



# A randomized, controlled study of an online intervention to promote job satisfaction and well-being among physicians

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## ABSTRACT

Although burnout, poor quality of life (QOL), depression, and other forms of psychological distress are common among physicians, few studies testing interventions to reduce distress have been reported. We conducted a randomized trial to determine the impact of a 10-week, individualized, online intervention on well-being among physicians ( $n = 290$ ). Participants were randomized to either the intervention or control arm. Those in the intervention arm received a menu of self-directed micro-tasks once a week for 10 weeks, and were asked to select and complete one task weekly. Baseline and end-of-study questionnaires evaluating well-being (i.e., burnout, depression, QOL, fatigue) and professional satisfaction (i.e., job satisfaction, work engagement, meaning in work, and satisfaction with work-life balance) were administered to both arms. Overall quality of life and fatigue improved over the 10 weeks of the study for those in the intervention arm (both  $p < 0.01$ ). When compared to the control arm, however, no statistically significant improvement in these dimensions of well-being was observed. At the completion of the study, those in the intervention arm were more likely to report participating in the study was worthwhile compared to those in the control arm. The findings suggest that although participants found the micro-tasks in the intervention arm worthwhile, they did not result in measurable improvements in well-being or professional satisfaction when compared to the control group. These results also highlight the critical importance of an appropriate control group in studies evaluating interventions to address physician burnout and distress.

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## 1. Introduction

Professional burnout, poor mental quality of life (QOL), depression, and other forms of psychological distress are common among physicians (Dyrbye, West et al., 2014; Shanafelt et al., 2015; Wallace, Lemaire, & Ghali, 2009). Large national studies have found burnout is more common among physicians than the general US working population even after controlling for work hours (Shanafelt, Boone et al., 2012; Shanafelt et al., 2015). This distress can lead to suicidal ideation, substance abuse, poor patient care, medical errors, career dissatisfaction, job turnover, and early retirement (Dyrbye et al., 2008; Dyrbye, Massie et al., 2010; Oreskovich et al., 2011, 2014; Shanafelt et al., 2009, 2010; Shanafelt, Balch et al., 2011; Shanafelt, Sloan, Satele, & Balch, 2011; Shanafelt, Bradley, Wipf, & Back, 2002; West et al., 2006; West, Tan, Habermann, Sloan,

& Shanafelt, 2009; West, Shanafelt, & Kolars, 2011). Work-related stressors such as excessive work hours and malpractice litigation as well as personal life events and work-home conflict appear to be contributing factors to distress (Balch et al., 2011; Dyrbye et al., 2006, 2012; Dyrbye, Sotile et al., 2014; Shanafelt, 2009; Shanafelt, Sloan, & Habermann, 2003). Despite the high prevalence of distress and seriousness of its consequences, few randomized intervention trials aimed at promoting physician well-being have been conducted.

A 2011 randomized controlled study of 74 physicians utilizing a facilitated small group curriculum that addressed a wide range of topics (e.g., self-care, meaning in work, dealing with suffering, mindful practice, work-life balance) demonstrated improvements in engagement and well-being (West et al., 2014). Implementing this intervention on a larger scale, however, is problematic due to reliance on trained facilitators, expense (cost of 1 h of paid physician time weekly plus lost revenue), and reduction in access for patients to get needed care. For interventions to be feasible within a busy healthcare setting approaches need to be brief, practical, and low cost. Others have tested the use of regular, brief, self-directed exer-

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cises (Fordyce, 1977, 1983) and electronically delivered tasks (Kypri et al., 2009; Seligman & Steen 2005) in non-physician populations. Built on the prior pioneering work demonstrating that multiple directed exercises can improve happiness (Fordyce, 1977, 1983) Dr. Martin Seligman, a leader in positive psychology, conducted an internet based randomized controlled trial evaluating the impact of five happiness exercises among non-physicians. Findings from that study suggest that brief exercises grounded in positive psychology and delivered electronically can increase happiness and decrease depressive symptoms (Mongrain & Anselmo-Matthews, 2012; Seligman & Steen, 2005). This study aligns with findings from other web-based interventions in the field of tobacco and alcohol research (Kypri et al., 2009; Prochaska, DiClemente, Velicer, & Rossi, 1993). However, evidence of the effect of similar interventions among physicians is lacking. We conducted a randomized controlled study to determine the efficacy of a 10-week, individualized, online intervention to promote measurable benefits in professional satisfaction and well-being among physicians.

## 2. Material and methods

### 2.1. Study design, setting, and participants

We conducted a randomized study of practicing physicians in the Mayo Clinic Departments of Medicine in Minnesota and Arizona and Mayo Clinic Department of Surgery in Minnesota. The study was conducted over three months in the fall of 2012. Physicians were recruited through departmental communications and announcements at Medical Grand Rounds. All participants provided written informed consent and participation was voluntary. The study was approved by the Mayo Clinic Institutional Review Board.

Participants were randomized to an intervention group or a control group using a computer-generated algorithm. Randomization was stratified by specialty (Internal Medicine or Surgery), campus (Rochester or Arizona), and baseline response to the single item, “The work I do is meaningful to me” (from the Empowerment at Work Scale (Spreitzer, 1995)). All participants were asked to complete baseline and end-of-study (3 month) survey. For both surveys consented participants received an e-mailed cover letter with a link to a web-based survey.

### 2.2. Study arms

In addition to instruments measuring primary outcomes of changes in well-being (i.e., burnout, depression, QOL, fatigue) and professional satisfaction (i.e., job satisfaction, work engagement, meaning in work, and satisfaction with work-life balance) pre-post study (see below) participants in both intervention and control arms completed brief (3–4 question) weekly surveys. These questionnaires included 1 item assessing overall QOL, (Gudex, Dolan, Kind, & Williams, 1996; Norman, Sloan, & Wyrwich, 2004; Rummans et al., 2006) 1 item measuring fatigue, (Balch et al., 2011; Dyrbye, West et al., 2014; Dyrbye, Satele, Sloan, & Shanafelt, 2014; West, Halvorsen, Swenson, & McDonald., 2013; West, Tan, & Shanafelt, 2012; West et al., 2009, 2011) and 2 items about happiness (Fowler & Christakis 2008; Sheehan, Fifield, Reisine, & Tennen, 1995). This was done so that each group received weekly e-mails that required an activity but were not part of the primary outcome analysis. The data from responses to these 4 items were not further analyzed, as these domains were evaluated separately in the baseline and end-of-study surveys. In the same 10 weekly survey, physicians in the intervention arm also received a menu of 5–6 self-directed micro-tasks (Fig. 1) and were asked to select and complete one task of their choosing weekly. These micro-tasks were speci-

Tasks were designed to cultivate well-being in one of 6 domains: meaning in work and job satisfaction, teamwork and social support, personal relationships and work-life balance, personal strengths (courage, honesty, patience, wisdom, humanity, justice, and transcendence), problem solving, and positive emotions. The menu of tasks for each week was drawn from a master list of 5 to 7 micro-tasks to create a diversity of choices and minimize redundancy.

*Choose the activity of greatest interest to you to complete over the next week*

- Reflect on a recent meaningful patient care experience. Take 2-3 minutes to reflect on what made this experience stand out and its impact on your work satisfaction. Consider sharing this experience with a colleague or your partner/significant other.<sup>1</sup>
- Write and send/deliver a letter thanking a nurse, secretary, or other ancillary personnel for a specific way in which they have helped you in your work.<sup>2</sup>
- Plan and schedule an outing with your significant other/spouse to nurture your relationship. Make the necessary reservations/arrangements right now.<sup>3</sup>
- Think about a time when you dealt with an emotionally challenging situation at work with particular skill. What personal attributes enabled you to manage the situation well?<sup>4</sup>
- Identify a challenging work related experience you are currently dealing with. Reflect on how you overcame similar challenges in the past. Based on your previous experience identify an initial step you could take to deal with the issue.<sup>5</sup>
- Jot down 3 things that you are grateful for in your life and why you value these things. Then, think about changes you could make in your life so that you live in greater accordance with what you value most.<sup>6</sup>

<sup>1</sup> Theme: promote meaning in work and job satisfaction

<sup>2</sup> Theme: teamwork and social support at work

<sup>3</sup> Theme: personal relationships/work-life balance

<sup>4</sup> Theme: recognizing/developing personal strengths

<sup>5</sup> Theme: problem solving

<sup>6</sup> Theme: positive emotions

**Fig. 1.** Example of weekly menu of micro-tasks sent to participants in the intervention arm.

cally crafted for physicians and intentionally designed to cultivate professional satisfaction and well-being in one of 6 domains:

- Promote meaning in work and job satisfaction,
- Foster teamwork and social support at work,
- Nurture personal relationships and work-life balance,
- Recognize and build on personal strengths (courage, honesty, patience, wisdom, humanity, justice, and transcendence),
- Encourage effective problem solving, and
- Promote positive emotions.

These 6 themes were informed by a robust literature on physician career satisfaction, well-being, positive psychology, and mindfulness (Brunwasser, Gillham, & Kim, 2009; Krasner et al., 2009; Lyubomirsky, 2008; Shapria & Mongrain, 2010). The tasks were deliberately chosen to resonate with physicians in practice, be easily implemented, and promote a positive culture within which physicians can thrive. Each activity took less than 5 min to complete and could be done while at work. The menu of tasks for each week was drawn from a master list of 5–7 micro-tasks to create a diversity of choices and minimize redundancy. Participants in both arms of the trial were reimbursed up to \$250 for the time spent in this study, pro-rated depending on participation. Participants who completed the baseline and 3-month survey within 4 days of the survey being sent from the survey research center received \$25 for each survey. Participants received \$20 for completion of the weekly surveys within 4 days of them being sent from the survey research center. Receipt of remuneration depended only on timely completion of the surveys, and did not depend on completion of other activities.

### 2.3. Study outcomes

Study participants completed standardized instruments to measure professional satisfaction (Schaufeli & Bakker, 2003; Spreitzer, 1995; Williams et al., 1999) and well-being (Maslach, 1986;

**Table 1**  
Baseline Demographic and Practice Characteristics.

	Intervention N = 145	Control N = 145	p-value <sup>1</sup>
<b>Demographics</b>			
Age			0.56
<30	0	0	
31–40	34 (25.2%)	43 (31.4%)	
41–50	41 (30.4%)	44 (32.1%)	
51–60	40 (29.6%)	34 (24.8%)	
>60	20 (14.8%)	16 (11.7%)	
Missing	10	8	
Relationship status			0.53
Single	8 (5.9%)	6 (4.4%)	
Married	118 (87.4%)	123 (89.8%)	
Widowed	2 (1.5%)	0 (0.0%)	
Divorced/separated	2 (1.5%)	4 (2.9%)	
Significant other	5 (3.7%)	4 (2.9%)	
Missing	10	8	
Gender			0.26
Male	87 (64.4%)	97 (70.8%)	
Female	48 (35.6%)	40 (29.2%)	
Missing	10	8	
<b>Practice Characteristics, No. (%)</b>			
Years at Employed at Mayo Clinic			0.68
<5	28 (20.7%)	23 (16.8%)	
5–10	32 (23.7%)	37 (27.0%)	
11–20	43 (31.9%)	49 (35.8%)	
21–30	25 (18.5%)	19 (13.9%)	
>30	7 (5.2%)	9 (6.6%)	
Missing	10	8	
Specialty			0.29
General Internal Medicine	37 (25.7%)	27 (18.8%)	
Sub-specialty Internal Medicine	60 (41.7%)	71 (49.3%)	
Surgeon	47 (32.6%)	46 (31.9%)	
Hours worked per week, Mean (SD)	59.6 (14.4)	60.0 (13.3)	0.43
Campus			0.99
Arizona—Department of Medicine	25 (17.2%)	25 (17.2%)	
Rochester—Department of Medicine	73 (50.3%)	74 (51.0%)	
Rochester—Department of Surgery	47 (32.4%)	46 (31.7%)	
Professional Satisfaction			
Work Engagement, Mean (SD) <sup>2</sup>	4.5 (1.0)	4.5 (1.0)	0.98
Meaning, Overall, Mean (SD) <sup>3</sup>	5.0 (0.8)	5.0 (0.9)	0.98
Job satisfaction, Mean (SD) <sup>4</sup>	3.9 (0.6)	4.0 (0.7)	0.53
Well-being			
Burnout <sup>5</sup>			
Emotional exhaustion, Mean (SD)	22.3 (10.3)	22.8 (10.6)	0.71
High EE, No. (%)	44 (32.6%)	48 (35.6%)	0.61
Depersonalization, Mean (SD)	5.7 (5.0)	6.7 (6.0)	0.24
High DP, No. (%)	32 (23.7%)	38 (27.9%)	0.43
Personal accomplishment, Mean (SD)	41.2 (5.4)	39.8 (6.0)	0.05
Low PA, No. (%)	13 (9.6%)	23 (17.0%)	0.07
Burned out, No. (%)	54 (40.0%)	61 (44.9%)	0.46
Depression screen positive, No. (%) <sup>6</sup>	35 (25.9%)	35 (25.5%)	0.94
Overall QOL, Mean (SD) <sup>7</sup>	6.8 (2.0)	6.8 (1.8)	0.98
Fatigue, Mean (SD) <sup>7</sup>	5.6 (2.3)	5.4 (2.3)	0.44
Satisfaction with work-life balance, No. (%) <sup>8</sup>			0.79
Strongly agree	4 (3.0%)	7 (5.1%)	
Agree	39 (29.1%)	44 (32.4%)	
Neutral	30 (22.4%)	31 (22.8%)	
Disagree	47 (35.1%)	40 (29.4%)	
Strongly disagree	14 (10.4%)	14 (10.3%)	
Missing	11	9	

<sup>1</sup> Fisher's Exact test or Kruskal-Wallis tests, as appropriate.<sup>2</sup> Measured using the absorption sub-scale of the Work Engagement Scale (range 0–6).<sup>3</sup> Measured using the Empowerment at Work Scale (range 1–7).<sup>4</sup> Measured using the Global Job Satisfaction sub-scale of the Physician Job Satisfaction Scale (range 1–5).<sup>5</sup> Measured using the Maslach Burnout Inventory. High emotional exhaustion (EE), high depersonalization (DP), and low sense of personal accomplishment (PA) was determined used pre-established cut-off scores.<sup>6</sup> Measured using the 2-item Primary Care Evaluation of Mental Disorders.<sup>7</sup> Participants rated their overall quality of life and fatigue on a standardized linear analog scale; For the fatigue item a higher score means lower fatigue severity.<sup>8</sup> Agreed or strongly agreed that they were satisfied with their work-life balance.

**Table 2**  
Pre-post differences in Professional Satisfaction and Well-Being of Participants.

Measure	Baseline	End of Study	P-value <sup>1</sup>
<b>Intervention</b>			
Work Engagement, Mean (SD) <sup>2</sup>	4.5 (1.0)	4.6 (0.9)	0.56
Meaning, Overall, Mean (SD) <sup>3</sup>	5.0 (0.8)	5.1 (0.8)	0.24
Job satisfaction, Mean (SD) <sup>4</sup>	3.9 (0.6)	4.0 (0.7)	0.83
<b>Burnout<sup>5</sup></b>			
Emotional exhaustion, Mean (SD)	22.3 (10.3)	22.3 (10.9)	0.49
High EE, No. (%)	44 (32.6%)	49 (35.8%)	0.25
Depersonalization, Mean (SD)	5.7 (5.0)	5.6 (4.9)	0.69
High DP, No. (%)	32 (23.7%)	29 (21.2%)	0.41
Personal accomplishment, Mean (SD)	41.2 (5.4)	40.5 (5.5)	0.32
Low PA, No. (%)	13 (9.6%)	11 (8.1%)	0.44
Burned out, No. (%)	54 (40.0%)	56 (40.9%)	0.84
Depression screen positive, No. (%) <sup>6</sup>	35 (25.9%)	30 (21.9%)	0.43
Overall QOL, Mean (SD) <sup>7</sup>	6.8 (2.0)	7.3 (1.9)	0.004
Fatigue, Mean (SD) <sup>7</sup>	5.6 (2.3)	6.6 (2.3)	<0.0001
Satisfied with work-life balance, No. (%) <sup>8</sup>	61 (45.5%)	58 (42.3%)	0.38
<b>Control</b>			
Work Engagement, Mean (SD) <sup>2</sup>	4.5 (1.0)	4.5 (1.0)	0.97
Meaning, Overall, Mean (SD) <sup>3</sup>	5.0 (0.9)	5.1 (0.9)	0.12
Job satisfaction, Mean (SD) <sup>4</sup>	4.0 (0.7)	3.9 (0.8)	0.21
<b>Burnout<sup>5</sup></b>			
Emotion exhaustion, Mean (SD)	22.8 (10.6)	22.7 (11.0)	0.97
High EE, No. (%)	48 (35.6%)	47 (33.3%)	0.67
Depersonalization, Mean (SD)	6.7 (6.0)	6.5 (6.0)	0.54
High DP, No. (%)	38 (27.9%)	39 (27.5%)	1.00
Personal accomplishment, Mean (SD)	39.8 (6.0)	40.3 (5.6)	0.22
Low PA, No. (%)	23 (17.0%)	14 (9.9%)	0.02
Burned out, No. (%)	61 (44.9%)	59 (41.5%)	0.39
Depression screen positive, No. (%) <sup>6</sup>	35 (25.5%)	40 (28.2%)	0.53
Overall QOL, Mean (SD) <sup>7</sup>	6.8 (1.8)	7.3 (1.7)	0.002
Fatigue, Mean (SD) <sup>7</sup>	5.4 (2.3)	6.4 (2.2)	<0.0001
Satisfied with work-life balance, No. (%) <sup>8</sup>	54 (39.7%)	46 (32.6%)	0.16

<sup>1</sup> Fisher's Exact test or Kruskal-Wallis tests, as appropriate.

<sup>2</sup> Measured using the absorption sub-scale of the Work Engagement Scale (range 0–6).

<sup>3</sup> Measured using the Empowerment at Work Scale (range 1–7).

<sup>4</sup> Measured using the Global Job Satisfaction sub-scale of the Physician Job Satisfaction Scale (range 1–5).

<sup>5</sup> Measured using the Maslach Burnout Inventory. High emotional exhaustion (EE), high depersonalization (DP), and low sense of personal accomplishment (PA) was determined using pre-established cut-off scores.

<sup>6</sup> Measured using the 2-item Primary Care Evaluation of Mental Disorders.

<sup>7</sup> Participants rated their overall quality of life and fatigue on a standardized linear analog scale; For the fatigue item a higher score means lower fatigue severity.

<sup>8</sup> Agreed or strongly agreed that they were satisfied with their work-life balance.

Rummans et al., 2006; Spitzer et al., 1994) at baseline and at the completion of the study (3 months after baseline). Burnout, a syndrome encompassing depersonalization, emotional exhaustion, and low sense of personal accomplishment, was measured using the 22-item Maslach Burnout Inventory (Maslach, 1986). We used established threshold scores to define high depersonalization, high emotional exhaustion, and low sense of personal accomplishment (Maslach 1986). Symptoms of depression were measured using the 2-item Primary Care Evaluation of Mental Disorders (PRIME MD), described and validated by Spitzer et al. (1994).

Quality of life (QOL) was measured using a single-item linear analog scale assessment question with response options of 0 (as bad as it can be) to 10 (as good as it can be) that has been validated in a variety of populations. (Gudex et al., 1996; Norman et al., 2004; Rummans et al., 2006) Consistent with the approach of West and others, fatigue was rated using a similar one-item standardized linear analogue scale with lower scores indicating a higher level of fatigue. (Balch et al., 2011; Dyrbye, Satele et al., 2014; Dyrbye, West et al., 2014; West et al., 2013; West et al., 2012; West et al., 2009; West et al., 2011)

Work engagement was measured using the six-item absorption sub-scale of the Work Engagement Scale. (Schaufeli & Bakker, 2003) Mean score was computed by adding scores (0–6) from the six

items and dividing that number by six. To assess degree of meaning in work we applied the 12-item Empowerment at Work Scale. (Spreitzer 1995) We used the five items from the Physician Job Satisfaction Scale to measure global satisfaction at work. (Williams et al., 1999) Response options were a five point agree-disagree scale with higher numbers reflecting greater job satisfaction. Additional items explored demographic and practice characteristics as well as satisfaction with work-life balance ("My work schedule leaves me enough time for my personal/family life," an item that has been used in numerous previous studies of both physicians and non-physicians. (Dyrbye et al., 2012; Dyrbye, Shanafelt, Balch, Satele, & Freischlag, 2010; Shanafelt et al., 2009; Shanafelt et al., 2010; Shanafelt, Boone et al., 2012; Shanafelt, Oreskovich et al., 2012)).

#### 2.4. Statistical analysis

We used standard summary statistics to characterize the sample. Changes in each metric from baseline to end-of-study were analyzed using Fisher's Exact and Kruskal-Wallis tests as appropriate. All tests were 2-sided, and the threshold for statistical significance was set at  $p < 0.05$ . We conducted all analysis using SAS version 9 (SAS Institute, Cary, NC).

**Table 3**  
Post-Intervention Changes for Randomized Arms of the Trial.

	Intervention (N = 145)	Control (N = 145)	p-value <sup>1</sup>
Professional satisfaction			
Work Engagement, Mean (SD) <sup>2</sup>	0.0 (0.9)	0.0 (0.8)	0.27
Meaning, Overall, Mean (SD) <sup>3</sup>	0.1 (0.7)	0.1 (0.5)	0.84
Job satisfaction, Mean (SD) <sup>4</sup>	0.0 (0.6)	-0.1 (0.6)	0.31
Well-being			
Burnout <sup>5</sup>			
Emotional exhaustion, Mean (SD)	0.4 (6.9)	0.0 (5.7)	0.73
Depersonalization, Mean (SD)	-0.1 (3.6)	-0.2 (3.8)	0.96
Personal accomplishment, Mean (SD)	-0.4 (4.5)	0.5 (4.5)	0.16
Overall Burnout, No. (%)			0.66
Same as baseline	106 (80.9%)	111 (83.5%)	
Improved (change from burned out to not burned out)	12 (9.2%)	13 (9.8%)	
Worsened (change from not burned out to burned out)	13 (9.9%)	9 (6.8%)	
Missing	14	12	
Depression screen positive, No. (%) <sup>6</sup>			0.52
Same as baseline	105 (80.2%)	111 (82.8%)	
Improved (change from screen positive to screen negative)	15 (11.5%)	10 (7.5%)	
Worsened (change from screen negative to screen positive)	11 (8.4%)	13 (9.7%)	
Missing	14	11	
Overall QOL, Mean (SD) <sup>7</sup>	0.6 (2.1)	0.5 (1.9)	0.58
Fatigue, Mean (SD) <sup>7</sup>	1.0 (2.5)	1.0 (2.7)	0.85
Satisfied with work-life balance, No. (%) <sup>8</sup>			0.39
Same as baseline	97 (74.6%)	107 (81.1%)	
Improved (change from disagreed to agreed)	14 (10.8%)	9 (6.8%)	
Worsened (change from agreed to disagreed)	19 (14.6%)	16 (12.1%)	
Missing	15	13	
End-of-study			
Was participating in this study worthwhile?			0.02
Strong no	6 (4.4%)	0 (0.0%)	
No	4 (2.9%)	9 (6.3%)	
Neutral	45 (32.8%)	63 (44.4%)	
Yes	66 (48.2%)	56 (39.4%)	
Strong yes	16 (11.7%)	14 (9.9%)	
Missing	8	3	

<sup>1</sup> Fisher's Exact test or Kruskal-Wallis tests, as appropriate.

<sup>2</sup> Measured using the absorption sub-scale of the Work Engagement Scale (range 0–6).

<sup>3</sup> Measured using the Empowerment at Work Scale (range 1–7).

<sup>4</sup> Measured using the Global Job Satisfaction sub-scale of the Physician Job Satisfaction Scale (range 1–5).

<sup>5</sup> Measured using the Maslach Burnout Inventory.

<sup>6</sup> Measured using the 2-item Primary Care Evaluation of Mental Disorders.

<sup>7</sup> Participants rated their overall quality of life and fatigue on a standardized linear analog scale; For the fatigue item a higher score means lower fatigue severity.

<sup>8</sup> Agreed or strongly agreed that they were satisfied with their work-life balance.

### 3. Results

A total 290 physicians participated in the study. All participants signed written informed consent to participate. Half of the participants were randomized to the intervention arm (n = 145) and half to the control arm (n = 145). Over 90% of participants in each arm completed both the baseline (intervention group: 134/145[93%] vs control group: 137/145[94%], p = 0.62) and end-of-study surveys (intervention group: 137/145[94%] vs control group: 142/145[98%], p = 0.12). No baseline differences in demographic characteristics (e.g., age, gender), work characteristics (hours worked per week, specialty area, years of service, campus), professional satisfaction or well-being were found between arms with the exception that personal accomplishment was slightly higher in the intervention group (mean 42.1 vs 39.8, p = 0.05, Table 1). Participation in the 10 weekly surveys (intervention arm: survey plus micro-task; control: survey only) ranged from 71 to 85% in the intervention arm and 86 to 98% in the control arm. The mean weekly participation was 83% among the intervention group and 95% among the control group.

Table 2 shows the change in engagement, meaning in work, job satisfaction, fatigue, depression, quality of life and burnout scales before and after the study in the intervention and control arms. Improvements in overall quality of life (mean 6.8 [SD 2.0] vs. mean 7.3 [SD 1.9], p < 0.01) and fatigue (mean 5.6 [SD 2.3] vs. 6.6

[SD 2.3], p < 0.0001; higher score indicates lower fatigue severity) were observed for individuals in the intervention arm. The prevalence of high depersonalization, low personal accomplishment, and positive depression screen also all decreased slightly between the beginning and end-of-study for individuals in the intervention arm, although the differences did not reach statistical significance.

Similar improvements in these dimensions were observed in the control arm (Table 2). Specifically, overall quality of life (mean 6.8 [SD 1.8] vs mean 7.3 [1.7], p = 0.002) and level of fatigue (mean 5.4 [2.3] vs mean 6.4 [2.2], p < 0.0001 [higher score indicates lower fatigue severity]) improved over the three month time period. In addition, the prevalence of low personal accomplishment declined (17% vs. 9.9%, p = 0.02) along with non-significant improvements in the prevalence of high emotional exhaustion and depersonalization that did not reach statistical significance.

Table 3 shows the changes from baseline to study completion for each randomized arm of the trial. When compared to the control arm, no statistically significant improvement in well-being or professional satisfaction was observed for the intervention arm. Despite the lack of statistically significant differences between arms in the dimensions of well-being measured, at the completion of the study, those in the intervention arm were more likely to report participating in the study was worthwhile in comparison to controls.

#### 4. Discussion

We report here one of the few randomized, controlled trials evaluating an intervention to improve professional satisfaction and well-being among physicians. The intervention our study evaluated was well grounded in the existing literature. Others have demonstrated that multiple targeted tasks can improve happiness (Fordyce, 1977; Fordyce, 1983) and that electronic delivery of micro-tasks can lead to improvements in multiple dimensions of positive mental health (Kypri et al., 2009; Seligman & Steen 2005; Shanafelt et al., 2014), promote behavior change, (Shanafelt et al., 2014) and decrease harmful behaviors (Kypri et al., 2009; Prochaska et al., 1993). Although built on a strong evidence base and executed with a high participation rate, the online intervention evaluated in this trial did not result in a meaningful improvement in well-being when post-intervention changes are compared between the randomized arms of the trial.

A variety of factors may explain this study's negative result. It is possible that the micro-tasks tested had no value for improving the endpoints measured or were overwhelmed by competing factors (Dyrbye & Shanafelt 2011; Shanafelt et al., 2015; Shanafelt, Boone et al., 2012; Wallace et al., 2009) that influence the outcomes measured. It is also possible that they had value but that the dose/frequency of the task was inadequate to effect change. Or it may be that there something different about physicians that might make this type of intervention less effective than in other populations. Although weekly participation rates were high in both arms of the study, there was lower weekly participation rate in the intervention group than in the control group. The study, however, was adequately powered and it is unlikely we would have found statistically significant differences between the arms of the study had weekly participation been 100%. Achieving such a high level of engagement among chronically overburdened physicians working in an increasingly complex health care arena may not be feasible or sustainable. It is notable in this regard that those in the intervention arm were more likely to report participating in the study was worthwhile than those in the control arm. We did not find statistically significant post-intervention differences between the randomized arms of the trial, as overall quality of life and fatigue improved in both arms during the course of the study. This finding may represent a Hawthorne effect as participants were aware they were participating in a physician well-being study. (McCambridge, Witton, & Elbourne, 2014) It may also be that the process of answering the four items weekly prompted physicians to engage in self-reflection that led to behavioral change resulting in improvements in QOL and fatigue in both arms.

Our study has a number of limitations. As this study was conducted at a single institution the generalizability of these results to other settings is unknown. However, our participants included physicians from multiple disciplines (general surgeons, subspecialty surgeons, general internist, and sub-specialty internist) working at multiple sites (Scottsdale, Arizona and Rochester, Minnesota) and at all career stages. Second, it is possible that a similar intervention of longer duration would have resulted in a net positive benefit. Third, similar to other studies of electronically delivered micro-tasks (Kypri et al., 2009; Prochaska et al., 1993; Seligman & Steen 2005; Shanafelt et al., 2014) we could not determine if participants in the intervention arm actually completed their chosen weekly micro-tasks.

It should be noted that, without the control group, we would have drawn the conclusion that the intervention was worthwhile based on the improved quality of life and reduction in fatigue in the intervention arm. With the additional data from the control group we learned that both groups experienced the same degree of improvement in quality of life and fatigue during the study period. This illustrates the limitations of efforts to address the challenge of

physician well-being/burnout through single arm studies without appropriate controls. In order for progress to be made in this area, it is critical that promising interventions undergo rigorous controlled testing to document efficacy. Requiring that interventions designed to improve physician distress adhere to the same level of evidence expected in other areas of medicine will focus organizational efforts on the activities that actually have value and also enable limited institutional resources to be directed where they will have the greatest impact.

#### 5. Conclusions

Additional research using randomized controlled study designs and an appropriate control group is needed to identify effective interventions to improve physician well-being and career satisfaction. Given the relationship between physician well-being and career satisfaction, (Shanafelt et al., 2009) quality of care delivered, (Shanafelt et al., 2010; Wallace et al., 2009; West et al., 2006) patient satisfaction and adherence, (Haas et al., 2000; Halbesleben & Rathert 2008; Linn et al., 1985) and physician turnover, (Shanafelt, Balch et al., 2011) doing so is vital for physicians, their employers, and the patients they serve.

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