

## Digital Divide and Stability of Access in African American Women Visiting Urban Public Health Centers

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*Abstract:* This exploratory study examines access to communication technologies, its association with health-related variables and study attrition, and its stability over time in a study of lower income African American women visiting urban public health centers. Participants ( $n = 1,227$ ) provided information about cancer-related behaviors in a baseline questionnaire that also assessed their e-mail and cell phone/pager access. Interviews conducted at 1-, 6-, and 18-month follow up determined attrition, and an e-mail message sent to participants at 6-month follow up determined stability of access. Fewer than 10% of women reported e-mail access; 26% reported cell/phone pager access. At 6-month follow up, 45% of e-mail accounts were inactive; accounts from pay access providers were more likely to be inactive than work- or school-based accounts (58% versus 25%). Cell phone/pager access was positively associated with mammography knowledge. Attrition rates were lower among women with access than among those without access. Priorities for future research based on these preliminary findings are discussed.

*Key words:* Digital divide, technology access, minority health, African American, health disparities, women.

Although the use of information and communication technologies has grown rapidly during the last 10 years,<sup>1,2</sup> a considerable gap remains between those with and without access to these technologies (the so-called digital divide). Estimates of the size of this gap and explanations of its causes and consequences vary widely. This exploratory study seeks to expand our understanding of the digital divide by

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describing access to technology, its association with demographic and health-related variables, its stability over time, and its association with attrition in a longitudinal research project among a population of lower income African American women visiting urban public health centers.

In 2001, 60.2 million U.S. homes had a personal computer and 53.9 million U.S. homes had Internet access.<sup>3</sup> However, in 2000, fewer than 20% of those with annual household incomes of less than \$15,000 had personal computers, whereas 86% of those with annual household incomes of over \$75,000 did.<sup>4</sup> Computer and Internet access also varies by level of education and race. In 2000, nearly 76% of households whose residents include a college graduate had home access to computers compared with less than 22% of households where residents did not finish high school.<sup>4</sup> In addition, African American and Hispanic households are less likely than white and Asian households to have Internet access.<sup>3</sup> In 2002, 60% of Asians and whites had Internet access, compared with 40% of African Americans and 32% of Hispanics.<sup>3</sup> Rates of Internet access from home are even lower for these groups (24% for both African Americans and Hispanics).<sup>5</sup>

The National Telecommunication and Information Administration examined gaps between technology haves and have-nots and found that, except for seniors, the have-nots are largely the same population that is historically underserved by the health care system.<sup>4</sup> As Eng and colleagues point out, the digital divide disproportionately affects minorities and people with low incomes (i.e., those who are in greatest need of health information and health services but least likely to have access to them).<sup>6</sup> Limited access to online health resources may also perpetuate or exacerbate health disparities. *Healthy People 2010*, which identifies eliminating health disparities as an overarching goal (p. 11), includes for the first time an objective to increase to 80% the proportion of U.S. households with Internet access.<sup>7</sup>

Little is known about the effects of limited access to technology among participants in research studies. High rates of geographic mobility and transience are well documented for younger, lower income, minority people<sup>8</sup> and the consequences of such transience (e.g., discontinuous telephone service, address changes) are associated with higher rates of attrition among participants in research studies.<sup>9,10</sup> Less is known, however, about how such transience might be related to the stability of access to technologies in these populations, or whether increased access will reduce attrition rates.

This paper seeks to answer two major questions: (1) What is the level of use of selected communication technologies in a population of lower income African American women visiting urban public health centers? (2) How, if at all, does access to these technologies vary by demographic characteristics and health-related outcomes within the population? In addition to this, data were gathered to provide preliminary evidence for two additional questions: (3) How stable is access to technologies over time in this population? (4) What is the association between access to technology and retention in a longitudinal research study?

## Methods

The present study examines baseline and follow-up data from a larger study examining the effectiveness of behaviorally and culturally tailored women's health

magazines promoting mammography and increased fruit and vegetable consumption among African American women.<sup>11</sup> This study was reviewed and approved by the Institutional Review Board of Saint Louis University.

**Data collection.** African American women on the project team recruited participants from the waiting rooms of 10 public health centers in St. Louis, Missouri. Criteria for participation included being ages 18–65 years, being able to read materials written in English at a fifth-grade level, never having been previously diagnosed with breast cancer, and having daily access to a working telephone (for follow-up telephone interviews). Participants had to have a working home telephone number to participate in the study; they could choose at which number (home/work/cell) or by which method (via phone or e-mail) they would prefer to be contacted. Women who met eligibility criteria and provided written informed consent to participate completed a baseline questionnaire and received a \$20.00 check for their participation. Participants were also informed that they would be contacted by telephone to complete a follow-up interview at 1, 6, and 18 months after completing the baseline questionnaire.

**Baseline questionnaire.** The baseline questionnaire was administered September through December 2000, and assessed women's status on a range of cultural characteristics and constructs from theories of health behavior change<sup>12,13</sup>; these data were used to create the tailored health magazines being tested in the larger trial. The questionnaire also gathered information related to current access to technology. These items are used in the current paper, and are described below.

*Access to communication technology.* Participants were asked to provide personal contact information to ensure they could be reached at follow up. This information included a home and work telephone number, home address, a contact person (not living with the participant but who would know how to get in touch with her) and his or her telephone number, pager, or cellular telephone number, and e-mail address. Participants who provided a pager or cellular telephone number or an e-mail address were classified as having access to these technologies.

*E-mail account type.* E-mail accounts were classified as *free access* if the account could be accessed from any computer (e.g., not necessarily a home or work computer), and included *Yahoo*, *Excite*, *Hotmail*, or *Juno* as part of the suffix in the e-mail address. Accounts were classified as *pay access* if *AOL*, *MSN*, *.net*, or comparable identifiers were included in the suffix of the e-mail address. Accounts were classified as *work or school access* if they included identifiers of employers or educational institutions (e.g., *.gov* or *.edu*) in the suffix of the address.

*Health-related characteristics.* Mammography knowledge was measured using five items that assessed women's perceptions of whether (1) mammograms find all breast cancers, (2) a mammogram is needed if a woman's breasts feel fine, (3) having a mammogram can reduce a woman's risk of dying, (4) a mammogram could find a breast lump before it is big enough to feel, and (5) having a mammogram could cause breast cancer. Breast cancer knowledge was measured using six items that assessed women's thoughts concerning whether (1) most lumps turn out to be breast cancer, (2) bumping or bruising the breasts could lead to breast cancer, (3) touching, rubbing, or squeezing the breasts could lead to breast cancer, (4) older women are more likely to get breast cancer than younger women, (5) African American women

are more likely to die from breast cancer than white women, and (6) it is better to leave a breast lump alone than to have it checked by a doctor. Women responded in a yes/no/not sure format, and correct responses were summed to form two index variables with possible values ranging from 0–5 for mammography knowledge and 0–6 for breast cancer knowledge. Test–retest reliability with a 2-week interval was acceptable for both the mammography ( $r = 0.62, p < 0.001$ ) and breast cancer ( $r = 0.63, p < 0.001$ ) knowledge in a sample of African American women from public housing communities.<sup>15</sup>

Perceived importance of eating fruits and vegetables was measured using two items (one for fruits, one for vegetables) with a 4-point Likert-type response format (very important, somewhat important, not very important, not at all important). A parallel set of two items assessed participants' interest in eating more fruits and vegetables. For both importance and interest, the fruit and vegetable items were combined and stratified into those choosing *very important* on both items versus all other response combinations. A set of 13 food frequency items assessed women's fruit and vegetable consumption in a typical week. These items were summed and divided by seven to estimate average servings per day for each woman. A single item assessed health insurance status.

*Sociodemographic characteristics.* The baseline questionnaire also assessed women's age, years of education, annual pretax household income, marital status and employment status.

## Follow-up

*E-mail account status.* To provide preliminary evidence about stability of e-mail access at 6-month follow-up, an e-mail message was sent to all participants enrolled to date who had provided an e-mail address on their baseline questionnaire. E-mail addresses were classified as inactive if the message was returned as undeliverable. These accounts returned messages such as *disabled, user unknown, illegal host, account inactive, and over disk quota*. All addresses that did not return such messages were classified as active. We did not attempt to reach women by calling their cellular telephone/pager numbers.

*Participant retention.* Retention rates were determined at each follow-up interval. For example, women who completed a telephone interview at 1 month postbaseline were classified as having *completed 1-month follow up*. Similar variables were created for 6- and 18-month follow up.

**Analyses.** Statistical analyses for this study had four objectives: (1) to assess the level of e-mail access and cellular phone and pager ownership in the study population; (2) to describe demographic and health-related differences between women who have and do not have each of these communication technologies; (3) to evaluate how stable this access is over time; and (4) to determine the extent to which access is associated with attrition in a longitudinal research study.

Access to each technology and the demographic and health-related characteristics of women who have and do not have access are presented with sample means for continuous variables and proportions for discrete variables. Because several of the demographic variables are associated with one another (e.g., education and income)

and likely are associated with access to technologies, we report both bivariate statistics and results from regression analyses that include all demographic variables in a model predicting a dichotomous access outcome (e.g., has an e-mail address/does not have an e-mail address).

To evaluate the stability of e-mail access over time, we calculated the proportion of e-mail accounts reported at baseline that were active and inactive at 6-month follow up. These analyses also examined whether account status at 6-month follow up varied by the type of e-mail account a woman reported at baseline and by demographic characteristics of the participant.

To determine whether access to each technology at baseline was associated with attrition at 1-, 6-, and 18-month follow up, we used multiple logistic regression, in which access to technology at baseline and any demographic variables associated with access were included in a model predicting a dichotomous attrition outcome (completed/did not complete 1-month, 6-month and 18-month follow-up interview). All analyses were conducted using SPSS for Windows Release 11.0 (SPSS, Inc., Chicago).

## Results

**Participants.** A total of 1,227 African American women were recruited for the study. As shown in Table 1, participants ranged in age from 18 to 65 years, with a mean age of 35.6 years ( $SD = 11.6$ ). The mean level of education was 12.3 years ( $SD = 1.9$ ) and ranged from 2–20 years. Most women were single (61.6%), with the remainder married (16.5%), separated or divorced (15.1%), widowed (3.6%), or not providing data on marital status (3.3%). Most women were employed either full time (45.5%) or part time (15.6%); 37.2% were not employed at the time of enrollment and 22 women did not provide employment status information. The median pretax annual household income was in the \$10,001–\$20,000 category and ranged from “less than \$5,000” (23.7%) to “more than \$60,000” per year (1.5%).

**Access to communication technologies.** At baseline, 112 women (9.1%) reported an e-mail address and 320 (26.1%) reported a number for a cellular telephone or pager (Table 2). Forty-six women (4%) reported both an e-mail address and cellular telephone or pager number. Of those reporting an e-mail address, an analysis of the address suffixes showed that 45% of accounts were from free access providers, 32% were from pay access providers, 21% were based at a workplace or school, and 2% ( $n = 2$ ) listed e-mail addresses that were of unknown origin (i.e., the origin could not be determined from the suffix provided).

**Characteristics of women who do and do not have access.** As shown in Table 3, younger women, those with more years of education, and those with higher income levels were significantly more likely to report an e-mail address. A multiple logistic regression model including all demographic variables as predictors of reporting an e-mail address was significant overall ( $-2 \log \text{likelihood} = 626.00$ ;  $\text{chi square} = 75.86$ ), as were the individual terms for years of education ( $b = 0.36$ , standard error [SE] ( $b$ ) = 0.06; odds ratio [OR] = 1.43, 95% confidence interval [CI] = 1.27–1.61), income ( $b = -0.92$ , SE ( $b$ ) = 0.28; OR = 0.40, 95% CI = 0.23–0.69) and age ( $b = -0.03$ , SE ( $b$ ) = 0.01; OR = 0.97, 95% CI = 0.95–0.99). Neither employment status,

**Table 1.**  
**STUDY PARTICIPANTS' CHARACTERISTICS**

Characteristics	All ( <i>N</i> = 1,227)
Mean age (y) (SD)	35.6 (11.6)
Mean years of education (SD)	12.3 (1.9)
Marital status (%)	
Single	61.6
Married	16.5
Separated or divorced	15.1
Widowed	3.6
Employment status (%)	
Employed full time	45.5
Employed part time	15.6
Not employed	37.2
Household income (%)	
<\$5,000	23.7
\$5,000–\$10,000	21.2
\$10,001–\$20,000	23.2
\$20,001–\$30,000	14.2
>\$30,000	13.1

**Table 2.**  
**REPORTED ACCESS TO COMMUNICATION TECHNOLOGIES BY  
STUDY PARTICIPANTS**

Type of communication technology	All ( <i>N</i> = 1,227)	
	<i>n</i>	%
E-mail only	112	9.1
Cellular telephone/pager only	320	26.1
E-mail and cellular telephone/pager <sup>a</sup>	46	4.0

<sup>a</sup>All women in this category are also included in the numbers of e-mail only and cellular telephone/pager only.

marital status, nor any of the health-related characteristics was a significant predictor of reporting an e-mail address at baseline. Among women who reported an e-mail address, demographic characteristics were not significantly associated with the type of e-mail account owned.

**Table 3.**

**ACCESS TO COMMUNICATION TECHNOLOGIES BY DEMOGRAPHIC AND HEALTH-RELATED CHARACTERISTICS OF PARTICIPANTS**

	E-mail account		Cellular telephone or pager					
	Yes (n = 112)	No (n = 1115)	Bivariate p-values <sup>a</sup>	Adjusted p-values <sup>b</sup>	Yes (n = 320)	No (n = 907)	Bivariate p-value <sup>a</sup>	Adjusted p-values <sup>b</sup>
<b>Demographic characteristics</b>								
Mean age (y)	35.5	35.7	0.293	0.012	32.6	36.6	0.000	0.000
Years of education (mean)	13.5	12.1	0.000	0.000	12.5	12.1	0.001	0.097
Income <\$20,000 (%)	20.9	49.8	0.000	0.001	38.8	50.0	0.001	0.170
Employed (%)	79.3	60.4	0.000	0.409	74.1	57.9	0.000	0.001
Single (%)	61.8	63.9	0.766	0.820	64.5	63.4	0.725	0.091
<b>Health-related characteristics</b>								
Current on mammogram <sup>c</sup> (%)	64.7	53.7	0.215	0.897	55.2	54.4	0.906	0.745
Mean breast cancer knowledge score	3.3	2.9	0.011	0.474	3.0	2.9	0.524	0.546
Mean mammography knowledge score	2.6	2.4	0.016	0.755	2.3	2.4	0.022	0.019
Mean servings fruits/ vegetables per day	3.5	3.7	0.317	0.075	3.7	3.7	0.959	0.625
“Very interested” in eating more F&V (%)	68.5	63.2	0.306	0.365	60.1	65.0	0.122	0.842
“Very important” to eat more F&V (%)	64.3	66.1	0.643	0.780	65.8	66.0	0.956	0.088
No health insurance (%)	10.6	19.6	0.022	0.153	19.1	18.6	0.866	0.255

<sup>a</sup> p-values derived from *t*-tests.

<sup>b</sup> Adjusted for age, education, income, employment status, and marital status.

<sup>c</sup> Women 40 years of age and older only (n = 416; number of women who responded to this question).

Younger age and employment were associated with reporting a cellular telephone or pager number (see Table 3). The multiple logistic regression model was significant overall (-2 log likelihood = 1236.15; chi square = 60.71), as were the individual terms for age ( $b = -0.04$ , SE ( $b$ ) = 0.01, OR = 0.96, 95% CI = 0.95–0.98) and employment ( $b = 0.58$ , SE ( $b$ ) = 0.17, OR = 1.78, 95% CI = 1.28–2.47). Neither education, income, nor marital status was a significant predictor of reporting a cellular telephone or pager number at baseline.

In adjusted analyses, women who reported a cellular telephone or pager number at baseline had lower scores on mammography knowledge ( $p = 0.019$ ). A multiple logistic regression model that included health-related variables and all demographic variables as predictors of reporting a cellular telephone or pager number was significant overall (-2 log likelihood = 1198.57; chi square = 64.72,  $p < 0.001$ ), as was the individual term for mammography knowledge score ( $b = -0.15$ , SE ( $b$ ) = 0.06; OR = 0.86, 95% CI = 0.76–0.98). No other health-related outcomes were associated with access in adjusted analyses.

**Stability of e-mail access over time.** Although 112 women reported e-mail addresses at baseline, only 100 of these e-mail addresses had been received at the time the e-mail message was sent to participants. Of these, 45 of our e-mail messages (45%) were returned as undeliverable. As shown in Table 4, a majority (57.6%) of pay accounts were inactive at 6-month follow up, as were 44.7% of free accounts, and 25% of work or school-based accounts. Type of e-mail account was not significantly associated with having an active versus an inactive account at the 6-month follow up. Multiple logistic regression was also used to determine whether demographic variables were associated with having an active versus an inactive e-mail status at the 6-month study follow-up (-2 log likelihood = 114.40; chi square = 14.85,  $p < 0.05$ ). Neither years of education, level of income, nor employment status was a significant predictor of e-mail account status. However, older age ( $b = 0.08$ , SE ( $b$ ) = 0.03; OR = 1.08, 95% CI = 1.03–1.13) and being single ( $b = 1.36$ , SE ( $b$ ) = 0.54; OR = 3.91, 95% CI = 1.36–11.26) were significantly and positively associated with having an active account at 6-month follow up.

**Access to technology and attrition.** Among women who provided an e-mail address at baseline, 86.6%, 84.8%, and 82.1% completed the 1-, 6-, and 18-month follow-up interviews, respectively. Among women who did not report an e-mail address at baseline, these completion rates were 82.8%, 76.5%, and 70.7%, respectively. As shown in Table 5, the differences at 6- and 18-month follow up were statistically significant in bivariate analyses, but not in analyses that adjusted for demographic characteristics. There were no differences in attrition rates by type of e-mail account or by e-mail account status.

Among women who reported a cellular telephone or pager number at baseline, 84.8%, 82.2%, and 77.2% completed the 1-, 6-, and 18-month follow-up interview, respectively. Women who did not report this information had completion rates of 81.6%, 75.5%, and 69.8% for these same follow-up periods, respectively. These differences were statistically significant at all three time periods in both unadjusted and adjusted analyses. Regression analyses showed that reporting a cellular telephone or pager number at baseline was a significant predictor of retention at 1-month ( $p = 0.002$ ),

**Table 4.****E-MAIL ACCOUNT STATUS AT 6-MONTH FOLLOW UP AMONG PARTICIPANTS WHO REPORTED E-MAIL ADDRESSES AT BASELINE**

E-mail account type	E-mail account status at 6-month follow up				
	Active ( <i>n</i> = 55)	Inactive ( <i>n</i> = 45)	$\beta$	OR	CI
All accounts ( <i>n</i> = 100)					
Work/school access ( <i>n</i> = 20)	75.0	25.0	0.89	2.42	0.76–7.76
Pay access ( <i>n</i> = 33)	42.4	57.6	-0.52	0.60	0.24–1.46
Free access ( <i>n</i> = 47)	55.3	44.7	—	1.00	—

6-month ( $p = 0.009$ ), and 18-month ( $p = 0.008$ ) follow up, after adjusting for demographic characteristics associated with ownership of these devices (see Table 5).

**Discussion**

This exploratory study is among the first to report data on how access to communication technologies in a lower income minority population is associated with health-related outcomes and research participation. Findings suggest that in a population of African American women from urban public health centers, access may be limited, relatively unstable, and associated with retention in a longitudinal research trial. Considering the limited number and rudimentary nature of several of the study's key measures (see below), any conclusions based on these findings should be made with caution. Studies that are specifically designed to address issues of technology access are needed, and we hope the findings reported here will help inform such future research.

Although national surveys report that 24–40% of African Americans had Internet access in 2001 through home or work,<sup>3,5</sup> only 9% of women in this sample reported an e-mail address. These discrepancies may be due to differences in the way access was operationally defined in this study, differences in sampling methodologies, our exclusive focus on a low-income community, or some combination of these factors. Having accurate estimates of different populations' access to technologies is fundamental to understanding the digital divide, monitoring changes in its magnitude, and identifying and addressing its causes and consequences. The difference between rates of access reported in this study and those found in previous surveys suggests a need for increased attention to both measures and sampling in future research on access.

Previous reports have suggested that those individuals and groups most negatively affected by the digital divide are the very ones most in need of health information and services.<sup>4,6</sup> This study provided no empirical support for this assertion. Although

**Table 5.**

**ATTRITION RATES AT 1, 6, AND 18-MONTH FOLLOW UP, BY ACCESS TO TECHNOLOGY AT BASELINE**

Attrition at follow up	E-mail address			Cellular phone or pager number				
	Yes	No	Bivariate <i>p</i> -values <sup>a</sup>	Adjusted <i>p</i> -values <sup>b</sup>	Yes	No	Bivariate <i>p</i> -values <sup>a</sup>	Adjusted <i>p</i> -values <sup>b</sup>
Completed 1 month ( <i>n</i> = 1,020)	86.6	82.8	0.303	0.448	87.5	81.6	0.015	0.002
Completed 6 month ( <i>n</i> = 948)	84.8	76.5	0.045	0.127	82.2	75.5	0.014	0.009
Completed 18 month ( <i>n</i> = 880)	82.1	70.7	0.010	0.149	77.2	69.8	0.012	0.008

<sup>a</sup> *p*-values derived from *t*-tests.

<sup>b</sup> Adjusted for age, education, income, employment status, and marital status.

bivariate analyses found women reporting an e-mail address had higher knowledge scores for breast cancer and mammography and were more likely to report having health insurance, none of these differences were significant in analyses that adjusted for age, education, income, employment status, and marital status. The only significant difference found in adjusted analyses actually showed a negative association between cellular phone or pager ownership and mammography knowledge scores. If access to technology is not just a proxy for low socioeconomic status, it should have some independent effects on health-related outcomes. The health-related outcomes examined in this study were selected for convenience only, because they were already being measured in the larger study. Future research and theory development should be much more specific in identifying how limited access might influence the health of families and individuals, and purposefully select outcome variables to test these expectations. For example, it might be hypothesized that patients with no Internet access are less well prepared to seek health information from their care providers and thus are less informed about their condition than those who do have access. Specific inquiries such as this may provide a better test of the effects of limited access.

Not surprisingly, women who reported an e-mail account or a cellular telephone or pager number were younger, more educated, and had higher incomes than women who did not have access to these technologies. In contrast, preliminary analyses showed that stability of e-mail accounts over time increased with age. Thus, although younger women were more likely to report e-mail addresses at baseline, their accounts were more likely to be inactive at 6-month follow up compared with older women. This may reflect instability and transience in the lives of young, low-income, minority women.<sup>8</sup> However, because the study did not check the status of e-mail accounts at baseline, we cannot know for sure if the accounts were inactive to begin with. Because of this limitation, our findings related to stability of e-mail accounts should be viewed cautiously.

Access to technologies at baseline was also associated with higher rates of retention in the study. It is quite possible that this finding simply reflects the fact that by having more contact information for some women than for others, the research team had more chances to locate certain participants at follow up. This explanation is most plausible for those reporting a phone number for a cellular telephone or pager, because telephone calls were the primary mode of communication used by members of the research team to contact participants at follow up. This explanation would be supported if access to cellular telephone/pager at 6-month follow up was associated with retention. However, these data were not collected in this study. One implication of these findings is that, among its other potential benefits, increasing access to communication technologies may also increase retention of participants in research studies conducted with populations that historically have had higher attrition rates.

Because the study has several important limitations, these findings should be considered preliminary, a first step to be verified and extended by other researchers. First, the present study uses as a proxy for access to technology women's reporting of an e-mail address and cellular telephone or pager number for the purpose of

helping to contact them in the future. We recognize that some women may not have provided this information because they did not want to be contacted through those channels, not because they did not have access to these communication technologies. This might help to explain why rates of access were lower in this population than have been reported elsewhere from national surveys. However, if this were the case, such misclassification (i.e., women with access being classified as not having access) would bias results toward the null, thus making it more difficult for analyses to find differences such as those reported.

A greater concern, we think, is uncertainty about how well these indicators reflect access. Although the primary use of the Internet is e-mail,<sup>14</sup> it is certainly possible, for example, to have web access and not have an e-mail account, just as the converse is possible. Similarly, the fact that an e-mail account was inactive at 6-month follow up does not necessarily mean that the owner no longer had e-mail access. For some accounts, the inactive status might have been temporary. But even if it was permanent, many individuals have multiple e-mail accounts, and data from industry marketing surveys suggest nearly one third of e-mail users may switch addresses annually. Thus, our measure of inactivity cannot be interpreted as loss of access. Given these limitations we strongly advise against interpreting these findings as reflecting anything more than the measures themselves.

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