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The Benefits of Discussing Adjuvant Therapies One At A Time Instead of All At Once

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Abstract

Purpose—Breast cancer patients must often decide between multiple adjuvant therapy options to prevent cancer recurrence. Standard practice, as implemented in current decision support tools, is to present information about all options simultaneously, but psychology research suggests that sequential decision processes might improve decision making. We tested whether asking women to consider hormonal therapy and chemotherapy separately would improve women's risk knowledge and/or affect treatment intentions.

Methods—We conducted an Internet-administered experimental survey of a demographically diverse sample of 1,781 women ages 40–74. Participants were randomized to experience a standard, comprehensive decision process versus sequential (one-at-a-time) decisions regarding adjuvant therapy options for a hypothetical breast cancer patient with an estrogen receptor-positive (ER+) tumor. We assessed comprehension of key statistics, perceptions of treatment effectiveness, and perceived interest in adjuvant chemotherapy, as well as participants' numeracy levels.

Results—When participants made sequential decisions, they demonstrated greater comprehension of decision-relevant risk statistics, as compared to when they made decisions all at once (all p 's < 0.001). Among higher numeracy participants, those making sequential decisions were less interested in chemotherapy ($p < 0.001$). Lower numeracy participants who considered all options simultaneously were insensitive to the degree of risk reduction, but those who made sequential decisions were sensitive ($p = 0.03$).

Conclusions—Presenting adjuvant therapy options sequentially improves women's comprehension of incremental treatment benefit and increases less numerate women's sensitivity to the magnitude of the achievable risk reduction over standard, all-at-once approaches. Sequential approaches to adjuvant therapy decisions may reduce use of chemotherapy among those at low risk for recurrence.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

Keywords

risk; patient education as topic; patient-provider communication; adjuvant therapies

INTRODUCTION

Breast cancer patients routinely face difficult decisions about adjuvant therapy options following their primary surgery. Such decisions are difficult for two reasons. First, the adjuvant therapy decision is inherently sensitive to patients' preferences and values.[1–3] Women must decide, for example, whether the burden of undergoing an extended adjuvant chemotherapy regimen is worth the incremental risk reduction it would achieve, a decision that depends not only on the value each woman places on her short term quality of life but also on the value she places on minimizing her long term concern about recurrence. Second, the adjuvant therapy decision is complicated and information intensive. If, for example, a patient has an estrogen receptor-positive (ER+) tumor, she will likely be choosing from at least four options: no adjuvant therapy, hormonal therapy (e.g., tamoxifen), chemotherapy, or a combination of both hormonal and chemotherapy. Each option is associated with a different chance of cancer recurrence and cancer-related mortality. Patients must identify the options relevant to their medical situation, comprehend the relevant risk statistics, and weigh their pros and cons in order to make informed, preference-congruent decisions.[2–6]

Recent research suggests that most patients have a difficult time making this decision. Many breast cancer patients are overwhelmed by the relevant information and may actually be more confused after viewing printouts from decision support tools such as Adjuvant! (www.adjuvantonline.com), than they were beforehand.[7,4,8,9] Adjuvant!, in particular, may compound the information overload problem by using suboptimal graphical formats [5] and displaying too many risk statistics at once [6], problems which result in communications that are particularly difficult for less numerate patients to understand.[9] Such confusion is especially concerning given that many early stage breast cancer patients achieve only limited risk reductions from adjuvant therapies and thus need to be sensitive to the magnitude of the achievable benefit of treatment.

A fundamental tenet of informed decision making is that patients and clinicians need to be aware of and consider all of the relevant treatment options.[10] Yet, decision research suggests that simplifying the decision-making process by removing extraneous facts and focusing attention on the most critical information can significantly improve patient knowledge and decision quality.[11,5,6] So, how can clinicians deal with the reality that patients need more information but may make better choices with less?

One potential solution to this dilemma may be found in the fact that good decision-making practice does not require that patients learn about the entire set of options *all at once*. Decision psychology research suggests that having to consider multiple options simultaneously can be overwhelming,[12,13] and most medical oncologists can recount how hard it is to explain multiple treatment options in an efficient yet understandable manner. An alternative approach, easily implementable in practice, would be to order the alternatives by their likely attractiveness and then present them *sequentially* (one at a time) to the patient. This process allows for consideration of the full set of treatment options yet focuses both clinicians' and patients' attention on tradeoffs between the incremental risk reduction achieved by each new option and the incremental burden that each step would cause the patient.

In this study, we examined the effects of presenting adjuvant therapy options to women all at once, as per standard practice, compared to presenting the same set of options sequentially

as a series of yes/no choices. We assessed how this change in presentation affected comprehension of decision-relevant statistics, beliefs about the efficacy of treatment options, and treatment intentions. In particular, we focus on whether a sequential decision process would increase women's sensitivity to variations in the incremental benefit of adjuvant therapy.

MATERIALS AND METHODS

Overview of Study Design

Study participants read a short clinical vignette in which they discussed adjuvant therapy options with their doctor. We experimentally manipulated two factors in a 2×2 factorial design: (a) Half of participants were presented with information about hormonal therapy, chemotherapy, and combined therapy (as well as no adjuvant therapy) all at once. The remaining participants experienced a sequential choice process, first choosing between hormonal therapy and no therapy and then considering adding chemotherapy to hormonal therapy. (b) The marginal reduction in mortality risk achievable by adding chemotherapy to hormonal therapy was either low (1%) or high (5%). We assessed participants' treatment intentions and their knowledge of the relevant risk statistics. This design received Institutional Review Board exempt status approval.

Participants

Study participants were women 40–74 years old (the age range of most breast cancer patients) randomly selected from a panel of Internet users administered by Survey Sampling International (SSI). Email invitations were sent to a stratified random sample of panel members. To ensure demographic diversity (but not representativeness), we established target response levels roughly matching the prevalence of different racial/ethnic groups in the U. S. population. We also drew three distinct age samples within each race (one-third each ages 40–49, 50–59, and 60–70). To offset variations in response rates, the number of email invitations in each sub-sample was dynamically adjusted until quotas were achieved. Upon completion, participants were entered into both an instant-win contest and a monthly drawing for modest cash prizes.

The Hypothetical Clinical Vignette

Participants read a vignette in which they imagined going for a routine mammogram, finding a lump, having a biopsy, and being diagnosed with breast cancer. They were then told that the tumor was removed by surgery and tested as ER+ (but no other tumor characteristics).

The remainder of the vignette then varied depending on whether the participant was randomized to receive a standard (all-at-once) or a sequential (one-at-a-time) discussion of the treatment options. Participants in the standard presentation group viewed a graphical and textual description of the mortality risks associated with all four treatment options (no adjuvant therapy, hormonal therapy only, chemotherapy only, or both chemotherapy and hormonal therapy). The vignette described the doctor as leaving no doubt that the patient should take hormonal therapy (because of the tumor's ER+ status) but leaving the question of whether to also take chemotherapy up to the patient.

By contrast, participants in the sequential discussion group first compared only hormonal therapy only versus no adjuvant therapy using a simpler graphic and then indicated which of these two options they preferred. Those who accepted hormonal therapy then considered the incremental effect of adding chemotherapy to hormonal therapy using a second risk graphic and made a choice between these two options. Those who initially rejected hormonal

therapy were presented with a choice between all four treatment options (including hormonal therapy) and asked to choose one.

Risk Information

All risk information was presented using pictographs (icon arrays), a format demonstrated to improve risk communication in multiple medical contexts, [14–18] including adjuvant therapy decisions.[5] Consistent with the format used by Adjuvant!, these graphics depicted the likelihood of survival, death from cancer, and death from other causes using different colored graphical elements.

We used mortality risk statistics derived from Adjuvant! for a 62 year old patient in good health with a 2.5cm Grade 2 ER+ tumor and 1–3 lymph nodes involved. All study participants received identical information regarding the possible outcomes of no adjuvant therapy and hormonal therapy only. However, we experimentally varied the magnitude of risk reduction achievable through chemotherapy (either by itself or in combination with hormonal therapy). Half of participants were told that the incremental 10-year risk reduction of adding chemotherapy was 1% (consistent with use of first-generation chemotherapy agents per Adjuvant!), while the remaining participants were told that the reduction was 5% (consistent with second-generation chemotherapy agents per Adjuvant!). These risk numbers are demonstrated in Figure 1 (a graphic shown to participants in the standard presentation condition who had a 5% risk reduction) and Figure 2 (a sequence of graphics shown to participants in the sequential presentation condition who had a 1% risk reduction).

Outcome Measures

Comprehension—We measured comprehension using three questions that assessed participants' ability to accurately report key statistics relevant to the adjuvant chemotherapy decision: (1) the chance the participant would be alive in 10 years with hormonal therapy only, (2) the chance the participant would be alive in 10 years with both chemotherapy and hormonal therapy, and (3) how many fewer women out of 100 would die from cancer if they took both chemotherapy and hormonal therapy instead of hormonal therapy only. Since exact numerical information sufficient to calculate these answers was provided in the graph legends, responses were only coded as accurate if exactly correct.

Additionally, we asked participants whether they would be more likely to die from cancer if taking hormonal therapy only, or if taking both chemotherapy and hormonal therapy. The former answer was coded as correct.

Perceptions of Treatment Effectiveness—Participants rated their perceptions of how much “taking both chemotherapy and hormonal therapy would reduce the chance that you would die from cancer, as compared to taking hormonal therapy only” on a 10 point scale, which ranged from “adding chemotherapy would not reduce the chance at all” to “adding chemotherapy would reduce the chance a great deal.”

Treatment Intentions—For the standard presentation group, we assessed treatment intentions using a single question that asked to choose between chemotherapy and hormonal therapy, hormonal therapy only, chemotherapy only, or no additional treatments at all. For the sequential decision group, we first assessed treatment preferences between only the hormonal therapy or no additional therapy options. After viewing additional information about chemotherapy, participants who previously accepted hormonal therapy were then asked to choose between combined chemotherapy and hormonal therapy or hormonal therapy only, while those who initially preferred no additional therapy were asked to make a final choice between all four treatment options.

Covariates

All study participants completed the Subjective Numeracy Scale (SNS), [19,20] a validated measure of quantitative ability and of preferences for receiving information in numerical form. The SNS has previously been shown to correlate with recall and comprehension of both textual and graphical risk communications [20] and was associated with risk comprehension in previous research on adjuvant therapy decision making.[5] For analysis purposes, we divided the sample into higher numeracy and lower numeracy participants by a median split.

Hypotheses

Our previous research showed that simpler risk graphics that included only two treatment options were more easily understood than graphics which included all four treatment choices.[5] Additionally, other studies suggest that evaluating a greater number of options at once may be cognitively overwhelming.[12,13] Consistent with this, we predicted that participants undergoing a sequential decision process involving a pair of these simpler graphics would have increased comprehension relative to participants considering four options simultaneously in the standard decision process.

By this hypothesis, participants making decisions sequentially should also be more cognizant of the (relatively) limited mortality risk reduction achievable by adding chemotherapy to hormonal therapy. As a result, we hypothesized that these participants would provide lower ratings of chemotherapy's effectiveness and be less likely to choose chemotherapy as an adjuvant treatment, as compared to participants considering all options simultaneously.

Lastly, increased knowledge and awareness of the incremental risk reduction associated with chemotherapy should increase women's sensitivity to the risk reduction magnitude. Thus, we hypothesized that the treatment effectiveness ratings and treatment choices would be more affected by our manipulation of the risk reduction provided by chemotherapy (1% vs. 5%) in the sequential presentation group than in the standard presentation condition.

Statistical Analysis

We used chi-square tests of proportions to test whether presentation format (standard versus sequential), risk reduction magnitude, and/or participant numeracy level affected comprehension of risk statistics and perceived interest in adding adjuvant chemotherapy to hormonal therapy. When appropriate, we then used logistic regression to assess the significance of any interactions between factors and/or participant numeracy. All analyses were performed using STATA 11,[21] and all tests of significance were two-sided and used $\alpha = 0.05$.

RESULTS

Participant Characteristics

Of the 2,438 individuals who began the survey, 570 participants were excluded for failing to provide an answer to any dependent measure, 9 were excluded for reporting their gender as male, 9 were excluded for indicating their age was outside the targeted age range, and 69 were excluded for indicating they had been previously diagnosed with breast cancer. Our analyses focus on the remaining 1,781 (73%) participants.

Sample demographic characteristics are described in Table 1. We observed a wide range of educational achievement, with 29% having completed a Bachelor's or higher college degree but also 24% with only a High School education or less. While 21% of respondents reported

having had a prior breast biopsy and 16% reported having a first-degree relative with a prior diagnosis of breast cancer, a sensitivity analysis showed that exclusion of these groups did not qualitatively change the results reported below (except for reduced statistical power). The SNS numeracy measure showed high scale reliability (Cronbach's $\alpha = 0.87$) and substantial variability within our sample ($sd=1.11$ on a 6 point scale). As expected given our randomization scheme, there were no significant variations in sample demographics across the experimental conditions.

Comprehension of Risk Statistics

Consistent with our hypothesis, participants who made sequential decisions were more likely than those who evaluated all options at once to correctly answer each of the three numerical risk comprehension questions (Table 2).

Numeracy, as measured by the Subjective Numeracy Scale, was a significant predictor of performance on all three numerical comprehension questions. But critically, both lower-numeracy and higher-numeracy participants showed significantly improved comprehension on these questions in the sequential presentation condition (Figure 3).

Reponses on the question comparing the mortality rates of hormonal therapy versus combination therapy did not differ significantly between the standard and sequential conditions, with one exception. Lower numeracy participants (but not higher numeracy participants) in the 1% risk reduction condition who were making decisions sequentially were significantly less likely than those in the standard presentation condition to correctly report that a person is more likely to die from cancer if taking hormonal therapy only versus both chemotherapy and hormonal therapy (59% vs. 74%, $\chi^2(1)=9.18$, $p=0.002$). We speculate that these less numerate participants may not have been able to translate the survival statistics (which they understood better when presented sequentially) into the mortality information requested by this question.

Treatment Beliefs

As predicted, relative to those in the standard presentation condition, participants in the sequential choice condition provided lower ratings of chemotherapy's effectiveness in both the 1% risk reduction (Sequential: Mean=4.82 vs Standard: $M=5.72$; $t=4.78$, $p<0.001$) and 5% risk reduction (Sequential: $M=5.79$ vs Standard: $M=6.83$; $t=6.48$, $p<0.001$) conditions.

Participants' numeracy level did not significantly predict the rating of chemotherapy's effectiveness. Both lower-numeracy and higher-numeracy participants provided significantly lower ratings of chemotherapy's effectiveness when making choices one at a time versus all at once (Lower Numeracy: $t=3.98$, $p<0.001$; Higher Numeracy: $t=6.15$, $p<0.001$).

Treatment Intentions

Figure 4 reports the percentage of participants who indicated that they would choose chemotherapy (either alone or in combination with hormonal therapy), broken down by presentation type, risk reduction magnitude, and numeracy level.

Higher numeracy participants (Figure 4, right panel) show a consistent pattern: They were sensitive to the magnitude of the risk reduction conferred by chemotherapy, with significantly higher intentions to take chemotherapy when the benefit is 5% instead of 1% ($\chi^2(1)=36.11$, $p<0.001$). However, they were significantly *less* likely to prefer chemotherapy when treatment options were presented sequentially versus all at once in the

standard presentation ($\chi^2(1)=21.17$, $p<0.001$). A logistic regression analysis showed no significant interaction between these factors.

Among lower numeracy participants (Figure 4, left panel), however, the sequential presentation resulted in a very different outcome than the standard presentation. Lower numeracy participants who viewed their treatment options all at once were completely insensitive to the magnitude of risk reduction that could be achieved with chemotherapy. In fact, they were (non-significantly) less likely to choose chemotherapy for a 5% risk reduction than for a 1% risk reduction.

By contrast, when lower numeracy participants were presented with a series of yes/no choices, they were sensitive to the risk reduction magnitude, choosing chemotherapy significantly more often when the benefit was larger ($\chi^2(1)=4.91$, $p=0.03$). A logistic regression analysis that included both factors showed that the presentation X risk reduction interaction was significant (Odds Ratio=1.86, $z=2.11$, $p=0.04$).

DISCUSSION

Our results clearly show that women who considered adjuvant therapy options one at a time had significantly better comprehension of relevant risk information than those who had to consider all options at once. Furthermore, participants who made such decisions sequentially were less likely to choose chemotherapy as an adjuvant treatment, gave lower ratings of chemotherapy's effectiveness, and, in terms of treatment choice, were more sensitive to our manipulation of the risk reduction provided by chemotherapy. Both lower-numeracy and higher-numeracy women benefitted from making choices sequentially.

These results are consistent with psychological literature that suggests that sequential decision making can reduce cognitive overload and improve decisions. Studies show that under some circumstances, choosing among more versus fewer options at once causes people to give up on making the choice entirely.[12,13] In other circumstances, choosing among more options simultaneously has the same detrimental effect as trying to keep irrelevant information in mind when making a decision.[22] Having too many options to consider is a common reason why people think of decision problems as being "hard." [23] Additionally, simply changing the way options are grouped together can change the decision that is ultimately made. Presenting three instead of two options at a time,[24] presenting options individually for evaluation instead of together in a pairwise choice,[25,26] and even changing which items are paired together in a series of choices [27] have all been shown to affect decision behavior.

For medical oncologists and others seeking to counsel breast cancer patients about adjuvant therapy decisions, our results suggest a relatively straightforward method to simultaneously satisfy the dictates of informed consent, simplify clinical consultations, and improve patients' ability to choose treatment options that are consistent with their preferences. Instead of providing patients with a comprehensive accounting of the survival and mortality risks associated with all possible treatment options (per standard practice and the current displays of Adjuvant! and similar tools), we suggest instead ordering the treatment choices by relative attractiveness and presenting them to patients one at a time. For ER+ patients, usually that will mean starting with hormonal therapy and showing how much risk reduction those treatments can provide. Once the patient has fully understood this tradeoff and made an interim choice, the incremental impact of chemotherapy or other adjuvant therapy options can then be discussed *in a binary comparison with the patient's previous choice*.

We emphasize that the full benefit of discussing options one at a time will not be achieved if patients are only told about total risk statistics (i.e., the total chance of survival). Such

presentations naturally lead patients to have a “more is better” mindset and focus only on maximizing survival. Instead, patients must be told incremental statistics. Only by doing the subtraction for patients and specifically describing just how much, or how little, the patient’s recurrence risk would change with each new treatment option will a sequential decision process help patients to truly comprehend the incremental risk-benefit tradeoff.

Our study’s primary limitation is its use of a non-patient sample making hypothetical decisions. As a result, we do not claim that the specific levels of interest in different adjuvant therapy options that we observed would correspond with the decisions of any population of actual breast cancer patients. Yet, the internal validity of our randomized experimental design makes it clear that presenting treatment options sequentially instead of all at once can alter women’s interpretations of decision-relevant risk information and, in the case of lower numeracy participants, increase their sensitivity to the most important statistic of all: the magnitude of the incremental risk reduction. We have no reason to believe that these effects would differ in a real world context. In fact, the impact of using a sequential decision-making process with actual patients may be larger than what we observed here with hypothetical scenarios. Actual patients face the emotional and physical stresses of cancer diagnoses and therapeutic interventions, time constraints on their decision making, and often more complicated clinical situations than our survey participants did. All of these factors could amplify the beneficial impact of simplifying adjuvant therapy communications.

Decision support tools have transformed adjuvant therapy decision making, and many oncologists use these tools regularly to help guide their consultations with breast cancer patients. While the benefit of such information is substantial, our research and others’ suggests that women may easily become overwhelmed by the statistics and graphs such tools create. Yet, a simple and apparently effective alternative exists: simply by discussing treatment options sequentially instead of all at once, clinicians may be able to improve patient comprehension of risk information and, for those with lower numeracy skills, patients’ ability to make informed decisions. We urge anyone who discusses adjuvant therapy decisions with breast cancer patients to consider implementing this approach.

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Fig. 1.
Pictograph showing all four treatment options (standard presentation) and a 5% incremental risk reduction from chemotherapy

Fig. 2.
Pictographs used in a sequential presentation that show a 1% incremental risk reduction from chemotherapy

Fig. 3.
Performance on numerical comprehension questions, by presentation type and numeracy level

Fig. 4.
Percent choosing adjuvant chemotherapy by presentation format, risk reduction magnitude, and numeracy level

Table 1

Sample characteristics

Characteristic (continuous)	Mean (Std. Dev.)
Age (range: 40–70)	54.3 (8.8)
Subjective Numeracy Score (range: 1–6)	4.07 (1.11)
Characteristic (binary)	N (%)
Race:	
Caucasian	1338 (75.1%)
African-American	144 (8.1%)
Other/mixed race	124 (7.0%)
Not reported	175 (9.8%)
Hispanic ethnicity (any race)	177 (9.8%)
Education:	
HS diploma or less	380 (21.3%)
Some college	746 (41.9%)
Bachelor's degree or more	454 (25.5%)
Not reported	201 (11.3%)
Prior breast cancer experience:	
Prior breast biopsy	329 (18.5%)
First-degree relative with breast cancer	252 (14.1%)

Table 2

Proportion of respondents correctly answering numerical comprehension questions, by presentation type and risk reduction level

Question	Risk Reduction Level	Percent Correct		χ^2	p
		Standard Presentation	Sequential Presentation		
Total # Alive with Hormonal Therapy Only	1%	28.6	58.0	64.47	<0.001
	5%	33.3	55.7	41.10	<0.001
Total # Alive with Combined Therapy	1%	27.5	43.2	21.74	<0.001
	5%	31.0	43.8	14.33	<0.001
Incremental # Alive by Adding Chemotherapy to Hormonal Therapy	1%	51.6	67.9	25.58	<0.001
	5%	46.6	77.5	58.28	<0.001