Patient Medication Information: Printed and/or Electronic?

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Abstract

Patients receive printed information with prescription medications containing information such as uses, side effects, and directions. This information is important for fostering patient compliance and safety. Given that billions of prescriptions are filled in the U.S. each year and the rise of digital technology, is it time to switch from information printed on paper to electronic versions? A major concern about all-electronic information is that many people do not have technology access and/or skills. Older adults in particular lag behind the general population in use of technology, yet are often ahead in the number of medications they take. A major objective of this research was to examine the age hypothesis – that older adults want printed medication information while young tech-savvy adults want electronic versions. To examine this and related issues, we recruited a large nation-wide sample of participants ranging in age from 18-97. We asked both older patients and young tech-savvy adults how they want to receive written medication information with their prescriptions in the future. Participants responded *Yes*, *No*, or *Maybe* for various printed and electronic options and gave reasons for their responses. The age hypothesis was not supported. Virtually all participants endorsed retaining printed medication information – 95% of both older patients and young adults said *Yes* or *Maybe*. Young adults were more open to electronic versions, but indicated that these should be in addition to the printed version. Furthermore, support for printed information is not likely to change as the proportion of people with electronic access and skill increases over time, since even young tech-savvy adults want to retain the printed version. Reasons given for these preferences suggest that cognitive factors may underlie the surprising results. Research is needed to compare the effects

of printed vs. electronic medication information on comprehension, memory, and other cognitive processes.

Introduction

Medication Information for Patients: Contrasting Views

What should patients know about the prescription medications they take? This question has a very long history, with remarkably contrasting views [1]. One view is that patients should know nothing. For example, the ethical statutes of the Royal College of Physicians (circa 1500) advised, “Let no physician teach the people about medicines or even tell them the names of the medicines, particularly the more potent ones…” The reason given for this admonition was that with this knowledge “the people may be harmed by … improper use of the medicines.” Violations resulted in a 40 shilling fine. Four centuries later, similar views were still prevalent. For example, a 1938 U.S. Federal Register notice advised that “Drug [information] should be written only in such medical terms as are not likely to be understood by the ordinary individual.” Vestiges of this view continue today. Some physicians avoid giving much information about the medications they prescribe, concerned that patients may get upset about possible side effects and assume they will experience all of them, even the very rare ones. With such misunderstandings, patients may not comply with directions for use or not take the drug at all.

In the 1960's and 1970's a dramatic shift in views about patient medication information began. Written information was required for a few drugs associated with significant health risks (oral contraceptives and estrogens). In the 1980's, the U.S. Food and Drug Administration (FDA) studied the role of written information in improving health outcomes and reducing risk, while consumer empowerment groups argued that such information should be widely available. By 1996, the long-held view that patients should not be told about their medications was completely reversed. A U.S. public law [2] mandated that patients should receive useful written information with all new prescription drugs. The number of drugs provided with written information soared; by the year 2000, nearly 90% of patients received a written document with their prescription [3] and by 2008, nearly 94% did so [4].

Why should patients have information about their prescriptions? It can enable them to have informed consent about the benefits and risks of their treatment, help them decide (with their healthcare provider) whether drug therapy is appropriate for them, increase the chances that they will comply with instructions, and take appropriate actions if side effects occur [5].

Medication Information for Patients: Current Status

Currently there are several types of prescription drug documents given to patients with their prescriptions, called consumer medication information (CMI), patient package inserts (PPI's), and Medication Guides. Some are approved and regulated by FDA (PPI's and Medication Guides) while the vast majority are not (CMI). Although CMI is not regulated, FDA has provided a guidance document [6] about good practices, which is followed by the private

vendors who produce these documents. All types of documents are typically several pages long and provide information such as what health conditions a drug treats, precautions (what to consider before taking it), warnings, side effects, how to take it, and other important information. Although the original intention was that CMI be provided with all *new* prescriptions, it is common practice for pharmacies to print them for refills as well, while PPI's and Medication Guides must be provided every time. A current FDA initiative considers adoption of a single standard, a 1-page medication document in a new format to replace all the others, called Patient Medication Information (PMI) [7]. We focused on CMI in this study but conducted it so that the results would apply to PMI as well, if it is adopted. For simplicity, we used the everyday term, "pharmacy leaflet" while working with participants. For convenience, we refer to "patient medication information" in this paper, but use this term in a generic way, with no assumptions about document length or format.

Printed vs. Electronic: Stakeholder Views

Billions of prescriptions are filled in the U.S. each year (3.8 billion in 2013) [8]. Most are dispensed with written information for patients, usually consisting of several printed pages. Many healthcare professionals have a stake in how this information is provided to patients, such as healthcare providers, healthcare administrators, hospitals and clinics, government regulators, pharmaceutical companies, pharmacies, and drug database companies (who develop CMI). CMI leaflets are printed at the pharmacy and are either stapled to the bag with the medication or put inside it. They also appear on selected patient-oriented medical websites. As the popularity of general medical websites increased, with a high proportion of visits seeking drug information,

some stakeholders began to ask – why not just provide this information electronically? Meanwhile, FDA began to consider posting patient medication information on government-based websites.

All of these changes sparked a spirited debate among healthcare stakeholders about the advantages of printed vs. electronic versions of drug "labeling" information (documents directed to professionals as well as patients). Much of the debate concerning patient-directed information has taken place in a series of public workshops hosted by FDA (e.g., [9]), designed to elicit views on the optimal content and format for patient medication information and how it should be distributed. Drug manufacturers generally support eliminating paper and relying exclusively on electronic delivery while drug document producers and patient advocates argue that all-electronic delivery could have a negative effect on public health. There are many reasons given on both sides of this issue. For example, advocates of electronic delivery argue it can provide the information in an interactive way (e.g., with hyperlinks to definitions of key terms) while those opposed argue that it would limit the availability of the information for those who are not comfortable with technology and/or have limited or no access to it.

To help inform and potentially resolve this debate, the Government Accountability Office (GAO) was mandated by Congress to "examine the benefits and efficiencies of electronic labeling as a partial or complete substitute and its impact on public health" [10]. Since drug labeling was already available in electronic form, the report focused on "the advantages and disadvantages of relying on electronic labeling as a complete substitute." GAO conducted interviews with a wide range of stakeholders, including FDA, other federal officials, physicians,

pharmacies, patients, drug manufacturers, and database vendors. They found no consensus on the advantages and disadvantages of eliminating paper and adopting an all-electronic substitute.

The GAO report examined three types of prescription drug documents, all approved by FDA – the comprehensive labeling document (often called the prescribing information or PI, intended for healthcare practitioners), Medication Guides, required for a small subset (383) of drugs, and patient package inserts (PPI's) required for two types of drugs (oral contraceptives and estrogens). It did not include the most common type of document given to patients – CMI. Furthermore, the report focused more on the views of professional stakeholders than on patients and provided general summaries of views rather than quantitative data. Therefore the current study focused on CMI and examined views of the general public (both patients and non-patients) using detailed data collection and analysis methods. The results are expected to apply to possible modifications in CMI in the future, such as the 1-page PMI currently under discussion.

Printed vs. Electronic: The Age Hypothesis

Electronic technology use is widespread among young adults – they spend considerable time on the internet and smart phones and use them for many purposes. Older adults are less likely to use technology in general, computers, and the internet [11]. Various factors have been examined to understand why older adults have lower interest and adoption of technology such as education, computer knowledge, computer anxiety [12], fluid intelligence, crystallized intelligence, cognitive abilities, and computer self-efficacy [11].

A recent study [13] compared older adults (age 65 and older) to the general adult population (age 18 and older). Technology adoption is increasing in the general population – for example 50% reported going online in 2000 and 86% in 2013. It is also increasing among older adults – only 14% reported going online in 2000 but 59% in 2013. Nevertheless, senior use of technology is lower than that of the general population and some are entirely isolated from digital life. Older adults were less likely to use cell phones than younger adults (77% vs. 91%, respectively), the internet (59% vs. 86%), or have broadband access (47% vs. 70%). Among older adults there was an age effect. For example, for seniors in their early 70's, 68% use the internet and 55% have broadband, while for those aged 75-79 these rates drop to 47% and 34% respectively. Two subsets of seniors emerged that implicate other factors. One group uses the internet and broadband at rates that approach (or even exceed) the general population. They tend to be younger, more highly educated, and more affluent. However internet and broadband use drop off around age 75. The other group has very little involvement in digital technology – 23% do not have digital phones, 41% do not use the internet at all, and 53% do not have broadband access at home. They tend to be older, less well-educated, less affluent, and often have health or disability challenges.

The large and robust differences between younger and older adults suggest an age hypothesis concerning preferences for printed vs. electronic versions of medication information. According to this hypothesis, younger adults (especially those who are tech-savvy) should favor electronic medication information and be uninterested in printed versions, while older adults should favor printed and be uninterested in electronic versions.

Current Study

This research was designed to: 1) examine preferences for printed vs. electronic delivery of prescription medication information in the general population; 2) examine preferences for various types of electronic delivery such as internet, email, and phone; 3) test the age hypothesis, that older adults prefer printed delivery and young adults prefer electronic delivery; and 4) inform the debate concerning whether all-electronic delivery is appropriate. Two contrasting groups served as research participants – older adult patients currently taking at least one prescription drug for a chronic health condition (with a wide range of education levels and other demographic variables) vs. young, well-educated tech-savvy adults. Focus on these two populations "stacks the deck" – older, less educated adults generally have lower adoption of technology and therefore may want to retain printed information, while young, tech-savvy, more educated adults are generally highly skilled and spend considerable time using technology and therefore may be ready to eliminate printed information and move to all-electronic versions.

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Materials and Methods

Participants

There were two groups of participants, older adult patients currently taking at least one prescription drug for a chronic health condition and healthy young adults. All were required to be age 18 or older.

Older Adult Patients

Recruitment

Patients were community-dwelling adults who had filled a prescription for the same drug (lisinopril) in the last 60 days. Lisinopril was selected since it is widely prescribed for a common health condition (hypertension). Since these patients typically get a refill every month along with a printed leaflet, they were familiar with current practices for providing prescription drug information. Patients received a letter from their pharmacy (a national chain pharmacy) inviting them to participate in the study. They could volunteer to participate either by phone or web. Those who elected phone participation called a toll-free number for the "call center" which was located in the Medical Cognition Laboratory at Duke University and was staffed by research assistants. The pharmacy mailed invitation letters to lisinopril patients across the U.S., in all states where it has stores. Letters were mailed to new cohorts of patients in waves every few weeks, to spread out replies and reduce chances of overloading the call center.

Participation Source and Rate

A total of 1,416 patients completed the study, 42% by phone and 58% by web. It is not possible to determine the exact response rate for several reasons. Although the call center was open 72 hours per week, it was often overloaded and could not answer all the calls. Some web

participants called to report problems with the internet or their computers. Most of these problems were clearly user errors. The call center assistants used the same online software while working with phone participants but did not experience such problems. Some web patients began the study but did not finish owing to internet problems, while some phone participants did not complete the study owing to phone problems such as poor reception or battery problems. Many patients tried to participate after data collection was completed. The response rate remained brisk but after the "study closed" message was posted both online and at the call center, it was not possible to track attempted responses further. An estimate of the attempted response rate is 20% and the completion rate 10%.

Demographic Variables

Patients varied widely in most demographic variables except gender (48% male, 52% female) and native language (97% spoke English as their first language).

Age. Patient ages ranged from 19-97, with a mean of 56.6 (SD=12.5). The percentage in each age decade was 20's = 2%, 30's = 5%, 40's = 17%, 50's = 35%, 60's = 26%, 70's = 9%, 80's = 4%, 90's= 1%. Phone participants were older than web participants, 59.7 (12.1) vs. 54.2 (12.2), respectively ($F(1,1414) = 69.53$, $p < .0001$, $\eta p^2 = .05$).

Education Level. Patients varied in their highest level of education attained, from grades 1-6 through professional. They provided this information using an 8-point categorical scale and the resulting percentage in each category was 9% for grade-1 through some high school, 26% high school graduate, 28% some college, 20% college graduate, 17% post-graduate. Patients who

participated by web had a higher education level (mean score 5.5 (1.5) on the 8-point category scale defined above) than phone patients (category score of 4.7 (1.4), ($F(1,1414) = 90.53$, $p < .0001$, $\eta p^2 = .06$).

Geographic Region. Patients were from 38 U.S. states, with roughly equal percentages from the four major regions defined by the U.S. Census Bureau – 27% Northeast, 22% Midwest, 29% South, 22% West.

Occupations. 59% of patients were currently working while 41% were not (6% unemployed, 9% disabled, and 26% retired). Occupations were initially classified using the International Standard Classification of Occupations (ISCO) system, then modified to delete job categories that did not occur in the sample and to combine those with similar types of responsibilities. There were 12% professionals, 17% managerial+technical+associate professionals, 15% clerical+service+sales, 11% trade+craft+operator+assembly, 5% elementary, 8% homemakers, and 5% other.

Ethnicity. When asked how they would describe their ethnicity, patients used a 5-point categorical list and the resulting percentages were 83% White, 13% African American, 1% Asian, 2% Hispanic, and 2% Other. Although patients were not asked to specify details for the Other category, spontaneous reports included Native American, Pacific Islander, and other designations.

Prescription History. For most patients (90%), their last prescription for lisinopril was a refill, while for the rest (10%) it was new ($\chi^2 = 910.40$, $df = 1$, $p < .0001$). The forms of payment used

for the prescription were commercial insurance (51%), government program (43%), or cash (7%) ($\chi^2 = 1.07$, df = 4, ns).

Young Adults

The comparison group consisted of 369 healthy young adults. They ranged in age from 18-22, with a mean of 18.9 (1.0), 32% male and 68% female. All were fluent in English (83%, spoke English as their first language). Most (91%) were from the U.S. (38 states), with 32% from the Northeast, 9% Midwest, 44 % South, and 16% West regions. The rest were from 15 foreign countries scattered across seven regions of the world. There was considerable ethnic diversity – 54% White, 10% African American, 22% Asian, 6% Hispanic, and 8% Other. All were undergraduate students at Duke University who volunteered to participate as part of an academic research requirement. Most were at the beginning of their college careers – 59%, 27%, 9%, and 6% in their first, second, third, and fourth years, respectively. They were highly experienced in using many types of electronic devices and are considered "tech savvy." All completed the preference portion of the study (indicating whether they want various printed vs. electronic versions of medication information in the future) while a subset of 82 also gave reasons for their responses.

Procedure

Basic Procedure

All participants read a "pharmacy leaflet" for lisinopril to familiarize (or remind) them about the type of written information provided with prescription drugs. They had up to 5 minutes to do so. Then they were told that there are many possible ways to get written information about prescription drugs and were asked, "If your doctor prescribed a medication for you in the future, how would you like to get information about it?" They were given five methods: 1) Get a leaflet printed on paper, given with the medicine at the pharmacy; 2) Get an internet link to the leaflet, given at the pharmacy; 3) Do an internet search on your own; 4) Have the leaflet sent to you by email**,** from the pharmacy; 5) Have the leaflet sent to your cell phone, from the pharmacy. For convenience, these options are called Printed, WebLink, WebSearch, Email, and Cell Phone. Note that all options would come from the patient's pharmacy except for WebSearch which they would conduct on their own. For each option, participants selected one of three possible responses – *Yes*, *No*, or *Maybe*, to indicate whether they would like to have the information in that form. After each response, all patients (and a subset of young adults noted above) were asked, "Briefly, why?" Finally, they were asked whether they would also like to receive the information "some other way." Web participants clicked a response option (*Yes*, *No*, or *Maybe*) for each item, then entered their reason(s) into a comment box below the item. Research assistants working with phone participants used the same software as the web participants, but read instructions and items aloud, then entered patients' oral responses into the software.

Scoring

Preference Responses

Preference responses were scored in three ways. They were left in their original categorical form (*Yes*, *No*, *Maybe*) and the percentage of participants who selected each choice was calculated for

each delivery option. They were also scored as *Yes+Maybe* vs. *No*. Finally, they were converted to a 3-point continuous favorability scale reflecting degree of preference, where 3=*Yes*, 2=*Maybe*, 1=*No*. All measures were examined overall as well as broken down by printed vs. electronic (with electronic scores computed as the mean across the four electronic options WebLink, WebSearch, Email, Phone) and older patients vs. young adults.

Reasons for Preferences

The reasons participants gave for their preferences were sorted into semantic categories. For example, "want to get it with the medicine" and "convenient" were frequent categories. Comments made by few participants (under 1% for the large sample of patients and under 5% for the smaller sample of young adults) were left uncategorized as "other." A few comments included more than one type of reason, so they received credit for multiple categories. The percentage of participants who gave each type of reason was calculated separately for each type of delivery option and for each type of response (*Yes*, *No*, *Maybe*). Comments about whether participants would like to receive the information "in some other way" were also sorted in to semantic categories and percentages of responses calculated.

Two coders sorted the 7,080 responses (1,1416 participants x 5 delivery options) into categories, using a multi-stage process. The first coder (with expertise in linguistics) developed semantic categories based on a random subset of 25% of comments for each option. The second coder independently sorted all comments into the established categories, left any that did not fit unscored, and suggested additional categories as needed. The agreement between the two coders was at or above 98% across delivery options; when there was a disagreement, the linguistic

expert reviewed both scores and designated a final score. Finally, new categories suggested by both coders were used to sort leftover comments, using the same basic process. Remaining comments that did not fit any of the categories were designated "other."

Ethics Statement

The study was approved by the campus Institutional Review Board (IRB) at Duke University. The informed consent process was conducted at the beginning of the session and was included in the software that guided the session. At the end of the consent process, participants were told how to get answers to questions they might have about participating in the study and given contact information for both the investigator and IRB. When asked whether they agreed to participate, web participants clicked "*Yes*" or "*No*." If they clicked "*Yes*," the screen advanced and they continued with the study; if they clicked "*No*" they automatically exited the software and were thanked for their time and interest. The same procedure was followed for phone participants, but conveyed orally by the research assistants.

Results

Results: Patients

Preference Responses

Fig. 1 shows the percentage of patients who replied *Yes*, *No*, or *Maybe* for each type of information delivery method. Support for retaining the information in printed form was nearly

unanimous – 95% of patients replied *Yes* or *Maybe*. Phone participants scored higher on this measure ($F(1,1366) = 17.165$, $p < .0001$, $\eta p^2 = .01$), but the same overall pattern across options occurred for both phone and web groups. Patients did not reject electronic versions outright, but their endorsements were lower than those for the printed version ($F(1,2827) = 4951.85$ $p < .0001$, $\eta p^2 = .64$).

Fig. 1 – Percentage of patients who replied *Yes*, *No*, or *Maybe* concerning whether they would like to receive written prescription medication information provided in printed vs. electronic forms.

Leaflet = "leaflet printed on paper, given with the medicine at the pharmacy"

WebLink" = "get an internet link to the leaflet, given at the pharmacy"

WebSearch = "do an internet search on your own"

Email = "have the leaflet sent to you by email, from the pharmacy"

CellPhone = "have the leaflet sent to your cell phone, from the pharma

Favorability Scores

Preference responses were converted to a 3-point continuous favorability scale (3=*Yes*, 2=*Maybe*, 1=*No*). Favorability scores varied across delivery options ($F(4,7011) = 286.4$, $p < .0001$, $\eta p^2 = .14$), with favorability for Printed leaflets highest, followed by WebLink and WebSearch, then Email, then Cell Phone. There were no differences between patients who participated by phone vs. web ($F(1,7006) = 1.264$, ns).

Reasons for Responses

Table 1 shows the reasons patients gave concerning how they want to receive written medication information in the future. For each delivery option, results are shown separately for each response choice (*Yes*, *No*, or *Maybe*). Conditional probabilities are reported; for example of those responding *Yes* to a particular delivery option, the percentage who gave each reason is reported. Percentages do not sum to 100%, since some patients gave more than one reason, a few gave no reason, and there was no agreement on some reasons (agreement scores less than 1%). Also, some gave comments that were not relevant to the question, such as, "I need to know about the med" or gave nonspecific responses such as "that would be nice." The main reasons given (at least 5% of each response group) are reported here, with additional reasons shown in Table 1.

S1 Table 1. Older Patients: Reasons for prererring printed vs. electronic medication information.

Printed Leaflets. When asked whether they would like to get a medication leaflet printed on paper at the pharmacy, nearly all patients responded *Yes*. ***Yes*-Responders** gave many reasons – they like getting the leaflet now with the medication, it is easy (to read, understand and get), it is convenient, they can read it at any time, they can look at it later, they would read it now with the medication, they like getting it with a new medication (but may not want it every time they get a refill), they like paper and having something physical, there could be problems getting it by computer or they have no computer, it is helpful, they can keep it in a particular location, they can get updates at the pharmacy, can use it to ask their doctor or pharmacist questions, it is a good/familiar source and makes sense, the source of the information is trusted, the leaflet will help them remember the information, and they will keep it for future reference ***No*-Responders**

do not want paper, would not read it, want the information another way, and want it only the first time they get a medication. ***Maybe*-Responders** often cited reasons given by *Yes*-Responders (e.g., would read it) or *No*-Responders (e.g., do not want paper). A frequent comment across all participants was that they want the leaflet only the first time they get a medication, not every time. This comment reflects the experience of this particular sample of patients – all were taking a drug (lisinopril) for a chronic condition, filled a prescription for it every month, and received the leaflet every time.

WebLink. When asked whether they would like to get an internet link to the leaflet with their medication, given to them at the pharmacy, over half the patients said *No*. ***Yes*-responders** said the link would enable them to get more information, it is convenient, they can look at any time, they use the internet often, they want to save paper, and/or they want it as back-up to the printed version. ***No*-Responders** said that they (or others) do not have a computer or web access, it requires extra time and effort, they would not read the leaflet from the link or remember to do so, they want paper, and/or they use the web only occasionally. ***Maybe*-responders** had both positive and negative comments about WebLink. On the positive side, the main reasons were that it is convenient, they can use it to get more information, and they would use it as a backup to the printed leaflet. On the negative side, they said a WebLink would take more time and effort, they have no or little computer/web experience, and they may not look or would forget to look at it.

WebSearch. When asked whether they would like to do an internet search on their own, over half the patients said no. ***Yes*-responders** said they might search to get more information, they like searching the web in general or have already searched for drug information, and it is convenient.

***No*-responders** said they do not have a computer/internet or have poor skills, it involves too much time/effort, and they would forget or just would not do it. ***Maybe*-responders** said they might search the web on their own to get more information or if they had questions/concerns.

Email. When asked whether they would like to have the leaflet sent to them by email from the pharmacy, nearly 3/4 of patients said *No*. ***Yes*-Responders** said that email would be convenient, save paper, be easy to read and get, they would read it, and could read it at any time. Many ***No*-Responders** do not have internet, computer, and/or email, while others are concerned that they might not see the email, ignore, lose, or delete it as spam, already get too many emails, do not check email often, and want to get the leaflet with the medication. Only 74% of ***Maybe*-Responders** gave reasons for their responses. Those who participated by phone often paused, sounded uncertain, gave no response, or said they just did not know why. Of those who did give reasons, some noted possible benefits of email including that they might read the leaflet. However they also had reservations about email – they want to retain printed leaflets given with the medication at the pharmacy or have limited/no email.

Cell Phone. When asked whether they would like to have the leaflet sent to their cell phone from the pharmacy, nearly all patients said *No*. **Yes-Responders** commented that cell phone delivery would be convenient, it would enable them to get more information or use it as a reference, it would save paper, permit easy access, and they could look at any time. 18% of ***No*-Responders** did not give a reason for their choice – they said things like “just don’t want it,” “are you serious,” or gave no response at all. Of those who did give reasons, some have no cell phone, cited intrinsic limitations of phones (such as the small screen), have only a basic cell service, and

want the printed leaflet anyway. Those who raised privacy concerns were often quite vehement in their comments, such as “no way,” or “stay off my cell phone” ***Maybe*-Responders** cited both pros and cons of cell phone delivery. On the positive side, they said it would be convenient or they can look at any time. On the negative side, they cited concerns about cell phone limitations, such as the small screen size, it is a “poor reading device,” there are ads and spam, and it will contribute to electronic clutter. **Other-Responders.** The question about cell phones clearly indicated that “the *leaflet* would be sent from the pharmacy to your cell phone. However a few patients assumed that it would be auditory rather than visual, while others thought that the information would be provided as a text message.

Other Ways. After patients responded to all the delivery options, we asked, “Would you like to receive this information in some other way?” Most gave no response (57%) or commented that they could not think of any (21%). Of those who did mention other options, 70% want a printed leaflet, provided either at the pharmacy with the medication (31%) or sent through the U.S. mail (39%). They had already said *Yes* to printed leaflets, so this was an additional spontaneous endorsement.

Results: Young Adults

The same analyses were performed on responses from the young adults as for the patients. However since young adults participated by web only, there are no results for phone vs. web participation.

Preference Responses

Young adults expressed strong support for retaining medication information in printed leaflet form, as shown in Fig. 2. This support was nearly unanimous – 95% replied *Yes* or *Maybe*. They also expressed support for electronic methods, but to a lesser extent ($F(1,735) = 784.09$ $p < .0001$, $\eta p^2 = .52$).

Fig. 2 – Percentage of young adults who replied *Yes*, *No*, or *Maybe* concerning whether they would like to receive written medication information provided in printed vs electronic forms.

Favorability Scores

There was an overall effect of favorability scores ($F(4,1830) = 3.462$, $p < .01$, $\eta p^2 = .01$). Each successive option was lower than the previous one: Leaflet > WebLink > WebSearch > Email > Cell Phone ($F(4,1830) = 3.462$, $p < .01$, $\eta p^2 = .01$).

Reasons for Responses

Reasons why young adults would like to get written medication information from the various delivery options are shown in Table 2, in the same manner as for patients. However, since only a subset of the young adults were asked to give reasons for their responses, only reasons given by at least 10% for each response option are reported here, with additional details in Table 2.

S2 Table 2. Young Adults: Reasons for preferring printed vs. electronic medication information.

Printed Leaflets. Most young adults responded *Yes* to printed leaflets. ***Yes*-Responders** commented that the printed format is easy to read, understand, and/or get, they would look at it later, they like getting it with their medication, it is convenient, they can read it at any time, and they like paper. There were too few ***No*-Responders** to categorize their responses. ***Maybe*-Responders** gave some positive reasons – that printed leaflets are convenient, easy to read, understand, and/or get, and the information is from a trusted source; however some were concerned that they might lose it and therefore not read it.

WebLink. ***Yes*-Responders** said the link is convenient, that it gives more ways to get the information, it would enable them to get more information, they can look at any time, and the source of the information (the pharmacy) is trusted. ***No*-Responders** complained that using a web link would take too much time, that they might forget to look at the link, and there can be various web problems.

WebSearch. ***Yes*-Responders** said web search on their own would enable them to find additional information. Most ***No*-Responders** cited problems with the quality of information on the web, while others said it is too time consuming or they might forget to do it. ***Maybe*-Responders** complained that information on the web is not trustworthy or that it would take extra effort to search. On a more positive note, some said it would provide more information about the medication and they could look for it at any time.

Email. ***Yes*-Responders** noted that it would be easy to read, understand, or get the information by email, it would enable them to look at the information later, and they would read it. ***No*-**

Responders gave many reasons -- that email is not a convenient method, they would ignore or delete it (because they get too much junk, spam, and pop-ups), they don't check email often, they would not read it, there can be web/computer problems, and they get too many emails. ***Maybe*-Responders** said they would read it, it is easy to read and understand it this way, and it is convenient; but some cited privacy concerns.

Cell Phone. ***Yes*-Responders** said cell phone delivery would provide easy access to the information, they could read it at any time, it would be convenient, and they could "reference" it. Although the question asked whether they would like to get the *leaflet* sent to their cell phone by the pharmacy, a few evidently thought it would come as a phone call and said they would listen to it, while others thought it would come as a text message. ***No*-Responders** often cited the limitations of cell phones such as the small screen or battery problems, were concerned that they might not remember the information, and gave various reasons about how they use their cell phones. ***Maybe*-Responders** cited some positive reasons -- convenience, easy access, and they would listen to a call. However some did not want to get text messages, expressed privacy concerns, or thought it would take too much effort.

Other Ways.

When asked whether they would like to receive the leaflet in "some other way," only 20% of young adults gave a response. Of these, 10% cited their doctor or a pharmacist, with no agreement among the rest.

Results: Comparison of Patients vs. Young Adults

The performance of patients and young adults was compared across the same measures as reported separately for each group. Each analysis included the between-groups factor Participant Type (patient vs. young adult) and the within-group factor Delivery Method (printed vs. electronic).

Preference Scores.

The overall analysis of *Yes+Maybe* responses was significant ($F(1,1730) = 29.39$, $p < .0001$, $\eta p^2 = .02$). Fig. 3 displays the results in a manner designed to highlight comparison of the two participant groups. Support for the printed leaflet was identical for the two groups -- 95% of both groups responded *Yes* or *Maybe* for this delivery option ($F(1,1730) = .055$, $p = .81$, ns). Young adults were more open to electronic methods – their *Yes+Maybe* scores were higher than those for patients for WebLink ($F(1,1730) = 26.68$, $p < .0001$, $\eta p^2 = .02$), WebSearch ($F(1,1730) = 7.28$, $p < .01$, $\eta p^2 < .01$), Email ($F(1,1730) = 57.83$, $p < .0001$, $\eta p^2 = .03$), and Phone ($F(1,1730) = 105.09$, $p < .0001$, $\eta p^2 = .06$). Nevertheless scores for all electronic methods were well below those for the Printed leaflet for both patients and young adults ($F(1,3562) = 3216.03$, $p < .0001$, $\eta p^2 = .47$). Furthermore the overall pattern of preferences for electronic methods was nearly the same in both groups.

Fig. 3 – Comparison of patients vs. young adults in their endorsement of printed vs. electronic delivery of written medication information.

Favorability Scores.

Results for favorability scores mirrored those for preference scores ($F(4,8846) = 7.53$, $p < .0001$, $\eta p^2 < .01$). Both patients and young adults had very high favorability scores for the printed leaflet and did not differ in favorability level ($F(1,1780) = 2.12$, ns). Young adults had higher favorability scores for electronic methods – WebLink ($F(1,1777) = 26.93$ $p < .0001$, $\eta p^2 = .01$), WebSearch ($F(1,1769) = 9.66$ $p < .01$, $\eta p^2 = .01$), Email ($F(1,1759) = 50.48$ $p < .0001$, $\eta p^2 = .03$), and Phone ($F(1,1766) = 72.12$ $p < .0001$, $\eta p^2 = .04$). However their much higher score for the printed leaflet and their comments indicate that they favor electronic methods to a lesser extent and *in addition to* the printed leaflet.

Fig. 4 – Favorability scores for patients vs. young adults. Data from Fig. 1 and 2, recalculated to obtain a continuous measure (where *Yes* = 3, *Maybe* = 2, No = 1).

Reasons for Responses

The reasons participants gave for their preferences were similar for older patients and young adults. However patients had more barriers to adopting electronic options based on life circumstances such as having no electronic access and/or skills.

Discussion

This research generated detailed information about how the general public wants to receive written information about their prescription drugs. The methods used ensured that participants

would consider all delivery options carefully – it required them to indicate *Yes*, *No*, or *Maybe* for every option (rather than selecting one or more choices) and asked them to give a reason for every response. The reasons were analyzed separately depending on whether participants indicated *Yes*, *No*, or *Maybe* for each option instead of lumping them all together. Furthermore the delivery options focused only on *written* information, so did not confound written with oral communication provided by healthcare professionals such as physicians and pharmacists. Finally, it studied a large, diverse, nation-wide sample of patients highly familiar with written medication information and compared their results to those of tech-savvy young adults. Therefore the results reflect a balanced and thorough examination of views concerning delivery of written medication information.

Printed vs. Electronic Information

The main results for older adult patients are not surprising – they preferred printed over electronic delivery of medication information. The magnitude of their endorsement of the printed version is striking – virtually all (95%) wanted to retain it (as indicated by their *Yes+Maybe* responses). According to a strong version of the age hypothesis, they would also reject electronic forms. However they were somewhat accepting of electronic delivery, although with considerable variation across the various forms. Both their preference responses and reasons indicate that any electronic versions would be in addition to the printed version.

The results for young adults concerning printed information are surprising. Despite their heavy use of technology, they also wanted to retain printed information – and at the same very high

level (95%) as the older adults. As might be expected, they endorsed electronic delivery more than the older adults, but it was not across the board – their overall pattern of acceptance of the various electronic forms was the same as for the older adults.

Although there was no age effect in preference for printed information, there were age differences in preference for electronic forms. However these were differences in degree, not kind – young adults endorsed electronic forms more than older adults, but seniors still endorsed them somewhat and showed the same overall pattern of acceptance across the various electronic forms (i.e., highest endorsement for WebLink, lowest for Cell Phone). There was a subtle age effect reflected in how patients chose to participate in the study. Those who opted to do so by phone were somewhat older than those who did so online; they were more likely to mention that they do not have access to technology or that their skills are poor.

Age vs. Cohort Effect

When an apparent age effect occurs, it could be based on a birth year cohort effect rather than aging. The mean age of the patients was almost 57, which means that most were born well before the adoption of electronic technology now prevalent in the general population. Adoption of technology among seniors is increasing [8], but this is partly due to people in later cohorts already familiar with technology entering the older age brackets and the number of people from earlier cohorts decreasing. It is very difficult to untangle the effects of age vs. cohort in cross-sectional studies like the current one. This problem, called the age-cohort effect, is well-recognized throughout research in public health, social science, and behavioral science (for a

recent review and analysis see [14]). Furthermore the period of observation may also be involved in apparent aging effects. For example, if we conducted the same study 10 years ago when technology adoption was not as widespread or ten years from now, the results might be different. This age-cohort-period effect makes it even more difficult to disentangle apparent age effects.

Those in favor of eliminating printed medication information for patients might argue that age-cohort-period problems do not matter – eventually a sufficient percentage of the population will adopt technology so we can eliminate printed medication information. According to this view, we just have to wait a bit longer and then move to an all-electronic environment. However this study shows that all participants value and want to keep printed information – even those currently aged 18-22 who have spent much of their lives using technology.

Cognitive Considerations

Neither age nor technology experience can account for the exceptionally strong desire to retain medication information in printed form. Life circumstances (such as income, education, and disability) are known to affect technology adoption [8] and are reflected to some extent in comments given by participants in this study. However cognitive factors may also be involved. Participants often gave cognitive reasons for their responses, such as whether a given delivery option would be easy to understand, read, or remember and whether they would remember to look at the information. Cognitive considerations have not been part of the debate about printed vs. electronic delivery of patient medication information.

A major – perhaps the main – goal of patient medication information is to enable people to understand the benefits, risks, directions, and other key information about the drugs prescribed to them. Memory for at least some of this information is also important. For example, if patients experience a serious symptom (such as unexplained bruising), would they consider that it could be a side effect of a drug they are taking? If so, they would be more likely to consult the written information and/or a healthcare provider.

There is considerable research on the cognitive effects of reading from screens vs. paper. Most studies through the early 1990's found that people read more slowly and with less comprehension from screens, e.g., [15]. However screen technology has improved substantially since then, both in the quality of images and user features. The results of more recent comprehension studies have been somewhat mixed, but most still show a comprehension advantage for paper. For example, a recent study [16] found that students who read texts in print scored significantly better on a reading comprehension test than those who read the same texts from screens.

Some research suggests that screens require more mental resources during the reading process [17]. If so, then fewer resources would be available for "deeper" and more thoughtful processing of information. The idea of "levels of processing" [18] led to experiments [19] showing that when information processing is more "shallow," less can be recalled later. Furthermore, recall is less organized after shallow processing, suggesting that knowledge of the information is

relatively unstructured. Neither result would be good outcomes for patient medication information.

Participants in the current study strongly endorsed retention of printed leaflets even if electronic versions are also provided. Some commented that they want to have something "physical" or that even if they received the leaflet electronically they would still print it. These results may reflect metacognition (knowledge of their own cognitive processes) – perhaps they understood that their cognitive processes are different (perhaps deeper and more thoughtful) while reading from paper vs. screens.

It is not straightforward to apply the results of previous research on paper vs. screen presentation to patient medication information, since studies varied widely in the type of text materials used (e.g., short paragraphs), participants, and experiment procedures. Research is needed for a head-to-head comparison of paper vs. screen presentation of patient medication information and their effects on comprehension, memory, and other cognitive processes. Whatever the results, they should help inform the debate about how to deliver patient medication information to foster optimal comprehension, memory, and behavior.

Conclusions

The phrase, "the jury is out" is often used for situations where either there is no consensus about an issue or there is not sufficient evidence to make a determination. The GAO report [12] found

no consensus about printed vs. electronic delivery of patient medication information, based mostly on interviews with professional healthcare stakeholders. However the current empirical research clearly shows that the general public wants to retain printed leaflets, whether or not electronic formats are also provided.

Might there be a future time when the public is ready for all-electronic delivery of patient medication information? Some might argue that "the jury is on temporary hold" – waiting until older adults increase their adoption and skill in using electronic methods, and new cohorts already familiar with technology increasingly populate the senior age brackets. The evidence from this research suggests that "the jury is in" – both older and younger individuals, patients and non-patients, and those tech-savvy and not – all endorsed retaining paper-based medication information. The strength of this endorsement was the same for both the older patients and young tech-savvy adults – 95% of both groups wanted to retain the printed version. Although young, tech-savvy participants were more open to electronic methods, they clearly indicated that such options should be *in addition to* paper versions. Older patients did not categorically reject electronic methods, suggesting that their strong preference for printed information is based at least in part on its intrinsic advantages rather than limited knowledge and experience with technology.

In conclusion, the printed vs. electronic debate would benefit from reframing. Instead of focusing on whether patient medication information should be provided only electronically, the practice of paper AND electronic delivery needs closer scrutiny. Possible differences in comprehension,

memory, and other cognitive processes should also be examined. Head-to-head experiments using patient medication information texts should be conducted before any policy is adopted.

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Supporting Information

S1 Table 1. Older Patients: Reasons for preferring printed vs. electronic medication information.

S2 Table 2. Young Adults: Reasons for preferring printed vs. electronic medication information.

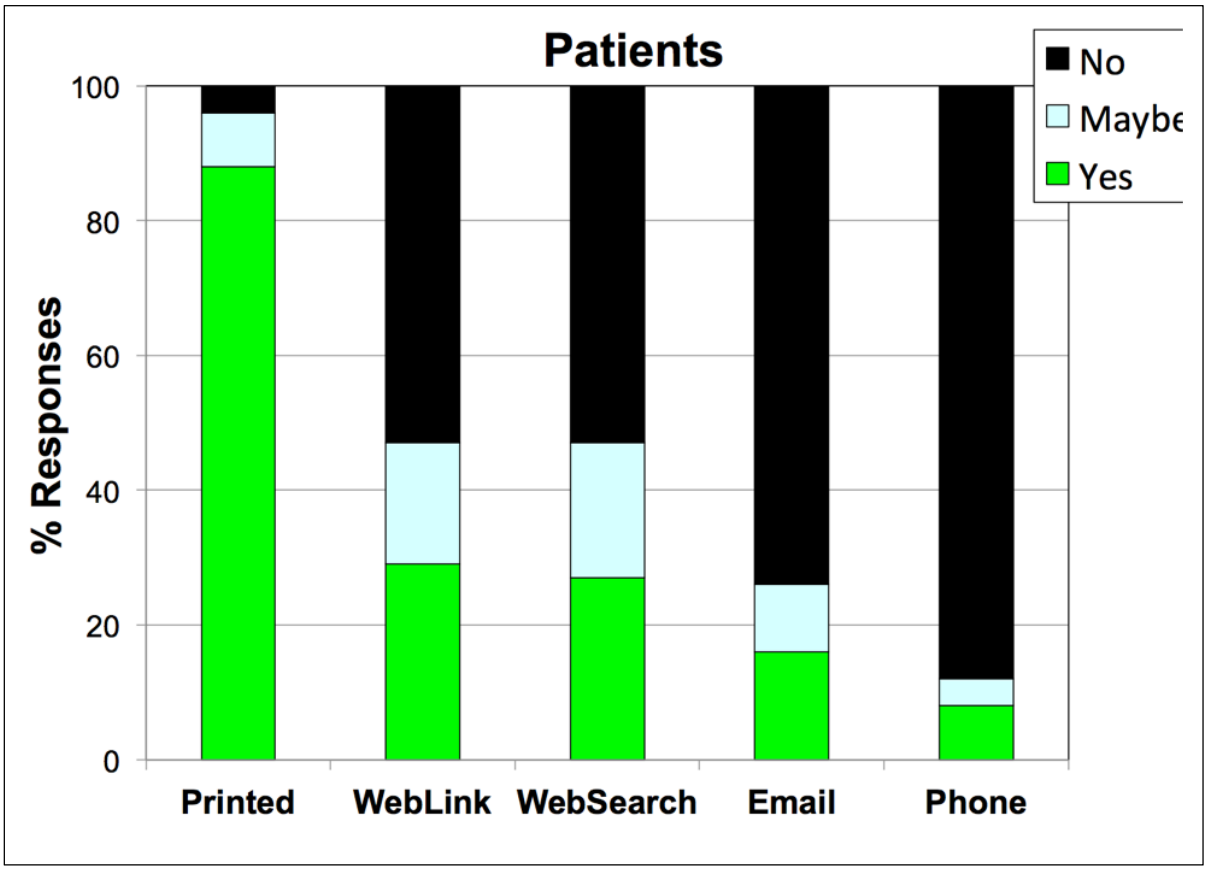

Figure 1 – Percentage of patients who replied Yes, No, or Maybe concerning whether they would like to receive prescription medication information provided in printed vs. electronic forms.

Printed = "leaflet printed on paper, given with the medicine at the pharmacy"
WebLink" = "get an internet link to the leaflet, given at the pharmacy"
WebSearch = "do an internet search on your own"
Email = "have the leaflet sent to you by email, from the pharmacy"
Phone = "have the leaflet sent to your cell phone, from the pharmacy"

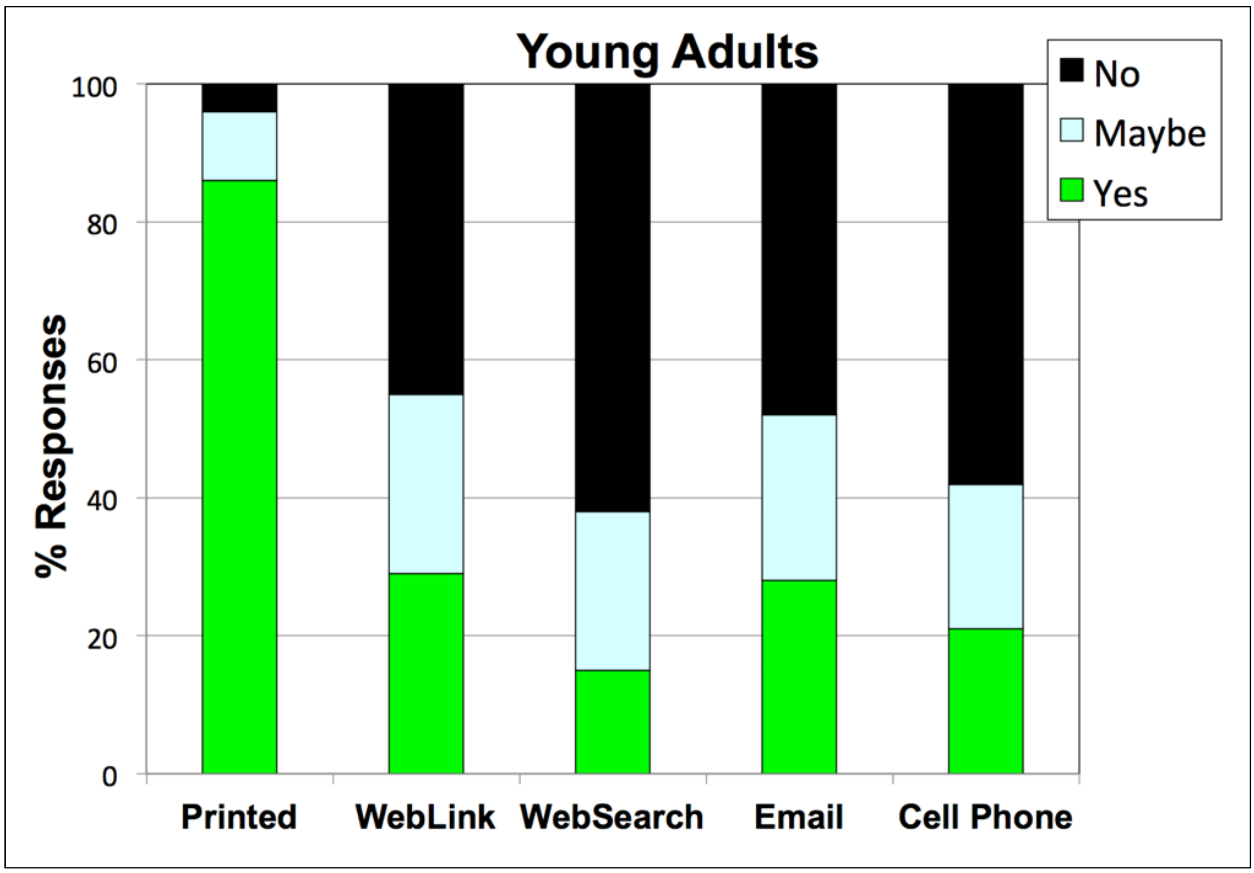

Figure 2 – Percentage of young adults who replied Yes, No, or Maybe concerning whether they would like to receive prescription medication information provided in printed vs. electronic forms.

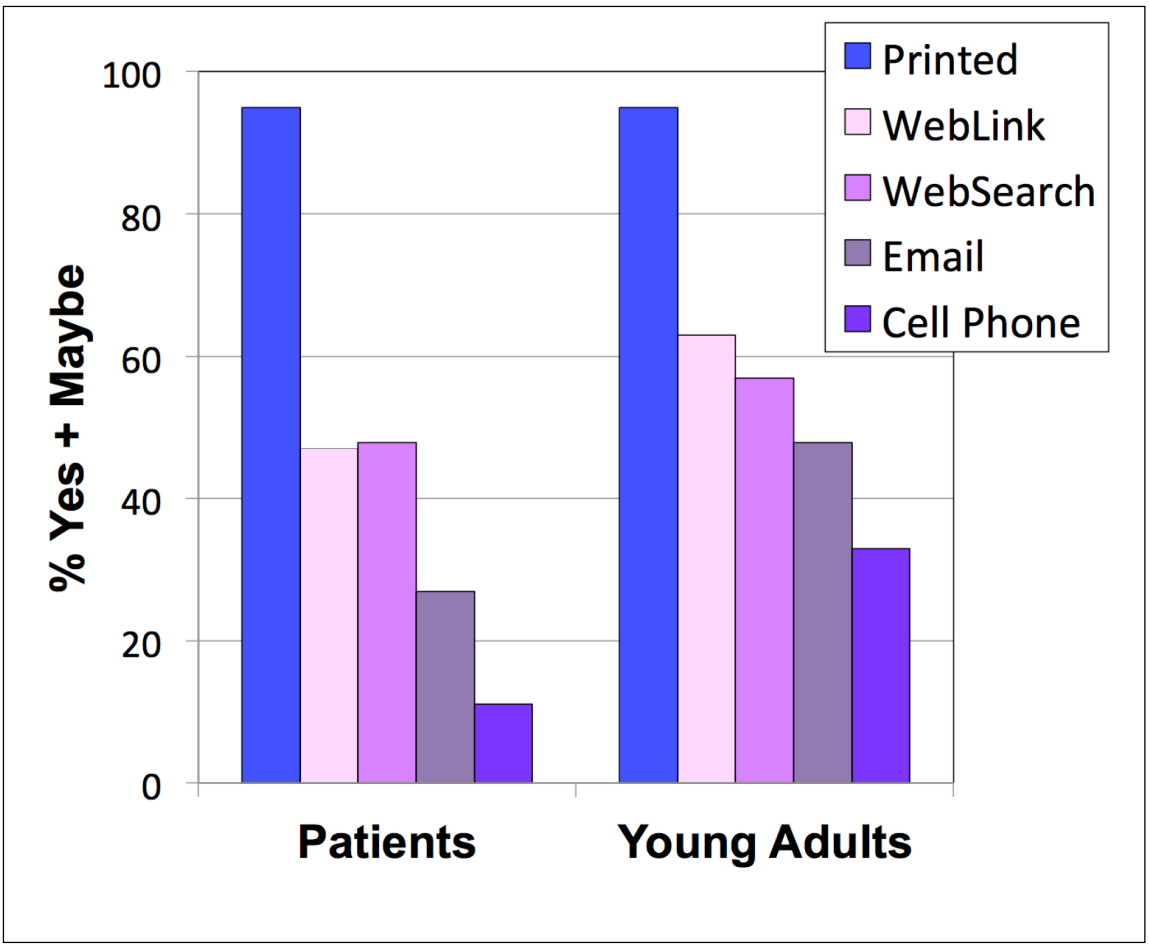

Figure 3 – Comparison of patients vs. young adults in their endorsement of printed vs. electronic delivery of prescription medication information.

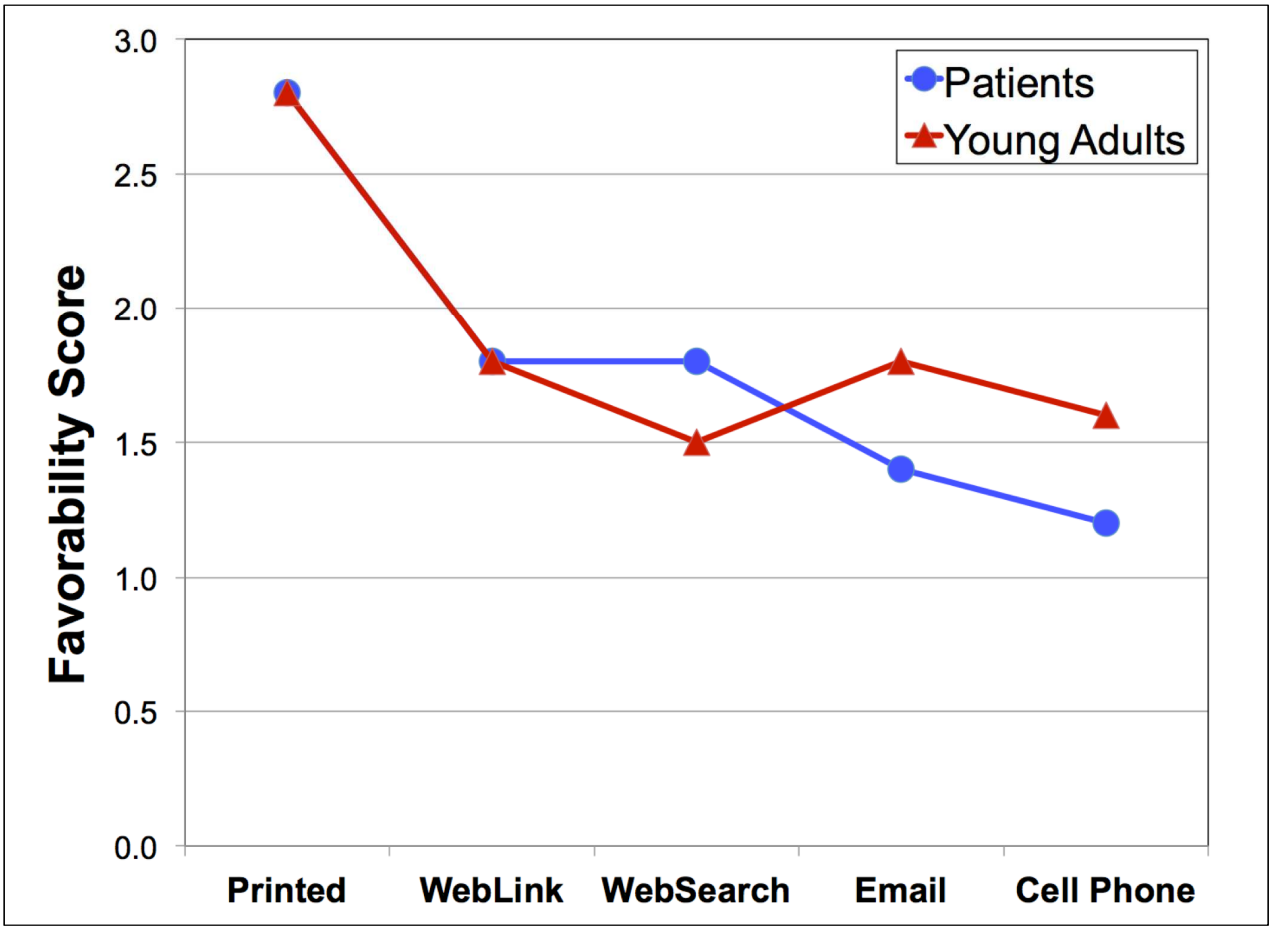

Figure 4 – Favorability scores for patients vs. young adults. Data from Figures 1 and 2 recalculated to obtain a continuous measure (where Yes = 3, Maybe = 2, No = 1).

S1 Table 1. Older Patients: Reasons for preferring printed vs. electronic medication information

Preference Responses
N's indicate number of participants who gave each response (*Yes, No,* or *Maybe*) for a given delivery option.
Sums of N's less than the sample (1416) indicate that some participants did not give a preference response.

Reasons for Preferences
Reasons with at least 1% agreement for a given preference response (*Yes, No*, or *Maybe*) are shown.
Excluded are reasons <1%, comments irrelevant to the question, and failures to give a reason.
% Agreement scores are conditional -- given the number who gave a certain response. (e.g., *Yes*), the % who agreed on each reason is shown
Slash marks (/) indicate minor variations of a given reason

Printed *("leaflet printed on paper, given with the medicine at the pharmacy")*

YES -Responders (N =1242)		*NO* -Responders (N = 110)		*MAYBE* -Responders (N = 62)	
Reasons	**% Agreement**	**Reasons**	**% Agreement**	**Reasons**	**% Agreeme**
Want it now, with the med	13	Do not want paper	23	Only the first time get a med	12
Easy (read/understand/get)	9	Would not read it	16	Would not read it	5
Would read it	9	Want it another way	11	Do not want paper	4
Convenient	8	Only the first time get a med	11	Would read it	3
Can read at any time	7			Would read it now	3
Can look at it later	6			If had questions	3
Would read it now	5			Easy (to read/understand/get)	2
Want it with new meds	4			Want it now, with the med	2
Like paper, physical object	3			Read at any time	2
No computer / poor skills	2			Look at it later	2
Helpful	2			Get updates	2
Will keep it / certain place	2			Use to ask Dr. or pharmacist	2
Get updates	2			Convenient	1
Use to ask Dr. or pharmacist	1			Helpful	1
Good/familiar/makes sense	1			Help remember	1
Trusted	1			Trusted	1
Help remember	1				
Would keep it	1				

WebLink *("get an internet link to the leaflet, given at the pharmacy")*

YES -Responders (N = 408)		*NO* -Responders (N = 749)		*MAYBE* -Responders (N = 252)	
Reason	**% Agreement**	**Reason**	**% Agreement**	**Reason**	**% Agreeme**
Get more information	23	No computer/web and/or poor skills	33	More effort/time	8
Convenient	16	Too much time/effort	12	No/little computer/web access/skill	6
Look at any time	7	Would not look or remember to do it	11	May not look / Forget	6
Use the internet a lot	6	Want paper	7	Convenient	6
Save paper	6	On web only occasionally	6	More information	5
Use as a back-up / more ways	5	Web problems	3	BackUp / More ways	5
It's the IT age	4	Not with the medication	3	Save paper / clutter	5
Helpful	3	Inconvenient	2	Look any time	3
Computer location	1	Not needed	1	Want paper	2
				Online a lot / Use internet	1
				Web problems	1
				Not for everyone	1

WebSearch *("do an internet search on your own")*

YES -Responders (N = 385)		*NO* -Responders (N = 731)		*MAYBE* -Responders (N = 286)	
Reason	**% Agreement**	**Reason**	**% Agreement**	**Reason**	13
Get more information	23	No computer/web and/or poor skills	30	Can get more information	6
Like/do web search	12	Too much time/effort	15	If have questions/concerns	4
Convenient	10	Would not do it / Forget to do it	7	Too much time/effort	3
Want to do own research	5	Want paper	5	Find out side effects	2
If have questions/concerns	4	Not trusted	5	No/little computer experience	2
Look at any time	4	No need / do not want it	5	Convenient	2
More ways to get the info	2	Problems finding correct information	2	Like/do web search	2
Want paper	2	Computer/web problems	2	Want to do own research	2
Find side effects	2	Don't use the web often	1	Back-up to paper	1
No/little computer experience	1			NotTrusted	1
Back-up to paper	1			Would not do it	

Email *("have the leaflet sent to you by email, from the pharmacy")*

YES -Responders (N = 227)		*NO* -Responders (N = 1020)		*MAYBE* -Responders (N = 146)	
Reason	**% Agreement**	**Reason**	**% Agreement**	**Reason**	8
Convenient	18	No web/computer/email	24	Want paper with med from pharmacy	7
Do not want paper	15	Would ignore/not see/lose/delete it	13	May/would read it	6
Easy (to read/understand/get)	13	Too much email	9	No/little computer/email at home	5
Would read it	8	Do not check email often	7	More ways to get the info	5
Read at any time	7	Want it with the med	7	Might delete as junk/spam/	5
More ways to get the info	4	Want paper from the pharmacy	5	Web access only occasionally	5
Want paper from pharmacy	4	Too much time/effort	4	Too much time/effort	4
Would keep/refer to it	4	Not convenient / access problems	2	Convenient	4
Get more information	3	Web/computer problems	2	Too many emails / might miss it	4
Get updates	2	Not needed	1	Can keep/store it	3
Look later	1	Would still print it	1	Save paper	3
Would print it anyway	1	Privacy concerns	1	Not timely	3
				Would only glance at it/would not read	2
				Easy (to read/understand/get)	1
				Would print it anyway	1

Cell Phone *("have the leaflet sent to your cell phone, from the pharmacy")*

YES -Responders (N = 107)		*NO* -Responders (N = 1244)		*MAYBE* -Responders (N = 50)	
Reason	**% Agreement**	**Reason**	**% Agreement**	**Reason**	18
Convenient	30	NoCell	15	*Smart phone limitations	14
More information / reference it	10	*Smart phone limitations	13	Convenient	6
Save paper	10	Basic cell (no web, email, dataplan)	8	Look at any time	4
Easy access	7	Want printed/with med/ would print	6	Reference it	4
Look when want	6	Use phone for other things	5	Easy access	4
No smart phone (self or others)	5	Too much time/effort; bothersome	5	Would not read it	2
Can read it	3	Privacy (no med info on phone)	5	No cell	2
Useful	2	Rarely use cell	4	Useful	2
Back-up	2	Would not read	3	Back-up	2
Get texts	2	Not needed/already get the info	3	Might read it	2
Get updates	2	Cell contraints (minutes, cost, battery)	3	Get updates	2
More way to get the info	1	Might not see/read; might lose/delete	2		
Want printed	1	Problems using / cell coverage	1	*Too small / hard to read / clutter / ads-spam	
Might delete it	1	To much time/effort	1		
		Do not like/hate cell	1		
		*Small screen / too much info / will not display correctly			

S2 Table 2. Young Adults: Reasons for preferring printed vs. electronic medication information

Preference Responses

N's indicate number of participants who gave each response (*Yes, No,* or *Maybe*) for a given delivery option.
369 young adults completed the preference task; a subset of 82 were asked to give reasons for their responses.
Sums of N's less than the sample (82) indicate that some participants did not give a preference response.

Reasons for Preference Responses

Reasons with at least 5% agreement for a given preference response (*Yes, No,* or *Maybe)* are shown.
Excluded are reasons <5%, comments irrelevant to the question, and failures to give a reason.
% Agreement scores that sum to >100% for a given column indicate that some participants gave more than one reason
% Agreement scores are conditional -- given the number who gave a certain response. (e.g., *Yes*), the % who agreed on each reason is shown
% Agreement scores based on small N's should be viewed with caution.
Slash marks (/) indicate minor variations in a given reason

Printed *("leaflet printed on paper, given with the medicine at the pharmacy")*

YES **-Responders**		***NO*** **-Responders**		***MAYBE*** **-Responders**	
N = 70		N = 3		N = 8	
Reasons	**% Young**	[Insufficient data]		**Reasons**	**% Young**
Easy (to read/understand/get)	30			NoRead/Lose	50
Look later	23			Convenient	25
Get it now, with med	19			Easy (Read, Underst, Get)	13
Convenient	13			Trusted	13
Read at any time	13				
Like paper	11				
Read it now	7				
Trusted	7				
Keep it (specific place)	6				

WebLink *("get an internet link to the leaflet, given at the pharmacy")*

YES **-Responders**		***NO*** **-Responders**		***MAYBE*** **-Responders**	
(N = 24)		(N = 37)		(N = 21)	
Reason	**% Young**	**Reason**	**% Young**	**Reason**	**% Young**
Convenient	46	Too much time	43	Extra effort	33
More ways to get it	25	Won't do it / Forget	32	Look any time	14
Get more information	25	Web problems	24	Won't do it / Forget	14
Look at any time	21	Not with med	8	Convenient	10
Trusted	17				

WebSearch *("do an internet search on your own")*

YES **-Responders**		***NO*** **-Responders**		***MAYBE*** **-Responders**	
(N = 12)		(N = 51)		(N = 19)	
Reason	**% Young**	**Reason**	**% Young**	**Reason**	**% Young**
Get more information	83	Quality of info on web	51	Not trusted	37
Convenient	8	Too much time	27	Extra effort	21
Not trusted	8	Won't do it / Forget	22	Get more information	16
				Look any time	11
				More ways	5

Email *("have the leaflet sent to you by email, from the pharmacy")*

YES **-Responders**		***NO*** **-Responders**		***MAYBE*** **-Responders**	**% Young**
(N = 24)		(N = 39)		(N = 20)	0.20
Reason	**% Young**	**Reason**	**% Young**	**Reason**	0.15
Easy (to read, understand, get)	48	Not convenient	15	Privacy concerns	0.10
Look later	26	Ignore / delete (junk,spam,email)	15	Would read it	0.10
Would read It	13	Do not check email often	13	Easy (to read, understand, get)	
Convenient	9	Would not read	13	Convenient	
		Web/computer problems	10		
		Too much email	10		
		Privacy concerns	8		

Cell Phone *("have the leaflet sent to your cell phone, from the pharmacy")*

YES **-Responders**		***NO*** **-Responders**		***MAYBE*** **-Responders**	
(N = 17)		(N = 47)		(N = 18)	
Reason	**% Young**	**Reason**	**% Young**	**Reason**	**% Young**
Easy access	41	Cell limitations	34	Convenient	29
Look any time	24	Would not remember info	11	Easy access	18
Convenient	12	Bothersome	9	Don't want text	18
Reference it	12	Would not read	9	Privacy concerns	18
Would listen/call	12	Don't want auditory	9	Would listen/call	12
		Use phone for other things	6	Too much effort	12
		Want printed	6		
		Too much time/effort	6		
		Privacy concerns	6		
		Too casual	6		