (rank 13)	"Anxiety problem" (rank 14)	"Child physical" (rank 15)
n of patients	65	83	88	39
Mean age (SD)	31.2 (9.6)	49.9 (11.2)	38.9 (12.9)	20.4 (7.5)
Proportion women	100%	47%	74%	90%
Proportion whites	23%	46%	59%	3%
Proportion Hispanic/Latino	28%	19%	26%	44%
Proportion				
Uninsured + self-pay	8%	5%	18%	8%
Private	42%	58%	34%	15%
Medicaid	37%	0%	30%	0%
Dual-eligible	0%	19%	0%	3%
Medicare	3%	13%	7%	3%
All others	5%	4%	6%	18%
Unknown	8%	1%	6%	
Proportion with preferred language English	91%	84%	94%	97%
Number of clinical encounters, mean	4.6	4.7	5.9	4.5
Number of chronic conditions, mean	0.6	2.1	1.2	0.5
Individual chronic conditions, n (%)				
hyperlipidemia	5%	100%	19%	3%
hypertension	3%	34%	16%	3%
depression	9%	22%	51%	18%
asthma	11%	12%	16%	18%
diabetes	2%	23%	9%	3%
HIV	2%	1%	0%	0%
chronic hepatitis	5%	2%	1%	0%
alcoholism	0%	5%	6%	0%
drug dependency	2%	2%	3%	0%

Characteristics of patients who clicked that word	"Prenatal care" (rank 16)*	"Anxiety state" (rank 18)	"Tobacco use" and "tobacco use disorder" (rank 19, 20)
n of patients	52	62	103
Mean age (SD)	28.6 (5.6)	37.8 (12.8)	38.7 (12.0)
Proportion women	100%	79%	68%
Proportion whites	17%	58%	44%
Proportion Hispanic/Latino	38%	24%	23%
Proportion			
Uninsured + self-pay	13%	13%	13%
Private	19%	40%	50%
Medicaid	65%	29%	25
Dual-eligible	0%	0%	1%
Medicare	0%	8%	7%
All others	2%	5%	0%
Unknown	0%	5%	5%
Proportion with preferred language English	90%	100%	96%
Number of clinical encounters, mean	4.3	4.7	5.0
Number of chronic conditions, mean	0.6	1.0	0.8
Individual chronic conditions, n (%)			
hyperlipidemia	4%	18%	11%
hypertension	4%	18%	15%
depression	10%	26%	18%
asthma	15%	21%	9%
diabetes	2%	3%	10%
HIV	2%	2%	0%
chronic hepatitis	0%	2%	4%
alcoholism	2%	5%	2%
drug dependency	2%	3%	5%

**The 17th ranked search term, "gynecologic exam," is omitted because of difficulties pertaining to the way the search term was formatted. Specifically, the full search term was captured as "gynecologic+exam&informat" which could not be analyzed in SAS because the string "informat" is a command term in that language.*

DISCUSSION

The new MedlinePlus Connect function is being used by large numbers of patients on a regular basis. In the first 12 months of this initiative, 36.5% of all MyChartMyHealth users explored at least one of the MedlinePlus Connect links. This relatively high rate of adoption suggests that the new functionality was perceived as potentially useful and usable by a large proportion of the MyChartMyHealth population.

In the 2nd month, usage rose to more than 1200 clicks per month, and monthly usage remained roughly steady for the subsequent year. This sustained rate of adoption suggests that patients were able to learn to use the function simply by inspecting the page; there was no gradual increase that would suggest increased diffusion of innovation through social networks, training, or publicity/marketing.

A wide variety of search terms were explored by IFH patients, and the vast majority of these were used by only a very small number of patients. It is notable that extremely simple concepts such as "routine physical exam," "routine medical exam," and "child exam" were among the most commonly searched. These MedlinePlus Connect pages were created by the NLM team during the development of MedlinePlus Connect because they were among the top items on the IFH patients' "Health Issues" lists and MedlinePlus did not have corresponding entries for them. Although this certainly reflects the commonness of these conditions in the MyChartMyHealth record, it may also suggest that patients have unanswered questions about these routine events that are potentially answerable through an electronic resource.

Frequency of use of the search terms followed an exponential or scale-free distribution (a common finding in use of Internet resources), meaning that a small number of terms were searched frequently, and then a very large number of terms were searched rarely. One implication of this finding is that every patient has unique information needs, and information interventions should not solely be judged on the basis of the frequency of their use. Resources that are accessed by only a very small proportion of patients may serve as critical information needs for those patients.

MedlinePlus Connect users differ substantially from non-MedlinePlus Connect users in interesting ways. Specifically, the MPC function appears to be popular among those who do not have private insurance and those who have Medicaid, as well as those who have more chronic conditions. This is an interesting constellation of characteristics suggesting that this information resource is valuable to disadvantaged patients, and also that this resource is being used appropriately by patients who have more severe medical needs and thus greater needs for information about their own medical conditions. It is possible that some patients who feel that their information needs are not being met during the clinical visit are turning to this electronic resource for assistance. In addition, although the MedlinePlus Connect function is being used heavily by Latino patients, it is preferentially being used by those who prefer to use English. Both MyChartMyHealth and MedlinePlus are currently available in Spanish versions, and it would be of interest to learn why MedlinePlus Connect links are being explored more by English-speaking patients.

Interestingly, MedlinePlus Connect users are also less likely to have missing data about their own ethnicity. This may be related to the frequency of the clinical visits but may also indicate that these patients are more engaged with the health system and with their IFH provider.

Finally, we were able to show relationships between patient clinical and demographic characteristics and their MedlinePlus Connect search terms. The clinical associations were strong and had high face validity; for example, patients with a diagnosis of hypertension made up the majority of those who searched for the term "hypertension" and women made up the 100% of those searching for terms pertaining to gynecological care and childcare.

CONCLUSIONS AND IMPLICATIONS

We conclude that the new MedlinePlus Connect information resource is being used regularly, is relatively usable for a large proportion of Institute for Family Health patients including the uninsured and Medicaid patients, and is being disproportionately used by those with the greatest medical information needs, namely, those with more medical conditions.