

## ***Integrating Pharmacotherapy with Multidisciplinary Rehabilitation after Oral Cancer Treatment***

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### **Abstract**

*Background: Oral cancer treatment frequently causes persistent impairments in swallowing, mastication, speech, salivary and oral function, nutrition, physical capacity, and social participation. Rehabilitation is increasingly recognized as a continuum of care spanning pre-treatment, active treatment, and survivorship, yet medication management is rarely considered explicitly within the rehabilitation pathway. Objective: This narrative review examined how pharmacotherapy and pharmaceutical care may be integrated with multidisciplinary rehabilitation after oral cancer treatment. Methods: Targeted literature searches identified evidence on oral and head and neck cancer rehabilitation, treatment-related symptoms, supportive pharmacotherapy, medication-related problems, and clinical-pharmacy services. Systematic reviews, meta-analyses, randomized trials, clinical guidance, and directly relevant observational studies were prioritized, and the evidence was synthesized thematically with emphasis on functional outcomes and multidisciplinary care. Results: Current evidence supports rehabilitation addressing swallowing, jaw mobility, speech, oral health, nutrition, exercise, shoulder function, and participation, although intervention protocols and outcome measures remain heterogeneous. Symptom-directed pharmacotherapy is relevant to pain, xerostomia, and mucositis. Medication-related problems are also common in head and neck cancer, and clinical-pharmacist services can identify and address these problems. However, direct evidence linking structured pharmaceutical care to rehabilitation participation and functional outcomes remains limited. Discussion: A five-stage, function-oriented pharmacotherapy–rehabilitation interface is therefore proposed as a hypothesis-generating framework rather than an established treatment algorithm. Conclusion: Integrating medication review with multidisciplinary rehabilitation may improve coordination of supportive care, but prospective studies are needed to determine whether this approach improves functional and patient-reported outcomes.*

**Keywords:** oral cancer; pharmacotherapy; pharmaceutical care; rehabilitation; head and neck cancer

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### **1. INTRODUCTION**

Oral cancer is associated with substantial treatment-related morbidity, and functional consequences may persist after completion of cancer-directed therapy. Surgery, radiotherapy, and systemic treatment can affect swallowing, speech, mastication, oral intake, salivary function, pain, and physical capacity. Recent global cancer data underscore the continuing burden of cancer, while contemporary reviews of oral cavity cancer identify dysphagia and dysphonia as important treatment-related sequelae.[1,2]

The functional burden is multidimensional. A recent narrative review of treatment complications identified mucositis, dysphagia, xerostomia, trismus, chewing difficulty, speech impairment, and other persistent functional problems as important rehabilitation targets after head and neck cancer treatment.[3] These impairments may interact: pain or mucositis can restrict oral intake; xerostomia can impair swallowing and speech; trismus can limit chewing and oral hygiene; and treatment-related deconditioning can further reduce activity and participation. Quality of life is therefore influenced not only by disease control but also by the patient's ability to eat, communicate, exercise, and participate in daily life.[2,3]

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Rehabilitation is therefore better viewed as a longitudinal component of cancer care rather than an intervention reserved for the post-treatment period. An updated scoping review identified 83 interventional studies in head and neck cancer rehabilitation, with swallowing, jaw function, whole-body exercise, and voice among the most frequently studied targets.[4]

Another scoping review of rehabilitation during treatment included 27 studies; 59% reported primary outcomes within the ICF impairment domain, supporting greater attention to activity and participation.[5] National multidisciplinary guidance also supports speech and swallowing rehabilitation and oral rehabilitation as complementary components of head and neck cancer care.[6,7]

At the same time, medication-related problems are clinically relevant in head and neck oncology. Repeated medication reviews in patients receiving chemoradiotherapy identified drug-drug interactions, adverse drug reactions, inappropriate treatment duration, and inappropriate dosage intervals as recurrent problems.[8] In a prospective multicenter study of 104 patients, clinical-pharmacist services addressed medication-related problems and were associated with stable quality-adjusted life-year measures during chemotherapy, whereas the control group showed a decline.[9] These findings provide a rationale for examining how medication optimization might support rehabilitation, but they do not establish that pharmaceutical care improves rehabilitation outcomes.

This narrative review therefore addresses a specific interface: how pharmacotherapy and pharmaceutical care may be incorporated into a multidisciplinary rehabilitation pathway after oral cancer treatment. The objective is not to propose medication as a substitute for rehabilitation, but to identify symptom and medication-related barriers that may be modifiable and to map these barriers onto functional rehabilitation goals. The central evidence gap is whether this integration improves activity, participation, adherence, or quality of life beyond standard multidisciplinary care.

## **2. METHODS**

### **2.1 Review Design**

This article was developed as a narrative review. A targeted literature search was used to identify high-relevance evidence across oral oncology, cancer rehabilitation, swallowing and trismus rehabilitation, supportive pharmacotherapy, and pharmaceutical care. Because this was not a systematic review, the search was used to inform thematic synthesis rather than to estimate pooled treatment effects or claim exhaustive retrieval.

### **2.2 Literature Identification**

Targeted searches were performed using combinations of terms related to oral cancer, head and neck cancer, rehabilitation, dysphagia, trismus, xerostomia, oral rehabilitation, swallowing exercise, exercise therapy, pharmacotherapy, medication-related problems, clinical pharmacist, and pharmaceutical care. PubMed-indexed records and publisher/journal records were used to verify bibliographic details. Recent systematic reviews, meta-analyses, randomized trials, clinical guidance, and directly relevant observational studies were prioritized, with older studies retained when they provided foundational evidence. Because oral-cancer-specific rehabilitation evidence is limited for some functional domains, directly relevant head and neck cancer evidence was also considered when the intervention and outcome were applicable to patients treated for oral cavity cancer.

### **2.3 Evidence Synthesis**

Evidence was synthesized thematically across six domains: (1) treatment-related functional consequences; (2) swallowing, trismus, exercise, and oral rehabilitation; (3) symptom-directed pharmacotherapy; (4) medication-related problems and pharmaceutical care; (5) multidisciplinary and longitudinal rehabilitation; and (6) research gaps at the pharmacotherapy–rehabilitation interface. Evidence strength was interpreted according to study design and directness rather than by assigning a formal quality score.

### **2.4 Interpretation of Evidence**

Claims concerning established clinical practice were distinguished from proposed applications. Where direct

evidence connecting pharmaceutical care with rehabilitation outcomes was unavailable, the relationship is presented as a hypothesis-generating clinical framework rather than an established treatment recommendation.

### 3. RESULTS

#### 3.1 Functional Consequences After Oral Cancer Treatment

The functional consequences of oral cancer treatment are multidimensional. Dysphagia and dysphonia may arise from anatomic alteration, tissue fibrosis, neuropathy, pain, xerostomia, mucositis, or treatment-related changes in oral and pharyngeal structures.[2] A systematic review similarly identified dysphagia, xerostomia, trismus, mucositis, chewing difficulty, and speech problems as common oral dysfunctions.[3] These impairments should be assessed using both impairment measures and meaningful functional outcomes, including oral intake, swallowing safety, communication, mouth opening, nutritional status, mobility, and participation.

Trismus deserves particular attention because reduced mouth opening can interfere with chewing, oral hygiene, dental procedures, nutrition, and speech. Recent reviews indicate that rehabilitation for trismus can improve functional outcomes, but protocols, adherence, and outcome measures remain heterogeneous.[10-12] A 2026 scoping review likewise highlighted substantial heterogeneity and limited use of condition-specific patient-reported outcomes.[11]

Table 1. Common treatment-related problems and rehabilitation targets after oral cancer treatment.

| Problem                   | Potential functional consequence                                     | Typical rehabilitation target                                                        |
|---------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Dysphagia                 | Reduced safety or efficiency of oral intake                          | Swallow assessment, compensatory strategies, therapeutic exercise, diet modification |
| Trismus                   | Limited oral access, chewing difficulty, hygiene difficulty          | Jaw-mobility exercise, stretching, device-assisted exercise when appropriate         |
| Xerostomia                | Difficulty swallowing, speaking, eating and maintaining oral comfort | Oral care, salivary management, hydration strategies, dietetic and dental support    |
| Mucositis/pain            | Reduced oral intake and therapy participation                        | Symptom control combined with graded functional rehabilitation                       |
| Speech impairment         | Reduced communication and social participation                       | Speech-language therapy and task-specific communication training                     |
| Nutritional compromise    | Weight loss, weakness and reduced treatment tolerance                | Dietetic assessment and individualized nutritional support                           |
| Deconditioning/fatigue    | Reduced mobility, endurance and daily activity                       | Exercise prescription and energy-management strategies                               |
| Psychosocial difficulties | Reduced participation, confidence and quality of life                | Psychological support, counseling and social reintegration                           |

A functional approach therefore requires longitudinal assessment rather than a single post-treatment evaluation. Rehabilitation goals should be individualized according to tumor site, surgery and reconstruction, radiotherapy exposure, baseline function, treatment toxicity, comorbidity, nutritional status, and patient priorities. This approach is consistent with the broader rehabilitation literature, which increasingly emphasizes activity and participation rather than impairment outcomes alone.[4,5]

#### 3.2 Rehabilitation Evidence and the Need for Function-Oriented Outcomes

Swallowing rehabilitation is one of the best-studied domains. A systematic review and meta-analysis of randomized trials found that swallowing exercises produced small improvements in swallowing function and moderate improvements in mouth opening, although effects on aspiration, performance status, and overall quality of life were less consistent.[13] Individual randomized trials have reported mixed results, illustrating the importance of intervention timing, adherence, treatment intensity, and outcome selection.[14,15] The evidence therefore supports swallowing rehabilitation as an important component of multidisciplinary care while also demonstrating that not every exercise protocol produces the same clinical effect.

Trismus rehabilitation also has a growing evidence base. A recent scoping review found that rehabilitation interventions for treatment-induced trismus remain heterogeneous and emphasized the need for standardized protocols and patient-reported outcomes.[11] Adherence is also important during radiotherapy, with a recent systematic review identifying modifiable barriers and facilitators to swallow and trismus exercise delivery.[15] Whole-body rehabilitation and prehabilitation extend the functional scope beyond the oral region. A systematic review and meta-analysis of prehabilitation interventions reported potential benefits of nutrition, exercise, and psychoeducation across outcomes such as weight, complications, dysphagia, and quality of life.[16] Exercise-based rehabilitation has also been studied in patients undergoing or recovering from head and neck cancer surgery, although the available trials remain heterogeneous.[17] Social and participation outcomes are also important because treatment and rehabilitation can affect eating, swallowing, relationships, identity, and daily activities.[15] Shoulder dysfunction remains relevant after neck dissection, and contemporary rehabilitation reviews emphasize structured assessment and management.[18]

### **3.3 Pharmacotherapy as Supportive Care**

In oral cancer rehabilitation, pharmacotherapy is best considered supportive and symptom-directed. Pain is common in head and neck cancer and may be caused by tumor-related mechanisms, surgery, radiotherapy, neuropathic processes, or treatment-related tissue injury.[19] Evidence from randomized trials remains insufficient to identify a single optimal pharmacological strategy for post-treatment head and neck cancer pain, reinforcing the need for individualized analgesic management and reassessment.[20]

Xerostomia is another clinically important target because salivary dysfunction can interfere with chewing, swallowing, speech, oral comfort, and oral health. A systematic review and meta-analysis of randomized trials found that pilocarpine can provide symptomatic benefit in radiation-induced xerostomia, although adverse effects such as sweating were more frequent than with placebo.[21] Pharmacological treatment should therefore be individualized according to residual salivary function, contraindications, adverse effects, and the patient's functional goals. Symptom management should complement, rather than replace, oral care, hydration strategies, dietary modification, and rehabilitation.

Oral mucositis represents an additional medication-sensitive barrier to rehabilitation participation. The MASCC/ISOO clinical practice guideline provides evidence-based recommendations for prevention and management of mucositis associated with cancer therapy.[22] From a rehabilitation perspective, the important issue is not simply whether mucositis is reduced, but whether symptom control permits oral intake, oral hygiene, swallowing practice, communication, and participation in therapy. This illustrates why supportive pharmacotherapy should be linked explicitly to functional goals. Medication-related problems are not theoretical in head and neck cancer. In a study of 26 patients undergoing consecutive cycles of chemoradiotherapy, repeated medication reviews identified an increasing burden of potential drug-related problems over the course of treatment, including interactions, adverse drug reactions, and inappropriate medication duration or dosing intervals.[8] Medication complexity was also associated with health-related quality of life. These findings support medication reconciliation and repeated review as potential supportive-care components that may be incorporated into longitudinal cancer rehabilitation.

Clinical-pharmacist intervention has also been evaluated in head and neck cancer. In a prospective multicenter study of 104 patients, clinical-pharmacist services addressed medication-related problems including chemotherapy administration, supportive care, comorbidities, dose calculation, and drug interactions. The intervention group maintained quality-adjusted life-year measures during chemotherapy, whereas the control group showed a decline.[9] Although this study was not designed to test rehabilitation outcomes, it demonstrates that pharmaceutical care can address clinically relevant treatment barriers in this population.

The distinction is important for interpreting the novelty of the present review. Evidence already supports clinical-pharmacist involvement in medication optimization and demonstrates a substantial rehabilitation literature addressing swallowing, trismus, exercise, shoulder dysfunction, oral rehabilitation, and quality of life.[4,8,9,13,18,23] What remains insufficiently studied is the deliberate connection between these two domains:

whether medication review is performed with explicit rehabilitation goals and whether such integration changes functional outcomes. The proposed contribution is therefore a conceptual integration of established domains, not a claim that an already validated pharmacotherapy–rehabilitation pathway exists.

Table 2. Potential multidisciplinary roles in oral cancer rehabilitation.

| Discipline                   | Primary contribution                                                 | Potential interface with medication management                                                  |
|------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Rehabilitation physician     | Functional assessment, goal setting and coordination                 | Identifies medication-related barriers to participation and coordinates optimization            |
| Speech-language therapist    | Swallowing, speech and communication rehabilitation                  | Reports symptoms or adverse effects affecting therapy participation                             |
| Physiotherapist              | Exercise, mobility, endurance and deconditioning management          | Identifies sedation, dizziness or other effects limiting physical activity                      |
| Dietitian                    | Nutritional assessment and dietary intervention                      | Addresses medication-related gastrointestinal or appetite problems affecting intake             |
| Dentist/prosthodontist       | Oral health, dental and prosthetic rehabilitation                    | Coordinates medication-related oral effects with oral rehabilitation                            |
| Oncologist/surgeon           | Cancer-directed treatment and surveillance                           | Provides oncological context for medication decisions and treatment toxicity                    |
| Clinical pharmacist          | Medication reconciliation, interaction and adverse-effect assessment | Identifies and communicates medication-related problems and supports collaborative optimization |
| Psychologist/psycho-oncology | Psychological adjustment and participation                           | Considers medication effects that may influence alertness, adherence or daily functioning       |

### 3.4 Medication-Related Problems and Pharmaceutical Care

Multidisciplinary rehabilitation requires explicit communication about symptoms, adverse effects, drug interactions, adherence, and functional barriers. The roles summarized in Table 2 are complementary: rehabilitation professionals identify functional consequences, while the clinical pharmacist contributes medication reconciliation and medication-related problem assessment. This division of responsibility supports coordinated care without implying that medication optimization is itself a rehabilitation intervention.

## 4. DISCUSSION

### 4.1 Integrating Pharmacotherapy With Multidisciplinary Rehabilitation

Based on the evidence reviewed, a function-oriented pharmacotherapy–rehabilitation interface can be conceptualized as a five-stage process: (1) identify the patient's priority functional limitation; (2) identify symptoms and medication-related factors that may impede function; (3) optimize pharmacological and supportive management within appropriate clinical guidelines; (4) coordinate rehabilitation interventions directed at the affected activity or participation domain; and (5) reassess both medication-related outcomes and functional outcomes. This sequence deliberately links medication decisions to rehabilitation goals rather than treating pharmacotherapy as an independent endpoint.

Table 3. Proposed pharmacotherapy–rehabilitation interface.

| Stage                         | Clinical question                                                | Example output                                                                    |
|-------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| 1. Functional assessment      | What is limiting activity or participation?                      | Dysphagia, trismus, pain, fatigue, reduced oral intake                            |
| 2. Medication review          | Could medication contribute to the problem?                      | Adverse effect, interaction, therapeutic gap, adherence issue                     |
| 3. Collaborative optimization | Can medication-related barriers be reduced safely?               | Medication adjustment, monitoring or supportive strategy                          |
| 4. Targeted rehabilitation    | What functional intervention is required?                        | Swallow therapy, jaw exercise, speech therapy, exercise, oral rehabilitation      |
| 5. Reassessment               | Did the intervention improve function without unacceptable harm? | Functional outcome, patient-reported outcome, medication safety and participation |

The framework intentionally avoids suggesting that medication produces functional recovery directly. Pharmacotherapy may reduce pain, xerostomia, mucositis, nausea, or other modifiable barriers, while rehabilitation addresses swallowing, mouth opening, speech, strength, endurance, oral function, and participation. The two components may therefore be complementary, but the hypothesis that their structured integration produces superior functional outcomes requires prospective testing.

#### **4.2 Care Across the Cancer Continuum**

The interface can be adapted across the cancer continuum. Before treatment, medication reconciliation, baseline functional assessment, nutritional screening, and prehabilitation can identify modifiable risks and establish patient-centered goals.[16] During surgery, radiotherapy, or systemic therapy, repeated assessment can address evolving symptoms, toxicity, medication complexity, and adherence. During survivorship, the emphasis may shift toward persistent dysphagia, trismus, xerostomia, deconditioning, pain, oral rehabilitation, return to activity, and social participation.

Oral rehabilitation itself should remain multidisciplinary. Contemporary systematic-review evidence indicates that prosthetic and oral rehabilitation can influence functional and quality-of-life outcomes, although the certainty and consistency of the evidence vary.[7,10] The rehabilitation team may therefore include rehabilitation physicians, physiotherapists, speech-language pathologists, dentists/prosthodontists, dietitians, nurses, psychologists, oncologists, and clinical pharmacists, with responsibilities coordinated around shared patient-defined outcomes.

#### **4.3 Relevance to Rehabilitation Practice in Indonesia**

The proposed model is also relevant to health systems in which access to multidisciplinary rehabilitation may be uneven. Previous work by Putra and Lany described barriers to rehabilitation access in Indonesia, including limitations in facilities, workforce, financing, referral systems, and service consistency.[24] These contextual barriers matter because a pharmacotherapy–rehabilitation pathway will only be clinically useful if medication review and rehabilitation can be connected through feasible referral and follow-up mechanisms.

The authors' previous review of oral-cancer rehabilitation emphasized functional, prosthetic, and psychosocial rehabilitation within multidisciplinary oncology pathways.[25] The present review extends that perspective by focusing specifically on the medication interface. This distinction is important: the previous work addressed the broader rehabilitation landscape, whereas the current manuscript asks how medication optimization and pharmaceutical care could be deliberately aligned with rehabilitation goals.

#### **4.4 Research Gaps and Future Directions**

The most important evidence gap is the absence of prospective studies directly testing whether structured pharmaceutical care improves rehabilitation outcomes after oral cancer treatment. Future studies could compare standard multidisciplinary rehabilitation with a model incorporating structured medication reconciliation, symptom-directed pharmacotherapy review, clinical-pharmacist input, and explicit functional goal setting. Such studies should report intervention fidelity and distinguish medication-related outcomes from rehabilitation outcomes.

Primary outcomes should be functional rather than exclusively pharmacological. Depending on the population, these may include swallowing function and oral intake, maximal interincisal opening, speech-related measures, nutritional status, physical performance, fatigue, pain, health-related quality of life, participation, treatment adherence, and healthcare utilization. The growing rehabilitation literature already demonstrates the feasibility of measuring these domains, while pharmaceutical-care studies provide methods for identifying drug-related problems and medication-related outcomes.[4,8,9,13,18]

Research should also account for patient heterogeneity. Surgical reconstruction, radiotherapy exposure, baseline swallowing function, trismus severity, xerostomia, nutritional risk, comorbidity, polypharmacy, and socioeconomic access may modify both medication needs and rehabilitation response. Stratified or adaptive study

designs may therefore be more informative than assuming a uniform post-treatment oral-cancer rehabilitation population.

Digital monitoring may provide another avenue for future research by linking symptom reporting, medication adherence, home rehabilitation, and functional assessment. However, digital approaches should be evaluated as delivery or monitoring tools rather than assumed to be effective simply because they are technologically feasible. The priority should remain clinically meaningful functional outcomes and equitable access to multidisciplinary care.

#### **4.5 Novelty and Clinical Proposition**

The novelty of this narrative review lies in framing pharmaceutical care as a potential component of the rehabilitation pathway rather than as an isolated oncology service. Existing literature supports multidisciplinary rehabilitation, symptom-directed pharmacotherapy, and clinical-pharmacist involvement in medication-related problems.[4,8,9] However, the literature identified for this review did not provide direct randomized evidence that a structured pharmacotherapy–rehabilitation model improves functional outcomes after oral cancer treatment.

Accordingly, the central proposition is deliberately hypothesis-generating: oral cancer treatment may generate symptoms and medication-related barriers; structured medication review may identify modifiable barriers; rehabilitation can then address the corresponding functional limitations; and repeated reassessment may allow both medication and rehabilitation plans to be adjusted. This model should be tested prospectively before it is considered an evidence-based standard of care.

#### **5. CONCLUSION**

Oral cancer treatment can produce interacting impairments in swallowing, mastication, speech, oral health, nutrition, physical function, and psychosocial participation, and current evidence supports multidisciplinary rehabilitation for these domains despite substantial heterogeneity. Medication-related problems are also common in head and neck cancer and can be identified and addressed by clinical pharmacists, while symptom-directed pharmacotherapy for pain, xerostomia, and mucositis should complement rather than replace functional rehabilitation. A function-oriented pharmacotherapy–rehabilitation interface is therefore proposed as a hypothesis-generating framework; prospective studies are needed to determine whether structured medication review combined with rehabilitation improves functional outcomes, participation, quality of life, and treatment safety compared with usual multidisciplinary care.

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