


## REVIEW

# An equity-based narrative review of barriers to timely postoperative radiation therapy for patients with head and neck squamous cell carcinoma

Elizabeth A. Noyes BS<sup>1</sup>  | Ciersten A. Burks MD<sup>2</sup>  | Andrew R. Larson MD<sup>2</sup> | Daniel G. Deschler MD<sup>2</sup>

<sup>1</sup>Harvard Medical School, Boston, Massachusetts, USA

<sup>2</sup>Department of Otolaryngology-Head and Neck Surgery, Massachusetts Eye and Ear, Harvard Medical School, Boston, Massachusetts, USA

**Correspondence**

Elizabeth A. Noyes, BS, Harvard Medical School, 25 Shattuck St., Boston, MA 02215.  
Email: elizabeth\_noyes@hms.harvard.edu

**Abstract**

**Objectives:** The majority of patients with head and neck squamous cell carcinoma (HNSCC) do not commence postoperative radiation treatment (PORT) within the recommended 6 weeks. We explore how delayed PORT affects survival outcomes, what factors are associated with delayed PORT initiation, and what interventions exist to reduce delays in PORT initiation.

**Methods:** We conducted a PubMed search to identify articles discussing timely PORT for HNSCC. We performed a narrative review to assess survival outcomes of delayed PORT as well as social determinants of health (SDOH) and clinical factors associated with delayed PORT, using the PROGRESS-Plus health equity framework to guide our analysis. We reviewed interventions designed to reduce delays in PORT.

**Results:** Delayed PORT is associated with reduced overall survival. Delays in PORT disproportionately burden patients of racial/ethnic minority backgrounds, Medicaid or no insurance, low socioeconomic status, limited access to care, more comorbidities, presentation at advanced stages, and those who experience postoperative complications. Delays in PORT initiation tend to occur during transitions in head and neck cancer care. Delays in PORT may be reduced by interventions that identify patients who are most likely to experience delayed PORT, support patients according to their specific needs and barriers to care, and streamline care and referral processes.

**Conclusions:** Both SDOH and clinical factors are associated with delays in timely PORT. Structural change is needed to reduce health disparities and promote equitable access to care for all. When planning care, providers must consider not only biological factors but also SDOH to maximize care outcomes.

**KEYWORDS**

adjunctive radiation, head and neck cancer, health disparities, squamous cell carcinoma, treatment delay

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2021 The Authors. *Laryngoscope Investigative Otolaryngology* published by Wiley Periodicals LLC on behalf of The Triological Society.

## 1 | INTRODUCTION

Postoperative radiation treatment (PORT) is an important adjunct to improve survival outcomes after surgery for head and neck squamous cell carcinoma (HNSCC).<sup>1</sup> Current National Comprehensive Cancer Network (NCCN) guidelines recommend initiating PORT within 6 weeks of surgery, yet the majority of HNSCC patients do not commence PORT within this time frame, a trend that has worsened over time.<sup>2-4</sup> Disparities in timely PORT initiation may contribute to disparities in overall survival outcomes among HNSCC patients.<sup>5</sup>

Timely PORT is significantly impacted by clinical factors as well as social determinants of health (SDOH), social and demographic factors such as socioeconomic status (SES), race and ethnicity, insurance, and geographic location that impact the development of illness, access to care, and health outcomes.<sup>2,3,6</sup> Inequity and disadvantage in SDOH have immense potential to cause harm.<sup>7-10</sup> Given the prevalence of delays in PORT initiation beyond the recommended 6 weeks, we explore how delayed PORT affects survival outcomes, what factors are associated with delayed PORT initiation, and what interventions exist to reduce delays in PORT initiation.

We employ the PROGRESS-Plus health equity framework to guide our narrative review of the SDOH that impact the timeliness of PORT initiation and assessment of interventions to improve timely delivery of PORT.<sup>11</sup> PROGRESS-Plus is an acronym of factors demonstrated to stratify health opportunity and outcomes: place of residence, race/ethnicity/culture/language, occupation, gender/sex, religion, education, SES, and social capital, as well as other “Plus” factors, which include personal characteristics associated with discrimination such as disability, personal relationships such as having smoking parents, and time-dependent relationships such as postoperative course.<sup>11</sup> This equity-based narrative review method allows us to explicitly consider and describe the SDOH and clinical factors that may impact delays in PORT.

## 2 | METHODS

We conducted a PubMed literature search including terms for radiotherapy, delay, and squamous cell carcinoma of the head and neck which yielded 179 results. These articles and those in their reference lists were reviewed and included if they were full-length papers published in English in the year 2006 or later in a peer-reviewed journal in the United States which describe the time interval between surgery and adjuvant PORT. Review of these papers led to the emergence of three thematic questions to address: how does delayed PORT affect outcomes; what factors are associated with delayed PORT; and what interventions exist to reduce delays in PORT initiation. Our narrative review was guided by the PROGRESS-Plus health equity framework to respond to these thematic questions and describe the impact of equity-related factors and SDOH on timely PORT.<sup>11</sup> We conducted additional analysis of clinical and care process factors that emerged from our review as factors that may affect timely PORT.

## 3 | RESULTS

### 3.1 | How does delayed PORT affect outcomes?

The present NCCN guideline recommendation to initiate PORT within 6 weeks of surgery is based on a 1979 study at Memorial Sloan Kettering Cancer Center that found greater rates of locoregional recurrence among 22 head and neck cancer patients who started radiation treatment more than 7 weeks after surgery.<sup>3,12</sup> This was affirmed by subsequent retrospective studies and a meta-analysis that demonstrated significantly higher locoregional recurrence rates when PORT initiation was delayed beyond 6 weeks.<sup>3,13-15</sup>

In a recent systematic review of survival outcomes of delayed PORT initiation, four of five studies found a significant association between delayed PORT initiation and overall survival, and an even greater association with recurrence-free survival.<sup>5,16-19</sup> The study that did not find a significant association between delay and overall survival used study cohort quartiles to define delayed PORT as greater than 64 days.<sup>20</sup> Another study found PORT delay beyond 50 days to be associated with worse overall survival among 25 216 patients with nonmetastatic HNSCC.<sup>3</sup> These studies show that starting PORT within 6 weeks or less of surgery is associated with improved survival even with intensity-modulated radiation therapy and concurrent systemic therapy.<sup>19</sup> Delays in PORT initiation account for the majority of delays in radiation treatment package time, the interval from surgery to completion of radiation treatment, which is associated with significantly decreased overall survival.<sup>21,22</sup>

Increasing the delay time in PORT initiation is associated with even worse survival outcomes. Among 41 291 patients with HNSCC, increasing delays beyond 7 weeks were associated with progressive survival decrements.<sup>19</sup> Another study of 15 064 patients with HNSCC demonstrated that each subsequent day that PORT was delayed beyond 40 postoperative days led to increased mortality risk up to 70 postoperative days.<sup>23</sup>

### 3.2 | What factors are associated with delayed PORT?

Here, we report on the association of delayed PORT with each of the PROGRESS-Plus factors except religion, as we did not find reports of associations with PORT delay. We consider insurance status alongside occupation as these are commonly associated. We then explore additional clinical and care process factors that emerged from the literature as being associated with timely PORT, including clinical American Joint Committee on Cancer (AJCC) stage, comorbidities, postoperative course, treating facility, and complex care processes (Table 1).

#### 3.2.1 | Place of residence

Patients who resided closer to the treatment facility where they received radiation therapy demonstrated greater rates of timely

**TABLE 1** Equity-based factors associated with delayed postoperative radiation treatment (PORT) among head and neck squamous cell carcinoma (HNSCC) patients, based on the PROGRESS-Plus health equity framework

PROGRESS-Plus <sup>11</sup>	Factors associated with delayed PORT:
Place of residence	<ul style="list-style-type: none"> <li>Residing further from facility (&gt;20 miles) and experiencing barriers to travel<sup>2,25</sup></li> </ul>
Race/ethnicity/culture/language	<ul style="list-style-type: none"> <li>Black race, Asian race, Hispanic ethnicity               <ul style="list-style-type: none"> <li>Patients of color are more likely to have lower socioeconomic status (SES), reduced access to care, and present with more advanced stage cancer<sup>2,3,26-31</sup></li> </ul> </li> </ul>
Occupation/insurance status	<ul style="list-style-type: none"> <li>Medicaid/Medicare, health maintenance organization, or no insurance<sup>2,3</sup> <ul style="list-style-type: none"> <li>People who are under- or unemployed have limited access to health insurance<sup>50</sup></li> <li>People of color and of lower SES are more likely to be under- or unemployed and have Medicaid or no insurance<sup>26,33,46-49</sup></li> </ul> </li> </ul>
Gender/sex	<ul style="list-style-type: none"> <li>There is not enough evidence to declare a relationship between gender/sex and delayed PORT<sup>2,3</sup></li> </ul>
Education	<ul style="list-style-type: none"> <li>Lower levels of education<sup>2,3,31,48,54</sup></li> <li>Most patients are unaware of the 6-week guideline and clinical consequences of delaying radiation treatment<sup>25</sup></li> </ul>
SES	<ul style="list-style-type: none"> <li>Lower household income<sup>2,3</sup></li> <li>Lower income patients experience reduced access to care<sup>27,36</sup></li> </ul>
Advanced clinical stage at presentation	<ul style="list-style-type: none"> <li>Higher clinical or pathologic American Joint Committee on Cancer Stage IV HNSCC<sup>2,3</sup> <ul style="list-style-type: none"> <li>Patients of color, lower SES, Medicaid/no insurance, geographic disadvantage, decreased health literacy, and decreased overall access to care demonstrate increased stage at diagnosis<sup>27-29,31,36,48,51,59</sup></li> </ul> </li> </ul>
Comorbidities and clinical characteristics	<ul style="list-style-type: none"> <li>Having one or more comorbidities<sup>3</sup></li> <li>Oral cavity cancer compared to other primary cancer sites<sup>66</sup></li> </ul>
Postoperative course	<ul style="list-style-type: none"> <li>Increased postoperative length of stay and 30-day unplanned readmissions<sup>2,3</sup></li> </ul>
Treating facility	<ul style="list-style-type: none"> <li>There is not enough evidence to declare a relationship between treatment at academic centers and delayed PORT<sup>2,3,66</sup></li> </ul>
Complex care processes	<ul style="list-style-type: none"> <li>Delay at any point in the care process: lack of preoperative radiation consultation, pathology reports beyond 7 postoperative days, PORT referral beyond 10 days of surgery, and PORT consultation beyond 10 days of referral<sup>26</sup></li> <li>Receiving surgery and PORT at different facilities<sup>2,3</sup></li> </ul>

PORT.<sup>2</sup> This may be mediated by geographic distance as well as socioeconomic disadvantage, as areas characterized by lower education and income demonstrate a lower density of health care providers and reduced access to high-quality health care.<sup>11,24</sup> Residing 20 miles away from the treatment facility was associated with delayed PORT.<sup>2</sup> Patients often face challenges presenting for care due to travel distance and costs, inability to take time off work, family care obligations, and not having family or caregivers able to transport them.<sup>25</sup> Infrastructure to alleviate travel burden and promote equitable distribution of care and providers may improve outcomes among geographically marginalized patients.<sup>11</sup>

### 3.2.2 | Race/ethnicity/culture/language

The relationship between race/ethnicity and radiation treatment delay is complex and is a manifestation of systemic racism experienced by people of color.<sup>7-9</sup> Black and Asian race and Hispanic ethnicity were independent risk factors for delayed PORT compared to White patients and also demonstrate an association with SDOH correlated with delayed radiation treatment and access to care, including being un- or underinsured, lower SES, lower education, delayed stage at presentation, and having medical comorbidities.<sup>2,3,26-31</sup> These racial and ethnic disparities in timely PORT contribute to lower survival outcomes among people of color.<sup>32</sup>

African American patients had a significantly lower rate of preoperative radiation consultations than White patients, which may contribute to delayed PORT.<sup>26</sup> Patients of color are more likely to have Medicaid or no insurance, which limits timely access to radiation treatment.<sup>26,33</sup> Black patients are more likely to reside in under-resourced neighborhoods with lower education and lower income, which can limit access to health care and PORT.<sup>7,24</sup> Having a primary language other than English can further inhibit access to and navigation through health care services.<sup>34</sup> Patients of color are more likely to get care from low-volume providers, which is associated with higher rates of postoperative complications and delayed PORT.<sup>35</sup>

There are numerous known barriers to timely presentation among people of color. Compared to White patients, patients of color show lower health literacy and less widespread knowledge of warning signs of cancer and thus may be less likely to present for timely evaluation.<sup>36-38</sup> Black patients especially are more hesitant to present for care due to historical and ongoing racism and distrust of the medical system.<sup>39-43</sup> Patients of color have less access to regular preventative care and less contact with the medical system to discuss concerning symptoms in a timely manner.<sup>27,30,35</sup> Black patients are overall less likely to be screened for head and neck cancer than White patients, thus delaying their diagnosis.<sup>28,29</sup> Delayed presentation and diagnosis increases the likelihood of presenting with more advanced stages of cancer and is associated with delayed PORT.<sup>2,3,28,29</sup>

Overall, these differences suggest that care is accessed, administered, and performed differently at both the patient and systemic level for Black patients compared to White patients, which contributes to racial differences in timely PORT.

### 3.2.3 | Occupation/insurance status

Patients without insurance or with Medicaid or Medicare experienced greater odds of delayed PORT compared to those with private insurance.<sup>2,3</sup> Health maintenance organization (HMO) patients also demonstrate higher rates of delayed PORT.<sup>44</sup>

Delays related to insurance are multifaceted and are impacted by enrollment barriers, restrictive referral systems, and decreased physician participation. HNSCC patients engage in inherently multidisciplinary and complex care, often encompassing multiple facilities and providers to complete imaging studies, surgery, and pre- and postoperative care visits as well as coordination of varying providers including primary care physicians, speech therapists, dentists, nutritionists, surgical oncologists, radiation oncologists, and medical oncologists. Each facility and provider may have different insurance guidelines, creating potential for delayed transitions of care. HMO patients in particular face restrictive networks and often need preauthorization for each referral and transition in care, creating potential for delays.<sup>45</sup>

Access to health insurance is unequal and intersects with other SDOH including race/ethnicity and SES.<sup>30,46</sup> Patients without insurance or with Medicaid are more likely to be people of color and of lower SES, whereas patients with private insurance are more likely to be White, younger, and of higher SES.<sup>26,33,46-49</sup> For patients under 65, employment-based insurance is the main source, which puts patients who are unemployed at risk of limited access to health insurance.<sup>50</sup> Directly associated with structural racism, Black, Indigenous people, and people of color are more likely to be unemployed or have lower wage employment where insurance may be unavailable or unaffordable.<sup>30,33</sup> Finally, patients with private insurance have better access to the highest quality of health care, as private insurance reimburses physicians and hospitals at greater rates than Medicare/Medicaid.<sup>49</sup>

### 3.2.4 | Gender/sex

Although one study found male patients were more likely to experience delayed PORT compared to female patients, another study reported the opposite finding.<sup>2,3</sup> HNSCC is significantly more prevalent in male patients, which may affect these findings.<sup>2,24,36,51</sup> Male patients are more likely to experience postoperative complications that are associated with PORT delay and demonstrate worse overall survival compared to female patients.<sup>52</sup> Although there is not enough evidence to declare a relationship between gender/sex and delayed PORT, Mazul et al. found that although female patients with HNSCC had greater overall survival than males, Black female patients had

significantly worse survival rates than White and Hispanic male patients.<sup>53</sup> This interaction would be interesting to study in rates of delayed PORT.

### 3.2.5 | Education

Patients with lower levels of education were more likely to experience delayed PORT beyond 6 weeks compared to patients with a higher level of education.<sup>2,3</sup> Education is a key SDOH and driver of health equity. Higher levels of education are associated with greater SES, employment rates, and insurance enrollment, which are associated with timely PORT.<sup>2,3,31,48,54</sup> Education is a driver of health literacy, which promotes positive health-seeking behaviors and successful interaction with the health care system and providers.<sup>48,55</sup>

Knowledge of the importance of timely PORT significantly affected timeliness of radiation. In interviews of 27 HNSCC patients undergoing surgery and PORT, almost all patients were unaware of the 6-week guideline and the clinical consequences of delaying radiation treatment.<sup>25</sup> Providers noted that patients were frequently exhausted from long days at health care facilities visiting multiple providers and undergoing imaging and testing and therefore may not absorb all the information that is given to them.<sup>25</sup> Concerted efforts are needed to increase health literacy and provide proactive health education, particularly for underserved and minority patients.

### 3.2.6 | Socioeconomic status

Lower median household income was associated with greater likelihood of delayed PORT, whereas higher incomes are associated with timely PORT.<sup>2,3</sup> SES is a powerful determinant that acts through many agents to affect health outcomes and access to care, including housing, nutrition, education, economic opportunity, living environment, and insurance.<sup>48</sup> Lower SES is a risk factor for receiving lower quality health care.<sup>48</sup> Those residing in low-income areas face lower numbers of care facilities and providers, particularly specialists.<sup>27,36</sup> Travel burden and inability to take time off work is a significant socioeconomic barrier and reason for treatment delay.<sup>25</sup> Patients who are un- or underemployed may lack benefits such as health insurance, paid sick leave, and disability insurance, which may worsen their financial status and make it more difficult to attend medical appointments in a timely manner.<sup>33,56,57</sup>

### 3.2.7 | Advanced clinical stage at presentation

Patients who presented with a higher clinical or pathological AJCC Stage IV HNSCC demonstrated greater odds of delayed PORT compared to those who presented with AJCC Stage I and Stage III cancers.<sup>2,3</sup> Patients who present with more advanced stage head and neck cancer require more aggressive surgical treatment, often require more complex reconstruction, face more postoperative complications, and have longer stays in the hospital, which further delay radiation

treatment.<sup>27,51,58</sup> Patients of color, lower SES, Medicaid or no insurance, geographic disadvantage, decreased health literacy, and decreased overall access to care exemplify SDOH that intersect to impact increased stage at diagnosis and subsequent delayed PORT.<sup>27-29,31,36,48,51,59</sup> Lower SES is associated with less health-seeking behavior, health care utilization, and lower health literacy, making socioeconomically disadvantaged patients less likely to present for timely evaluation.<sup>48</sup> Psychosocial influences such as medical mistrust are associated with lower rates of screening and delays in presenting for care.<sup>39-42</sup> Patients of lower SES are overall less likely to be screened than their higher SES counterparts.<sup>27,36</sup>

### 3.2.8 | Comorbidities and clinical characteristics

Patients with one or more comorbidities were less likely to receive timely PORT than those without comorbidities.<sup>3</sup> Comorbidities are associated with lower quality care, including decreased likelihood of receiving NCCN guideline-concordant care.<sup>60,61</sup> Increasing comorbidities in HNSCC patients are associated with increased postoperative complications and longer duration of hospitalization, which are associated with delayed PORT.<sup>3,61,62</sup> Comorbidities affect the timeliness of diagnosis and the choice of adjuvant treatment offered, which also delay PORT.<sup>26,61</sup> Comorbidities are present in patients inequitably, as Black patients and patients of lower SES are more likely to have medical comorbidities than White patients and those of higher SES.<sup>30,63-65</sup>

Patients with oral cavity cancer were more likely to experience PORT delays than those with primary tumor site of the oropharynx, hypopharynx, or larynx.<sup>66</sup> Patients with oral cavity cancer often face more complex reconstructions, such as with fibular flaps, and thus are correlated with longer postoperative stays and complications that contribute to delays in radiation.<sup>2,3,67</sup>

### 3.2.9 | Postoperative course

Increasing postoperative length of stay (LOS) beyond 4 days was associated with significantly increased odds of delayed PORT, particularly beyond 15 days.<sup>2,3</sup> Having 30-day unplanned readmissions was associated with delays in PORT.<sup>2</sup> These measures are considered quality metrics in head and neck cancer care due to their relation to survival.<sup>62</sup> Postsurgical sequelae including delayed wound healing and other clinical complications can delay discharge or lead to readmission, often leading to delayed radiation referrals and missed appointments.<sup>68</sup> Surgical complications may require time for healing before radiation treatment.<sup>68</sup>

### 3.2.10 | Treating facility

Many studies found that surgery or radiation at an academic medical center compared to a nonacademic center was associated with delayed PORT initiation.<sup>2,3,66</sup> Another study found that delays were

more common at a nonacademic center.<sup>69</sup> Academic medical centers tend to care for more complex patients and may serve as a proxy for patient complexity contributing to delayed PORT and higher rates of postoperative complications and longer hospital LOS.<sup>2,3,70,71</sup> There is not enough evidence to suggest a relationship between treatment at academic centers and delayed PORT, and this would be an interesting area for future study.

### 3.2.11 | Complex care processes

The complex and multidisciplinary nature of head and neck cancer care, often involving multiple appointments, procedures, providers, and facilities over a long period of time, compounds the potential for delays in care. Timeliness at all points in the care process was found to be important for timely PORT.<sup>26</sup> Having a preoperative radiotherapy consultation was associated with timely PORT.<sup>26</sup> Patients whose pathology reports returned within 7 postoperative days and those who received a PORT referral within 10 days of surgery and PORT consultation within 10 days of PORT referral were more likely to receive timely PORT.<sup>26</sup> Delays were most common in initial primary care referral to surgeons and initiation of radiation treatment after surgery.<sup>44</sup>

Patients who received their surgery and PORT at different facilities were more likely to experience delayed PORT.<sup>2,3</sup> During transitions in care, it may be unclear to patients and providers who are directing the next steps in care. Insufficient coordination and communication during care transitions can delay PORT referrals and consultations and prolong the start of radiation treatment.<sup>25</sup> Surgical and radiation oncologists may not have the same familiarity of the recommended timeline and particular consequences of delaying radiation treatment for head and neck cancer patients and furthermore may not communicate important and relevant information during care transitions, such as what treatment patients received and what treatment is necessary.<sup>25</sup> Providers face cumbersome patient handoffs, having to reconcile differing electronic health records or fax over hundreds of pages of records, leading to further delays in care.<sup>25</sup> On the other hand, receiving PORT at the same center can facilitate timely care due to improved communication and accessibility of medical records.<sup>26</sup>

Delayed dental evaluations and extractions were strongly associated with delayed PORT.<sup>68,72</sup> Patients receiving radiation to the head and neck require dental evaluation and imaging and may need extractions before receiving radiation treatment to reduce the risk of osteoradionecrosis.<sup>68,72,73</sup> Patients' preferred or local dentists may be unfamiliar with the specific needs for these patients in the context of their treatment.<sup>25</sup> Furthermore, dental care can be challenging to coordinate in a timely manner and may depend upon insurance and access to care, and significant out-of-pocket costs from the patient.<sup>74</sup>

### 3.2.12 | Summary

Delays starting PORT disproportionately burden people of color, those with Medicaid or no insurance, those of low SES, and those with overall

less access to care. Care is accessed and performed differently at both the patient and systemic levels according to patients' characteristics, which contributes to disparities in timely PORT. Delays are more common among patients with more comorbidities, advanced stage of disease, those who experience postoperative complications, and at transitions of care. These complex factors intersect to produce conditions that predictably predispose certain patients to delayed PORT.

### 3.3 | What interventions exist to reduce delays in PORT initiation?

Many of the delays in PORT are related to deeply rooted systemic inequities that must be targeted on a large scale. Recognizing that systemic change occurs slowly, patients need timely PORT care immediately; therefore, local interventions that mitigate avoidable delays, streamline care, and support patients through their treatment may help improve the timeliness of PORT. Some factors associated with delayed PORT are modifiable and may be targeted directly by interventions, such as a patient's insurance status and transitions in care. Others are non-modifiable, such as a patient's race/ethnicity, though interventions may target mediating factors such as access to care. We surveyed the literature for interventions aimed at reducing delays in PORT.

Methods to identify patients at a high risk for delay can help direct resources and interventions to those with the greatest need. Levy et al. developed validated nomograms to generate estimates of PORT initiation delay personalized to each patient, incorporating race/ethnicity, insurance, tumor site, and facility type (academic or nonacademic).<sup>66</sup> They developed two nomograms: one based on preoperative factors including clinical stage and comorbidity and one based on postoperative factors including LOS and care fragmentation.<sup>66</sup> Shew et al. used machine learning to predict delays beyond 50 days in adjuvant radiation after surgery for HNSCC, based on patient and care process factors, most importantly treating facility and urban vs rural patient demographic.<sup>75</sup>

The Stanford Head and Neck Cancer Oncology Program conducted an institutional quality improvement project to reduce delays in PORT initiation.<sup>72</sup> From chart reviews of 56 patients with oral cavity carcinoma patients who underwent surgery and radiation, the team identified three key drivers of PORT delay: delayed dental extractions, delayed radiation oncology initial consult, and poor patient engagement. They developed 12 interventions to address these drivers of delay. All patients with oral cavity cancer received a preoperative Panorex scan and attended a formal dental consultation if needed. Any necessary dental extractions were performed pre- or intraoperatively. Consultations with radiation oncology occurred earlier in the care pathway, as soon as the need for adjuvant treatment was identified. If pathology reports were the deciding factor to consult radiation oncology, a 10-day postoperative reminder was sent via the electronic medical record (EMR) to the surgical oncologist. To increase patient engagement, the team developed a Clinical Visit Summary, a checklist to outline the important elements and timelines of the patient's individual care pathway. Compared to 62% of patients receiving timely

PORT before the intervention, 73% achieved timely PORT afterward, and avoidable delays were decreased from 24% to 9%.<sup>72</sup>

Another quality improvement project developed by Graboyes et al. called Navigation for Disparities and Untimely Radiation Therapy (NDURE) centers on social workers as dedicated patient navigators who met with patients for three in-person sessions to support them through their treatment.<sup>76</sup> The intervention focused on patient education, including a personalized risk estimate of PORT delay and discussion of expectations for PORT.<sup>66,76</sup> They developed a personalized PORT care plan to keep in the EMR for each patient with a barrier reduction plan to address their particular barriers. The patient navigator scheduled all appointments and tracked referrals and appointment completion, and patients were provided with travel assistance. NDURE was tested in 15 patients with HNSCC undergoing surgery and PORT in a single-arm clinical trial and resulted in timely PORT for 86% of patients overall and 100% of Black patients.<sup>76</sup>

Developing ways to predict the risk of delay is an important step to understand who is at risk and focus resources and attention on those at risk. Targeted interventions such as NDURE demonstrate high rates of timely PORT when specifically attending to access to care and providing support and resources through transitions in care.

## 4 | CONCLUSION

HNSCC patient outcomes are heavily dependent on their ability to access care, including PORT, in a timely manner. PORT delays are more apparent in transitions in care and in complex and advanced-stage patients and present inequitably along common fault lines of race/ethnicity, SES, and insurance status, likely contributing significantly to disparities in overall survival of HNSCC patients. These disparities mandate continued need for structural change to reduce health disparities and promote equitable access to care for all, with particular focus on underserved and minority patients. When planning care, providers must consider not only biological factors but also SDOH to maximize care outcomes. Delays in PORT may be reduced by interventions to identify patients who are most likely to experience delayed PORT, provide support according to their specific needs and barriers to care, and streamline overall care and referral processes.

### CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### ORCID

Elizabeth A. Noyes  <https://orcid.org/0000-0003-4656-4269>

Ciersten A. Burks  <https://orcid.org/0000-0002-9377-5715>

### BIBLIOGRAPHY

1. Harris BN, Pipkorn P, Nguyen KNB, et al. Association of Adjuvant Radiation Therapy with survival in patients with advanced cutaneous squamous cell carcinoma of the head and neck. *JAMA Otolaryngol Head Neck Surg.* 2019;145(2):153-158. doi:10.1001/jamaoto.2018.3650

2. Graboyes EM, Garrett-Mayer E, Sharma AK, Lentsch EJ, Day TA. Adherence to National Comprehensive Cancer Network guidelines for time to initiation of postoperative radiation therapy for patients with head and neck cancer. *Cancer*. 2017;123(14):2651-2660. doi:10.1002/cncr.30651
3. Harris JP, Chen M, Orosco RK, Sirjani D, Divi V, Hara W. Association of survival with shorter time to radiation therapy after surgery for US patients with head and neck cancer. *JAMA Otolaryngol Head Neck Surg*. 2018;144(4):349-359. doi:10.1001/jamaoto.2017.3406
4. National Comprehensive Cancer Network. *NCCN Clinical Practice Guidelines in Oncology: Head and Neck Cancers*. Vol 3; 2021. [https://www.nccn.org/professionals/physician\\_gls/pdf/head-and-neck.pdf](https://www.nccn.org/professionals/physician_gls/pdf/head-and-neck.pdf)
5. Graboyes EM, Kompelli AR, Neskey DM, et al. Association of Treatment Delays with survival for patients with head and neck cancer: a systematic review. *JAMA Otolaryngol Head Neck Surg*. 2019;145(2):166-177. doi:10.1001/jamaoto.2018.2716
6. Bergmark RW, Sedaghat AR. Disparities in health in the United States: an overview of the social determinants of health for otolaryngologists. *Laryngoscope Investig Otolaryngol*. 2017;2(4):187-193. doi:10.1002/lio2.81
7. Bailey ZD, Feldman JM, Bassett MT. How structural racism works – racist policies as a root cause of U.S. racial health inequities. *N. Engl. J. Med*. 2021;384(8):768-773. doi:10.1056/nejmms2025396
8. Hardeman RR, Medina EM, Boyd RW. Stolen breaths. *N Engl J Med*. 2020;383(3):197-199. doi:10.1056/NEJMp2021072
9. Lee BX. *Structural Violence. Violence: an Interdisciplinary Approach to Causes, Consequences, and Cures*. 1st ed. Oxford, UK: John Wiley & Sons, Inc; 2019:123-142.
10. Farmer PE, Nizeye B, Stulac S, Keshavjee S. Structural violence and clinical medicine. *PLoS Med*. 2006;3(10):1686-1691. doi:10.1371/journal.pmed.0030449
11. O'Neill J, Tabish H, Welch V, et al. Applying an equity lens to interventions: using PROGRESS ensures consideration of socially stratifying factors to illuminate inequities in health. *J Clin Epidemiol*. 2014; 67(1):56-64. doi:10.1016/j.jclinepi.2013.08.005
12. Vikram B. Importance of the time interval between surgery and postoperative radiation therapy in the combined management of head & neck cancer. *Int J Radiat Oncol Biol Phys*. 1979;5(10):1837-1840. doi:10.1016/0360-3016(79)90568-6
13. Vikram B, Strong EW, Shah JP, Spiro R. Failure in the neck following multimodality treatment for advanced head and neck cancer. *Head Neck Surg*. 1984;6(3):724-729. doi:10.1002/hed.2890060304
14. Mantravadi RVP, Haas RE, Liebnik EJ, Skolnik EM, Applebaum EL. Postoperative radiotherapy for persistent tumor at the surgical margin in head and neck cancers. *Laryngoscope*. 1983;93(10):1337-1340. doi:10.1002/lary.1983.93.10.1337
15. Huang J, Barbera L, Brouwers M, Browman G, Mackillop WJ. Does delay in starting treatment affect the outcomes of radiotherapy? A systematic review. *J Clin Oncol*. 2003;21(3):555-563. doi:10.1200/JCO.2003.04.171
16. Tam M, Wu SP, Gerber NK, et al. The impact of adjuvant chemoradiotherapy timing on survival of head and neck cancers. *Laryngoscope*. 2018;128(10):2326-2332. doi:10.1002/lary.27152
17. Chen MM, Harris JP, Orosco RK, Sirjani D, Hara W, Divi V. Association of Time between surgery and adjuvant therapy with survival in Oral cavity cancer. *Otolaryngol Head Neck Surg*. 2018;158(6):1051-1056. doi:10.1177/0194599817751679
18. Cramer JD, Speedy SE, Ferris RL, Rademaker AW, Patel UA, Samant S. National evaluation of multidisciplinary quality metrics for head and neck cancer. *Cancer*. 2017;123(22):4372-4381. doi:10.1002/cncr.30902
19. Graboyes EM, Garrett-Mayer E, Ellis MA, et al. Effect of time to initiation of postoperative radiation therapy on survival in surgically managed head and neck cancer. *Cancer*. 2017;123(24):4841-4850. doi:10.1002/cncr.30939
20. Fujiwara RJT, Judson BL, Yarbrough WG, Husain Z, Mehra S. Treatment delays in oral cavity squamous cell carcinoma and association with survival. *Head Neck*. 2017;39(4):639-646. doi:10.1002/hed.24608
21. Daniels CP, Bressel M, Corry J, et al. Treatment package time in node-positive cutaneous head and neck squamous cell carcinoma. *Pract Radiat Oncol*. 2019;10(1):29-35. doi:10.1016/j.prro.2019.09.009
22. Goel AN, Frangos MI, Raghavan G, et al. The impact of treatment package time on survival in surgically managed head and neck cancer in the United States. *Oral Oncol*. 2019;88:39-48. doi:10.1016/j.oraloncology.2018.11.021
23. Ho AS, Kim S, Tighiouart M, et al. Quantitative survival impact of composite treatment delays in head and neck cancer. *Cancer*. 2018; 124(15):3154-3162. <http://www.ncbi.nlm.nih.gov/pubmed/29742280>
24. Gourin CG, Podolsky RH. Racial disparities in patients with head and neck squamous cell carcinoma. *Laryngoscope*. 2006;116(7):1093-1106. doi:10.1097/01.mlg.0000224939.61503.83
25. Graboyes EM, Halbert CH, Li H, et al. Barriers to the delivery of timely, guideline-adherent adjuvant therapy among patients with head and neck cancer. *JCO Oncol Pract*. 2020;16(12):e1417-e1432. doi:10.1200/op.20.00271
26. Janz TA, Kim J, Hill EG, et al. Association of care processes with timely, equitable postoperative radiotherapy in patients with surgically treated head and neck squamous cell carcinoma. *JAMA Otolaryngol Head Neck Surg*. 2018;144(12):1105-1114. <http://www.ncbi.nlm.nih.gov/pubmed/30347012>
27. Rereddy SK, Jordan DR, Moore CE. Dying to be screened: exploring the unequal burden of head and neck cancer in health provider shortage areas. *J Cancer Educ*. 2015;30(3):490-496. doi:10.1007/s13187-014-0755-2
28. Ling H, Gadalla S, Israel E, et al. Oral cancer exams among cigarette smokers in Maryland. *Cancer Detect Prev*. 2006;30(6):499-506. doi:10.1016/j.cdp.2006.10.005
29. Dodd VJ, Watson JM, Choi Y, Tomar SL, Logan HL. Oral cancer in African Americans: addressing health disparities. *Am J Health Behav*. 2006;32(6):684-692. doi:10.5555/ajhb.2008.32.6.684
30. Yearby R. Racial disparities in health status and access to healthcare: the continuation of inequality in the United States due to structural racism. *Am J Econ Sociol*. 2018;77(3-4):1113-1152. doi:10.1111/ajes.12230
31. Zajacova A, Lawrence EM. The relationship between education and health: reducing disparities through a contextual approach. *Annu Rev Public Health*. 2018;39(3):273-289. doi:10.1146/annurev-publhealth-031816-044628
32. Guttmann DM, Kobie J, Grover S, et al. National disparities in treatment package time for resected locally advanced head and neck cancer and impact on overall survival. *Head Neck*. 2018;40(6):1147-1155. doi:10.1002/hed.25091
33. Lillie-Blanton M, Hoffman C. The role of health insurance coverage in reducing racial/ethnic disparities in health care. *Health Aff*. 2005; 24(2):398-408. doi:10.1377/hlthaff.24.2.398
34. Pearson WS, Ahluwalia IB, Ford ES, Mokdad AH. Language preference as a predictor of access to and use of healthcare services among Hispanics in the United States. *Ethn Dis*. 2008;18(1):93-97. <http://www.ncbi.nlm.nih.gov/pubmed/18447107>
35. Bulatao RA, Anderson NB. *Understanding racial and ethnic differences in health in late life: a research*. Washington (DC): National Academies Press; 2004.
36. Goodwin WJ, Thomas GR, Parker DF, et al. Unequal burden of head and neck cancer in the United States. *Head Neck*. 2008;30(3):358-371. doi:10.1002/hed.20710
37. Berkman ND, Sheridan SL, Donahue KE, et al. Health literacy interventions and outcomes: an updated systematic review. Evidence report/technology Assessment no. 199. *Evid Rep Technol Assess (Full Rep)*. 2011;(199):1-941. <http://www.ncbi.nlm.nih.gov/pubmed/23126607>

38. Villagra VG, Bhuvu B, Coman E, Smith DO, Fifield J. Health insurance literacy: disparities by race, ethnicity, and language preference. *Am J Manag Care*. 2019;25(3):E71-E75.
39. Adegbenbo AO, Frnd C, Tomar SL, Logan HL. Perception of racism explains the difference between Blacks' and Whites' level of healthcare trust. *Ethn Dis*. 2006;16(4):792-798.
40. Adams LB, Richmond J, Corbie-Smith G, Powell W. Medical mistrust and colorectal cancer screening among African Americans. *J Community Health*. 2017;42(5):1044-1061. doi:10.1007/s10900-017-0339-2
41. Powell W, Richmond J, Mohottige D, Yen I, Joslyn A, Corbie-Smith G. Medical mistrust, racism, and delays in preventive health screening among African-American men. *Behav Med*. 2019;45(2):102-117. doi:10.1080/08964289.2019.1585327
42. Jaiswal J, Halkitis PN. Towards a more inclusive and dynamic understanding of medical mistrust informed by science. *Behav Med*. 2017;45(2):79-85. doi:10.1080/08964289.2019.1619511
43. Johnson RL, Saha S, Arbelaez JJ, Beach MC, Cooper LA. Racial and ethnic differences in patient perceptions of bias and cultural competence in health care. *J Gen Intern Med*. 2004;19(2):101-110. doi:10.1111/j.1525-1497.2004.30262.x
44. Itamura K, Kokot N, Sinha U, Swanson M. Association of insurance type with time course of care in head and neck cancer management. *Laryngoscope*. 2020;130(11):E587-E592. doi:10.1002/lary.28423
45. Chernew ME, Wodchis WP, Scanlon DP, McLaughlin CG. Overlap in HMO physician networks. *Health Aff*. 2004;23(2):91-101. doi:10.1377/hlthaff.23.2.91
46. Young GJ, Cohen BB. The process and outcome of hospital care for Medicaid versus privately insured hospital patients. *Inquiry*. 1992;29(3):366-371. <http://www.ncbi.nlm.nih.gov/pubmed/1398905>
47. Kirby JB, Kaneda T. Coverage using a life table approach \*. *Demography*. 2010;47(4):1035-1051.
48. Fiscella K, Franks P, Gold MR, Clancy CM. Inequality in quality: addressing socioeconomic, racial, and ethnic disparities in health care. *JAMA Otolaryngol Head Neck Surg*. 2000;283(19):2579. doi:10.1001/jama.283.19.2579
49. Akinjemiju T, Sakhuja S, Vin-Raviv N. Racial and socio-economic disparities in breast cancer hospitalization outcomes by insurance status. *Cancer Epidemiol*. 2016;43:63-69. doi:10.1016/j.canep.2016.06.011
50. Yabroff KR, Dowling EC, Guy GP, et al. Financial hardship associated with cancer in the United States: findings from a population-based sample of adult cancer survivors. *J Clin Oncol*. 2016;34(3):259-267. doi:10.1200/JCO.2015.62.0468
51. Osazuwa-Peters N, Christopher KM, Hussaini AS, Behera A, Walker RJ, Varvares MA. Predictors of stage at presentation and outcomes of head and neck cancers in a university hospital setting. *Head Neck*. 2016;38(5):E1826-E1832. doi:10.1002/hed.24327
52. Shepherd SJ, Creber N, Mansour K, Wiesenfeld D, Iseli TA, Amott D. Relationship between age, comorbidities and complications in head and neck cancer patients undergoing curative surgery. *ANZ J Surg*. 2020;90(5):851-855. doi:10.1111/ans.15611
53. Mazul AL, Naik AN, Zhan KY, et al. Gender and race interact to influence survival disparities in head and neck cancer. *Oral Oncol*. 2021;112:105093. doi:10.1016/j.oraloncology.2020.105093
54. Hahn RA, Truman BI. Education improves public health and promotes health equity. *Int J Health Serv*. 2015;45(4):657-678. doi:10.1177/0020731415585986
55. Stormacq C, van den Broucke S, Wosinski J. Does health literacy mediate the relationship between socioeconomic status and health disparities? *Health Promot Int*. 2019;34(5):E1-E17. doi:10.1093/heapro/day062
56. Carroll WR, Kohler CL, Carter VL, Hannon L, Skipper JB, Rosenthal EL. Barriers to early detection and treatment of head and neck squamous cell carcinoma in African American men. *Head Neck*. 2009;31(12):1557-1562. doi:10.1002/hed.21125
57. Tangka FKL, Subramanian S, Jones M, et al. Insurance coverage, employment status, and financial well-being of Young women diagnosed with breast cancer. *Cancer Epidemiol, Biomarkers Prev*. 2020;29(3):616-624. doi:10.1158/1055-9965.EPI-19-0352
58. de Melo GM, de Cássia Braga Ribeiro K, Kowalshi LP, Deheinzeln D. Risk factors for postoperative complications in oral cancer and their prognostic implications. *Arch Otolaryngol Head Neck Surg*. 2001;127(7):828-833.
59. Panth N, Simpson MC, Sethi R, Varvares MA, Osazuwa-Peters N. Insurance status, stage of presentation, and survival among female patients with head and neck cancer. *Laryngoscope*. 2020;130(2):385-391. doi:10.1002/lary.27929
60. Chen MM, Roman SA, Yarbrough WG, Burtness BA, Sosa JA, Judson BL. Trends and variations in the use of adjuvant therapy for patients with head and neck cancer. *Cancer*. 2014;120(21):3353-3360. doi:10.1002/cncr.28870
61. Sinha P, Kallogjeri D, Piccirillo JF. Assessment of comorbidities in surgical oncology outcomes. *J Surg Oncol*. 2014;110(5):629-635. doi:10.1002/jso.23723
62. Weber RS, Lewis CM, Eastman SD, et al. Quality and performance indicators in an academic Department of Head and Neck Surgery. *Arch Otolaryngol Head Neck Surg*. 2010;136(12):1212-1218. doi:10.1001/archoto.2010.215
63. Tammemagi CM, Nerenz D, Neslund-Dudas C, Feldkamp C, Nathanson D. Comorbidity and survival disparities among black and white patients with breast cancer. *JAMA*. 2005;294(14):1765-1772. doi:10.1001/jama.294.14.1765
64. Pathirana TI, Jackson CA. Socioeconomic status and multimorbidity: a systematic review and meta-analysis. *Aust N Z J Public Health*. 2018;42(2):186-194. doi:10.1111/1753-6405.12762
65. de CB RK, Kowalski LP, do RDDO LM. Perioperative complications, comorbidities, and survival in oral or oropharyngeal cancer. *Arch Otolaryngol Head Neck Surg*. 2003;129(2):219-228. doi:10.1001/archotol.129.2.219
66. Levy DA, Li H, Sterba KR, et al. Development and validation of Nomograms for predicting delayed postoperative radiotherapy initiation in head and neck squamous cell carcinoma. *JAMA Otolaryngol Head Neck Surg*. 2020;146(5):455-464. doi:10.1001/jamaoto.2020.0222
67. Lahtinen S, Koivunen P, Ala-Kokko T, et al. Complications and outcome after free flap surgery for cancer of the head and neck. *Br J Oral Maxillofac Surg*. 2018;56(8):684-691. doi:10.1016/j.bjoms.2018.07.009
68. Strohl MP, Chen JP, Ha PK, Seth R, Yom SS, Heaton CM. Can early dental extractions reduce delays in postoperative radiation for patients with advanced Oral cavity carcinoma? *J Oral Maxillofac Surg*. 2019;77(11):2215-2220. doi:10.1016/j.joms.2019.05.007
69. George JR, Yom SS, Wang SJ. Combined modality treatment outcomes for head and neck cancer: comparison of postoperative radiation therapy at academic vs nonacademic medical centers. *JAMA Otolaryngol Head Neck Surg*. 2013;139(11):1118-1126. doi:10.1001/jamaoto.2013.4539
70. Burke L, Khullar D, John Orav E, Zheng J, Frakt A, Jha AK. Do academic medical centers disproportionately benefit the sickest patients? *Health Aff*. 2018;37(6):864-872. doi:10.1377/hlthaff.2017.1250
71. George JR, Yom SS, Wang SJ. Improved outcomes in adjuvant radiotherapy for oral cavity carcinoma at an academic center: a matched-pair analysis. *Laryngoscope*. 2014;124(7):1603-1608. doi:10.1002/lary.24552
72. Divi V, Chen MM, Hara W, et al. Reducing the time from surgery to adjuvant radiation therapy: an institutional quality improvement project. *Otolaryngol Head Neck Surg*. 2018;159(1):158-165. doi:10.1177/0194599818768254
73. Wang T-H, Liu C-J, Chao T-F, Chen T-J, Hu Y-W. Risk factors for and the role of dental extractions in osteoradionecrosis of the jaws: a national-based cohort study. *Head Neck*. 2017;39(7):1313-1321. doi:10.1002/hed.24761
74. Okunseri C, Bajorunaite R, Abena A, Self K, Iacopino AM, Flores G. Racial/ethnic disparities in the acceptance of Medicaid patients in dental practices. *J Public Health Dent*. 2008;68(3):149-153. doi:10.1111/j.1752-7325.2007.00079.x



75. Shew M, New J, Bur AM. Machine learning to predict delays in adjuvant radiation following surgery for head and neck cancer. *Otolaryngol Head Neck Surg.* 2019;160(6):1058-1064. doi:10.1177/0194599818823200
76. Graboyes EM, Sterba KR, Li H, et al. Development and evaluation of a navigation-based, multilevel intervention to improve the delivery of timely, guideline-adherent adjuvant therapy for patients with head and neck cancer. *JCO Oncol Pract.* 2021;17(10):e1512-e1523. doi:10.1200/op.20.00943

**How to cite this article:** Noyes EA, Burks CA, Larson AR, Deschler DG. An equity-based narrative review of barriers to timely postoperative radiation therapy for patients with head and neck squamous cell carcinoma. *Laryngoscope Investigative Otolaryngology.* 2021;6(6):1358-1366. doi:10.1002/lio2.692