

Scientific Article

Posttraumatic Growth in Radiation Medicine During the COVID-19 Outbreak

Ajay Kapur, PhD,^{a,b,*} Brett Rudin, MBA,^{a,b} and Louis Potters, MD^{a,b}^aDepartment of Radiation Medicine, Northwell Health Cancer Institute, Lake Success, New York; ^bZucker School of Medicine, Hempstead, New York

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Abstract

Purpose: It has been reported that adversarial growth during traumatic events potentially enhances coping with sequelae. The purpose of this work was to assess posttraumatic growth (PTG) among radiation medicine staff members at the individual level as well as changes in perceptions of departmental culture after the COVID-19 pandemic.

Methods and Materials: An anonymous PTG inventory (PTGI) survey comprising 21 indicators was disseminated to all 213 members of our multicenter radiation department to measure perceptions of change in personal, interpersonal-relationship, and philosophy of life factors using principal-factor analysis. Additionally, 8 department safety-culture indicators from the National Hospital Patient Safety Culture Survey developed by the Agency for Healthcare Research and Quality were included to assess changes in department safety-culture perceptions versus a prepandemic survey. The survey was repeated 15 months later to assess longitudinal trends.

Results: With a 56.3% survey-response rate, PTGI factor analysis yielded Cronbach's alpha values exceeding 0.90 for the 3 aforementioned PTG factors. The average growth per indicator was 2.3 (out of 5.0), which fell between small and moderate. The values were 2.4 (personal), 2.1 (interpersonal), and 1.6 (philosophy) for the 3 factors. The total PTGI score (47.7 ± 28.3 out of 105 points) was lower for masked, patient-facing, frontline workers members (41.8 ± 28.4) compared with others (53.1 ± 27.3 , P value .001). For the Agency for Healthcare Research and Quality survey there was an improvement of 15% in perceptions of department safety culture, and 7 of the 8 indicators showed improvements compared with baseline. The follow-up survey demonstrated overall sustained findings, albeit with a trend toward declining PTG scores for nonfrontline workers, notably in interpersonal relationships (47.4 ± 27.0 , P value .05).

Conclusions: A fair-to-moderate degree of PTG was observed in personal and interpersonal relationship factors whereas least growth was noted in spiritual and religious beliefs. Perceptions of department patient-safety culture improved substantially. Sustained improvements were thus perceived at the individual and department levels.

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Introduction

After the outbreak in late 2019 of the severe acute respiratory syndrome coronavirus-2 in Wuhan, China, and the global spread of COVID-19, the World Health Organization declared COVID-19 to be a pandemic on March 11, 2020. With a worldwide caseload at that time of over 118,000 infected people and 4291 deaths in 114

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*Corresponding author: Ajay Kapur, PhD; E-mail: akapur@northwell.edu

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countries,¹ the caseload has since risen, as of December 2021, by a factor of 2100, and fatalities have increased by a factor of over 1100.² The United States, with the largest reported caseload of all countries has undergone 4 waves of the pandemic. Radiation therapy has been quite resilient during the pandemic, being able to continue ambulatory clinical operations. The initial wave in New York with anticipation across the country created a call to action to anticipate the worst in terms of caring for patients with cancer. Substantial changes were made to operations, even in excess of masking and personal protection of the staff and patients with consideration of altered fractionation and other changes to routine care. These changes were designed to (1) manage the safety of the staff and (2) to create continued access to patients requiring radiation therapy services.³⁻⁶

The acute effect of the first wave of COVID-19 even with mitigation plans implemented was a traumatic event for staff, to say the least, having to manage themselves and their families and then at work with patients with cancer. Nevertheless, traumatic events, though fraught with adversarial conditions, may sometimes elicit positive developments. These developments come not as a direct result of the trauma, but based on rumination and cognitive appraisals that emerge from the struggle with it, to disengage from pretrauma core beliefs, build new schema, and establish priorities for a new normal.^{7,8} These may come in the form of growth in personal perceptions, interpersonal relationships, and in the philosophies of life. Such developments are different from resilience or crisis management, which inure the experience of trauma or restore the “old normal” and have been referred to instead as “posttraumatic growth” (PTG).

In the 1990s an instrument called the “PTG inventory” (PTGI) was introduced that has since been used and validated⁹⁻¹⁶ numerous times, encompassing a wide range of traumatic events such as natural disasters, accidents, bereavement, terrorist attacks, and the diagnosis of illnesses such as cancer. This instrument is useful in determining how successfully people can potentially reconstruct or strengthen perceptions of self, relationships with others, and meaning of events so as to arrive at an enhanced level of functioning.^{7,8}

It has been reported that people who achieve PTG and maintain it over time are less distressed subsequently, which assists to better cope with sequelae.¹⁷ In the context of COVID-19, these refer to successive waves of the pandemic over time. A wide array of publications on PTG during COVID-19 have appeared in the literature using the PTGI survey instrument.¹⁸⁻²⁶ Given the interest in enhancing coping with future events and the unique challenges in radiation therapy,²⁷ in this work we sought to assess, using the PTGI instrument, whether our staff members in radiation medicine experienced and maintained such growth at the individual level. Organizational PTG has been recently presented in the literature to

suggest that organizations may also exceed prior levels of functioning through cognitive, emotional, and structural responses to a traumatic event that disrupts core activities.^{28,29} A secondary goal in this work was to assess whether there was perceived growth in the culture of safety in our department after COVID-19 trauma, to facilitate coping and resilience in subsequent waves. For this we used select safety culture indicators from the national hospital patient safety culture survey instrument developed by Agency for Healthcare Research and Quality (AHRQ) and used widely by hospitals across the nation.³⁰

Methods and Materials

In response to the declaration of the pandemic, our department put in place several interventions to modify clinical operations for the safety of patients and staff members.³¹⁻³⁵ An internal anonymous survey was prepared in Survey Monkey (Momentive Inc., San Mateo, CA) for electronic dissemination to all 213 members of multicenter radiation medicine department as part of our quality management program. The survey consisted of 3 sections: (1) PTG indicators for staff; (2) AHRQ survey indicators for department safety culture; and (3) demographic questions. The survey was administered during the first wave of the pandemic (May 2020) and repeated 15 months later during wave 4. Both times the surveys were kept open for a week and staff were informed upfront via email to enter perceived changes relative to the prepandemic baseline (December 2019). The surveys were unpaired with no crosslinked identifiers to retain anonymity. Findings were not presented to the staff until the completion of the second survey to minimize bias.

The first section of the survey included 21 PTG indicators encompassing 5 growth domains: (1) appreciation of life; (2) new possibilities; (3) personal strength; (4) relating to others; and (5) spiritual change. As an example, “I discovered that I’m stronger than I thought I was,” was an indicator in the “personal strength” domain. Respondents were instructed to indicate the degree of their perceived growth after the pandemic on a 6-point Likert scale ranging from 0 (no change) to 5 (very great degree). The domains were not stated explicitly in the survey. Thus, the greatest perceived PTG per respondent would have 5 points on any 1 question, leading to a potential total score of 105 points over 21 questions for that respondent. The average PTG scores across all respondents were obtained for each indicator. Further, an average PTG score was computed across all indicators to yield a composite average PTG score for all respondents in the department.

In the second section, 8 safety culture indicators were included from the AHRQ survey that encompassed management support, supervisor/manager expectations and actions, communication openness, teamwork, and overall perceptions of patient safety culture. As an example, “Staff

feel free to question the decisions or actions of those with more authority” was an indicator in the “communication openness” domain and answerable on a 5-point Likert scale with options of “never,” “rarely,” “sometimes,” “most of the time,” and “always.” The response was considered favorable if “most of the time” or “always” was selected. On some indicators the choices were “strongly disagree” to “strongly agree” and the response was considered favorable if “agree” or “strongly agree” was selected on a positively framed question. Thus, for any single safety culture indicator, the fraction of respondents that provided favorable responses yielded the percent-positive-value (PPV) for that indicator. We had completed the full 42-indicator AHRQ survey *before* the pandemic in December 2019. The PPV values for the 8 indicators were then compared with the baseline prepandemic PPV values as well as with the benchmarks provided in the 2018 AHRQ survey conducted in hospitals across the nation.

The third section had 2 optional demographic questions – the staff division (such as nursing, medical physics) and whether the staff member did not work at this time, worked from home, worked at the site but not facing the patient, or was masked and facing the patient. The latter category was classified as a frontline staff member for separate analysis. PTG scores for frontline workers were compared with those for all other staff members to assess differences if any.

For data analysis on the PTG section, principal factor analysis with Pearson correlations, Varimax rotations, and Kaiser-Meyer-Olkin sampling adequacy assessment was performed using the XLSTAT add-on in Microsoft Excel to reduce the dimensionality of the 21 observed indicators to 3 unobserved dimensions (corresponding to personal growth, interpersonal relationships, and philosophy of life of the original PTGI construct) as well as to the conventional 5 dimensions discussed previously and widely used in the literature. Cronbach’s alpha exceeding 0.70 was considered adequate for internal data consistency and reliability in factor analysis.

Results

Of the 213 staff members, 120 responded to the first survey and 122 responded to the second, over a period of a week, yielding a response rate of over 56%. On average, the time taken to complete the survey for each respondent was just under 5 minutes. Overall staffing levels did not change significantly through the study period. Staff divisions were well represented in surveys 1 and 2, respectively, with breakdown as follows: radiation therapists (21.7%, 21.3%), medical physicists (12.5%, 13.9%), other (11.7%, 10.7%), physicians (10.8%, 10.7%), nursing staff (10.0%, 12.3%), dosimetrists (9.2%, 7.4%), billing staff (7.5%, 3.3%), administrators (5.8%, 6.6%), secretaries

(5.0%, 9.0%), informatics staff (1.7%, 0.0%), and residents (1.7%, 1.6%). In survey 1, 2.5% and in survey 2, 3.3% of respondents left the staff division blank. In the 2 respective surveys, 48.3% and 59.8% of the respondents identified as being frontline staff while 2.5% and 3.2% did not complete this demographic question. Although there were up to 5 respondents per survey who provided patterned responses (such as the same score on all questions) the effect on the overall PTG score was minor (under 0.2 points).

Perceived growth at the individual level

The total PTGI score averaged over all respondents and indicators out of 105 points for the first survey was 47.7 (standard deviation, 28.3; median, 47) and for the second survey was 46.7 (standard deviation, 28.2; median, 47). In survey 1, frontline staff had an average PTGI score of 41.8 (standard deviation, 28.4; median, 42.5) while nonfrontline staff had an average score of 53.1 (standard deviation, 27.3; median, 53.5). Thus, frontline staff perceived a lower PTG compared with others in survey 1 (P value .001). In survey 2, this difference in PTGI scores was reduced between the frontline and nonfrontline staff (frontline staff average PTGI 46.2: standard deviation, 29.1; median, 49; nonfrontline staff average PTGI 47.4: standard deviation, 27; median, 47). The differences between these 2 groups in survey 2 were not statistically significant (Table 1). These results have been normalized on the 6-point Likert scale (Table 1) to place in context the qualitative interpretation of the degree of growth perceived, which fell between small and moderate for both surveys (between 2 and 3 on the Likert scale). Differences in the 2 surveys were statistically significant only for frontline versus nonfrontline staff in survey 1, and for nonfrontline staff between survey 1 and survey 2 (Table 1). However, for all respondents considered together, the findings of survey 1 were sustained in survey 2.

Factor analysis on the PTGI sections of the surveys supported the 3-factor construct but not the 5-factor one, likely in part due to the high correlations noted between the indicators and also a relatively small sample size (Table 2). However, for completeness, the factors from the 5-factor model have been included to place them in context of the 3-factor construct (Table 2, Fig 1). The 3-factor construct yielded the expected factors corresponding well with personal growth, interpersonal relationships, and philosophy of life for a total Cronbach’s alpha of 0.97 and a cumulative variance of 66.3%.

In the 3-factor construct, the most perceived growth occurred at the personal level, followed by interpersonal relationships and lastly the philosophy of life. The growth indicators with the most perceived growth for all respondents included a reprioritization of what is important in life, finding greater appreciation for the value of one’s life,

Table 1 PTG and safety culture perceptions summary

Survey respondents	PTG mean (out of 5.0)	AHRQ PPV mean
Survey 1 (wave 1)		
All n = 120	2.3	79.8%
Frontline n = 58	2.0	73.7%
Nonfrontline n = 62	2.5	85.6%
Survey 2 (wave 4)		
All n = 122	2.2	78.3%
Frontline n = 73	2.2	72.9%
Nonfrontline n = 49	2.3	86.7%
Mann-Whitney tests for PTG surveys P values		
All respondents survey 1 versus survey 2		.522
Frontline versus nonfrontline survey 1		.001*
Frontline versus nonfrontline survey 2		.764
Frontline survey 1 versus survey 2		.116
Nonfrontline survey 1 versus survey 2		.050*

Abbreviations: AHRQ = Agency for Healthcare Research and Quality; PPV = percent-positive-value; PTG = posttraumatic growth.
 * 2-tailed P values less than .05 are considered significant.
 For PTG, the scores are shown on a 6-point scale reflecting the degree of perceived growth: 0: no change, 1: very small, 2: small, 3: moderate, 4: great, 5: very great. For the AHRQ indicators, the percentage of positive/favorable responses is provided. Mann-Whitney nonparametric statistical tests for ordinal data in PTG surveys were used to compare independent samples for statistical significance.

and the ability to better appreciate each day. The growth was perceived to be at a moderate level (Table 1, Fig 1). Those with the least perceived growth included having a stronger religious faith, a willingness to express emotions, and a better understanding of spiritual matters. The

growth in these indicators fell between very small to a small degree. All other indicators had perceived growth to a small degree. Between the 2 surveys, average PTGI scores increased for frontline staff across all factors of the 3-factor construct but decreased for nonfrontline staff

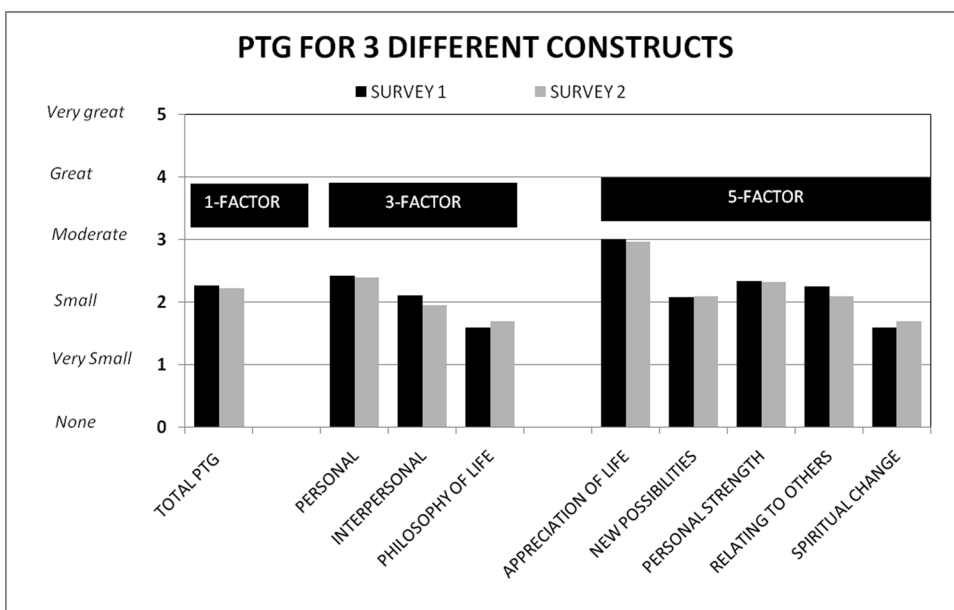


Figure 1 Degree of growth perceived as expressed in different constructs on a 6-point scale (as in Table 1) and its evolution over a period of 15 months for all respondents. The 1-, 3-, and 5-factor constructs reduce the dimensionality of 21 growth indicators to 1, 3, and 5 latent or unobserved factors to simplify the interpretation. See text for details.

Table 2 Mean scores for PTG indicators

Q no.	PTG indicator	5-factor construct	Mean PTG wave 1	Mean PTG wave 4	Trend	3-Factor construct factor loadings		
						personal 0.96 variance 33.5%	interpersonal 0.91 19.8%	philosophy 0.92 13.0%
1	I changed my priorities about what is important in life.	<i>Appreciation of life</i>	3.1	3.0	↓	0.72*	0.21	0.24
2	I have a greater appreciation for the value of my own life.		3.0	3.0	↑	0.71*	0.28	0.31
13	I can better appreciate each day.		3.0	2.8	↓	0.73*	0.45	0.19
17	I am more likely to try to change things which need changing.	<i>New possibilities</i>	2.5	2.5	↓	0.72*	0.40	0.20
11	I am able to do better things with my life.		2.2	2.1	↓	0.68*	0.33	0.26
14	New opportunities are available which wouldn't have been otherwise.		2.1	1.9	↓	0.50*	0.30	0.25
3	I developed new interests.		1.9	2.1	↑	0.52*	0.34	0.41
7	I established a new path for my life.		1.7	2.0	↑	0.63*	0.30	0.39
4	I have a greater feeling of self-reliance.	<i>Personal strength</i>	2.5	2.4	↓	0.73*	0.27	0.29
12	I am better able to accept the way things work out.		2.4	2.2	↓	0.64*	0.40	0.27
10	I know better that I can handle difficulties.		2.3	2.4	↑	0.74*	0.31	0.33
19	I discovered that I'm stronger than I thought I was.		2.2	2.3	↑	0.59*	0.36	0.38
15	I have more compassion for others.	<i>Relating to others</i>	2.7	2.4	↓	0.59*	0.47	0.14
16	I put more effort into my relationships.		2.5	2.5	↑	0.64*	0.41	0.18
6	I more clearly see that I can count on people in times of trouble.	<i>Relating to others</i>	2.4	2.0	↓	0.26	0.66*	0.26
8	I have a greater sense of closeness with others.		2.4	2.1	↓	0.49	0.56*	0.29
20	I learned a great deal about how wonderful people are.		2.3	1.9	↓	0.32	0.72*	0.29
21	I accept needing others better.		2.0	1.7	↓	0.39	0.72*	0.32
9	I am more willing to express my emotions.		1.5	1.9	↑	0.44	0.61*	0.28
5	I have a better understanding of spiritual matters.	<i>Spiritual change</i>	1.8	1.8	↑	0.34	0.36	0.81*
18	I have a stronger religious faith.		1.4	1.6	↑	0.33	0.36	0.72*

Abbreviation: PTG = posttraumatic growth.

* The highest loadings on each of the 3-factor construct.

The mean scores for PTG indicators (out of 5 points as in Table 1) over the 2 surveys and factor loadings (survey 1) for the 3-factor construct (last 3 columns) obtained from principal factor analysis. Cronbach's alpha and percent variance after rotation for the 3-factors are indicated. Keiser-Meyer-Olkin measures of sampling adequacy for the 21 indicators ranged from 0.89 to 0.96, indicating our survey data were amenable to factor analysis. Also included in column 3 are the factors of the original 5-factor construct proposed in the literature showing their relationship with the 3-factor construct.

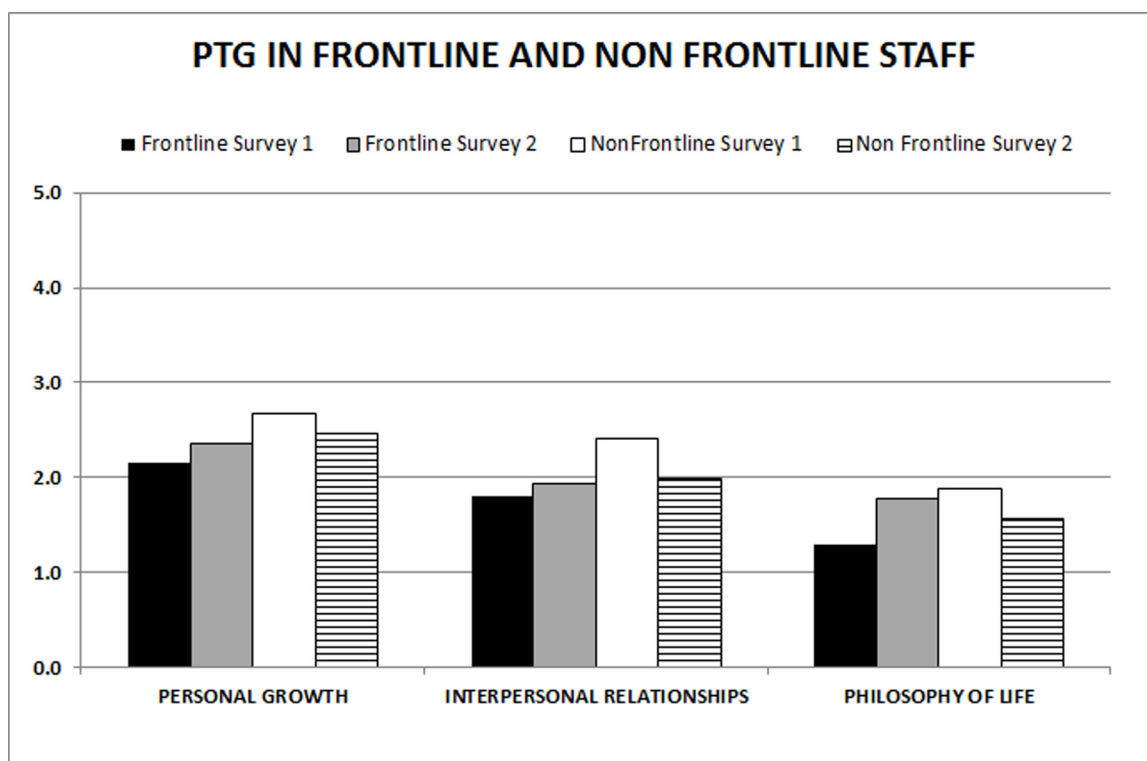


Figure 2 Changes in posttraumatic growth (PTG) scores among frontline and nonfrontline staff over the 2 survey periods shown on a 6-point scale as in Figure 2 for the 3-factor construct on personal growth, interpersonal growth, and growth in the philosophy of life.

(Fig 2), with a more notable reduction in interpersonal relationships. Within this factor, even though the magnitude of perceived growth was greater or at-par for nonfrontline staff, there were notable reductions for nonfrontline staff from survey 1 to survey 2 in counting on others in troubled times, a sense of closeness with others, learning how wonderful people are, and accepting needing others better. However, both groups perceived growth in being more emotionally expressive in the second survey.

Perceived growth at the department level

The average PPVs for the 8 AHRQ safety culture indicators for all respondents in survey 1 was 79.8% and marginally lower in survey 2 (Table 1). Relative to the prepandemic survey, the PPVs improved on average by 15% in survey 1 and 14% in survey 2 (Table 3). Relative to the national averages of the 2018 AHRQ survey, the PPV values were on average 10% and 9% higher in the 2 surveys, respectively, whereas the prepandemic PPV was 3% lower (Fig 3). In all 3 surveys the PPV for the indicator on adequacy of our policies and procedures at preventing errors exceeded the 90th percentile of nation-wide responses. In contrast, the PPV for another indicator on getting work required to be done quickly through team

efforts consistently remained lower than the national average. In the prepandemic survey, 5 of the 8 indicators underperformed national averages in PPV. In survey 1, 2 of these had improved beyond the 90th percentile PPV values, 4 of the 8 indicators exceeded the national PPVs, and 2 continued to be below the national averages. However, 7 of the 8 indicators showed improvements relative to the prepandemic survey. In survey 2, only 1 indicator previously mentioned continued to remain below the national average though with improved PPV values (indicator 6, Fig 3, Table 3). Thus, improvements were noted in management support for patient safety, overall perceptions of patient safety, supervisor and manager expectations and actions supporting patient safety, teamwork across units, and communication openness.

Discussion

Our findings indicate that despite facing the deadliest pandemic since 1918, staff members of our radiation medicine department perceived a small-to-moderate level of posttraumatic growth, as well as a more favorable department safety culture relative to the prepandemic time point. These perceptions were sustained over the course of 4 waves of the pandemic.

Table 3 PPVs for 8 safety culture indicators

AHRQ indicators	National response		Radiation medicine response		
	AHRQ average	90th percentile	Prepandemic	Wave 1	Wave 4
Management support for patient safety					
1. F8. The actions of department management show that patient safety is a top priority.	76%	85.0%	79.4%	90.7% [†]	79.0%
2. F1. Department management provides a work climate that promotes patient safety.	81%	91.0%	80.2% [*]	91.5% [†]	85.7%
Overall perceptions of patient safety					
3. A18. Our procedures and systems are good at preventing errors from happening.	74%	83.0%	83.9% [†]	90.7% [†]	88.2% [†]
Supervisor/manager expectations & actions promoting patient safety					
4. B2. My supervisor/manager seriously considers staff suggestions for improving patient safety.	80%	88.0%	79.3% [*]	86.4%	82.4%
Teamwork within units					
5. A11. When one area in this unit gets really busy, others help out.	72%	81.0%	52.6% [*]	67.8% [*]	73.9%
6. A3. When a lot of work needs to be done quickly, we work together as a team to get the work done.	87%	93.0%	78.8% [*]	76.3% [*]	78.2% [*]
Teamwork across units					
7. F4. There is good cooperation among department units that need to work together.	62%	76.0%	64.1%	71.2%	74.8%
Communication openness					
8. C4. Staff feel free to question the decisions or actions of those with more authority.	50%	60.0%	45.1% [*]	63.6% [†]	63.9% [†]

Abbreviations: AHRQ = Agency for Healthcare Research and Quality; PPV = percent-positive-value.
^{*} PPV lower than AHRQ average PPV
[†] PPV higher than AHRQ 90th percentile
 PPVs for 8 safety culture indicators prepandemic and in waves 1 and 4 of the pandemic compared with national averages and the 90th percentile of all AHRQ respondents (2018) across 6 safety composites.

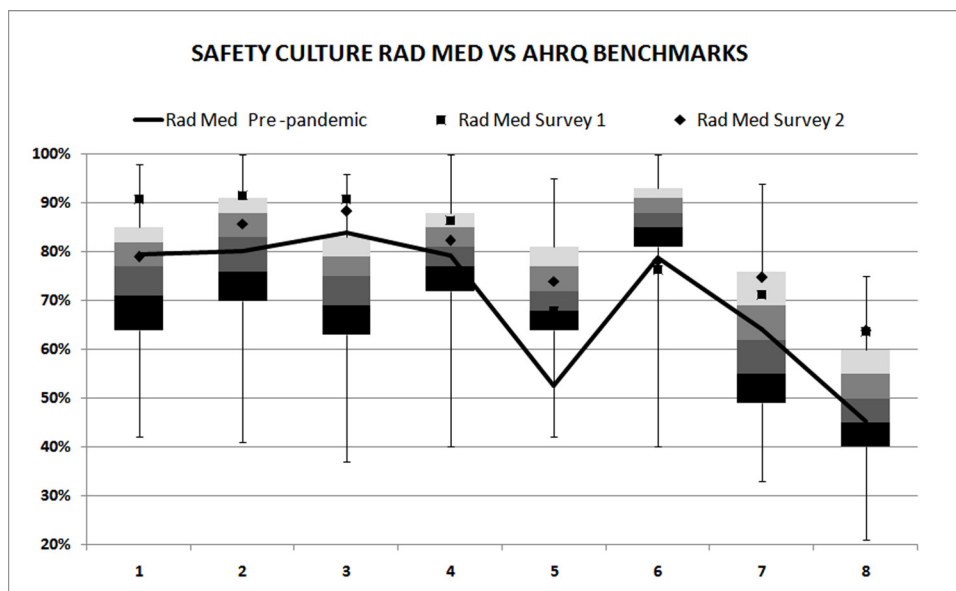


Fig. 3 AHRQ safety culture percent positive values for 8 indicators (Table 3) in our radiation medicine department for the prepandemic. Wave 1 and wave 4 surveys shown in the context of the nationwide benchmarks for participating hospitals in 2018. The box and whisker plots show the minimum, 10th, 25th, median, 75th, 90th percentiles and the highest values for the nation. Survey 1 scores are shown in squares, survey 2 in diamonds. *Abbreviations:* AHRQ = Agency for Healthcare Research and Quality; Rad Med = Radiation Medicine.

At the individual level, the highest perceived growth was in self perceptions, specifically in the appreciation of the value of one's own life, shifting priorities toward the more important things, and appreciating each day. Growth was also perceived in personal strengths, exploring new possibilities, and interpersonal relationships. Least growth was noted in spiritual and religious beliefs. With a composite PTGI score of 47.7 ± 28.4 , the prevalence of moderate-or-higher perceived growth was 49.7% (nearly half of the respondents). For 90% of the respondents, there was at least 1 indicator where the perceived growth was moderate or higher. Seventy-four percent of respondents had at least 1 indicator with perceived growth exceeding moderate levels.

Our findings are similar to other studies on PTG for various types of traumatic events, albeit the degree of growth noted (composite PTGI 47.7 ± 28.3) is lower compared with the original work of Tedeschi and Calhoun⁷ (PTGI 81.9). Other PTG studies have included traumatic events such as bereavement (PTGI 71.1 ± 20.8), motor vehicle accidents (PTGI 61.0 ± 25.6), sexual assault (PTGI 56.5 ± 23.6),¹⁴ and the diagnosis of breast cancer (PTGI 57.8 ± 25.4).¹² A recent pre-COVID-19 meta-analysis of 26 reviewed nonpandemic-related publications with disease, accident, and specific profession subgroups culminated in a combined prevalence of 52.58% moderate-or-higher growth perception. Ours of 49.7% falls within the 95% confidence interval of this study (48.66%–56.48%).³⁶ However, with a dearth of past pandemic-related PTG studies, it isn't clear if direct comparison of our study on the degree of perceived growth with such other traumatic events is meaningful.³⁷ Our findings are similar to a study on PTG in the context of Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) traumatic events where the PTGI score was 40.5 and where the 5-factor construct was also not supported for events of this type despite greater sample sizes.³⁸ Specifically for COVID-19 studies, our findings are similar to those reported in non-health care settings, such as 893 high-COVID stress reporting respondents across the United States and Canada with a 77% prevalence of moderate-or-higher growth in at least 1 indicator³⁷ and prevalence of 43.3% moderate-or-higher growth among 4069 U.S. veterans.³⁹ Most health care-related publications have focused on frontline workers, mainly nurses. Our findings compare well with such studies in Australia ($n = 767$, PTGI 21.6 ± 11.72 out of 50),⁴⁰ in Taiwan ($n = 12,596$, PTGI 28.0 ± 11.5 out of 60),⁴¹ in Turkey on nursing students ($n = 467$, PTGI 45.63 ± 24.13),⁴² and in Turkey on health care workers ($n = 66$, PTGI 45.04 ± 26.39).⁴³ Our scores are notably lower than others, including a study on clinical nurses in China ($n = 1790$, PTGI 67.17 ± 14.79),²³ on frontline nurses in China ($n = 167$, PTGI 70.53 ± 17.26 out of 100),⁴⁴ and on frontline workers in New York ($n = 2579$, 76.8% prevalence of moderate-or-higher growth).⁴⁵ These latter studies reiterated

key drivers for PTG endorsed in the seminal publications of Tedeschi and Calhoun, such as social support, deliberate rumination, positive emotions, and role models, which provide targeted direction for future interventions.

It is important to point out 2 limitations in our current study. The first is that this was a self-reported study at a single multicenter institution, albeit with a mix of community, private, and academic practices. The second is that unlike other studies, we did not undertake assessments of associated stress factors. Our goal was to ascertain potential risks of the widely perceived pandemic stress on the quality of care while at the same time enforcing acute interventions required for safe operations as part of our quality management program. Although there is some debate on whether posttraumatic stress disorder is meaningful in the context of the COVID-19 pandemic,⁴⁶ we did not include assessments of associated stress factors for 2 additional reasons. First, the COVID-19 pandemic is an unprecedented health crisis, and therefore the insights from social and behavioral sciences may help understand the psychological effect that is currently still being assessed.¹⁸ And second, because even for traumatic incidents with precedents, there are mixed results on the relationship between posttraumatic stress disorders and PTG, ranging from no relationship to more complex associations.¹⁴ Likewise, we did not undertake assessments of longitudinal stress patterns in the aftermath of COVID-19, to validate whether growth perceived was real or simply a coping mechanism for stress and thus illusory.³⁷ Such a study, though resource intensive, would provide direction to meaningfully interpret the PTGI scores and facilitate adversarial growth, yet most past studies on PTG have not considered this important aspect.

An interesting observation in our study was the differing evolution of PTG over time between frontline and nonfrontline staff members. Frontline staff initially perceived less PTG than nonfrontline staff, but incremental growth patterns were observed over time. For nonfrontline staff, perceived PTG appeared to eventually reduce to a point where the differences between the 2 were not statistically discernible. These findings may be related to 2 key insights from the seminal publications of Tedeschi and Calhoun.^{7,8} The first is that those who experience greater trauma may report more growth. And the second is that people with higher coping capacity will report relatively less growth. Frontline workers who work in close proximity with patients have experience in working under potential threats of exposure to other respiratory viruses such as influenza and mechanisms of their spread.⁵ Given this experience, they are likely to have higher coping capacity than nonfrontline workers in working under newer respiratory illness conditions, particularly with appropriate use of personnel protective equipment. However, with subsequent and more virulent waves of the pandemic, there may be additional trauma experienced.

During this period, vaccinations were eventually approved and made accessible, which may have allayed the trauma for all staff.

Working remotely and incorporating telehealth into clinical operations have become a new normal in the wake of the pandemic for nonfrontline workers. Over time, physical displacement reduces the opportunity for discourse with others that existed earlier. We observed a notable reduction in the perception of *interpersonal relationship growth* for nonfrontline workers in survey 2. From an organizational perspective, however, this is a key area to target growth. The indicators from the AHRQ survey chosen for this study largely focused on those composites that affect such relationships, such as management support in creating a supportive work climate, teamwork within and across divisions, supervisor responses to staff suggestions, and communication openness. The indicator on “getting work required to be done quickly through team efforts” consistently remained lower than the national average in both surveys and likely attributed to specific policies in our department that minimize or preclude hastened actions for high-risk tasks.^{47,48} These traditional composites aside, our next steps are to focus on pandemic-relevant initiatives that would foster deliberate rumination and social support highlighted by others specifically as drivers of adversarial growth, given our observed decline in scores for workers displaced from traditional social settings.

Conclusions

With the advent of the COVID-19 pandemic, staff members in radiation medicine experienced a fair-to-moderate degree of PTG in personal and interpersonal relationship factors with least growth in spiritual and religious beliefs. Perceptions of department patient-safety culture have improved substantially. Growth has thus been perceived at the individual and the department levels. We believe these sustained growth patterns have culminated in a higher level of functioning, albeit to a modest degree, that will prepare us better for subsequent waves of the pandemic.

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