Effectiveness and Implementation of Palliative Care Interventions for Patients with Chronic Obstructive Pulmonary Disease: A Systematic Review – Supplementary material

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Table S1: Example search strategy for PubMed

{"advanced COPD"[tiab] OR "end-stage COPD"[tiab] OR advanced chronic obstructive*[tiab] OR end-stage chronic obstructive*[tiab]

OR

{"Pulmonary Disease, Chronic Obstructive"[Mesh] OR "chronic obstructive pulmonary disease"[tw] OR "COPD"[tw] OR COPD*[tw] OR "COAD"[tw] OR "Chronic Obstructive Airway Disease"[tw] OR "Chronic Obstructive Lung Disease"[tw] OR "Chronic Airflow Obstructions"[tw] OR "Chronic Airflow Obstruction"[tw] OR "chronic bronchitis"[tw] OR "pulmonary emphysema"[tw] OR "Pulmonary Emphysemas"[tw] OR "Focal Emphysema"[tw] OR "Panacinar Emphysema"[tw] OR "Panlobular Emphysema"[tw] OR "Centriacinar Emphysema"[tw] OR "Centrilobular Emphysema"[tw]}

AND

{"Palliative Care"[Mesh] OR "palliative care"[tw] OR "palliative care interventions"[tw] OR "palliative care intervention"[tw] OR "Palliative Therapy"[tw] OR "Palliative Treatment"[tw] OR "Palliative Treatments"[tw] OR "Palliative Surgery"[tw] OR "Palliative therapy"[tw] OR "palliative phase"[tw] OR "palliative phases"[tw]

OR "palliation"[tw] OR "palliative"[tw] OR palliat*[tw] OR "Palliative Medicine"[mesh] OR "Terminal Care"[Mesh:noexp] OR "Hospice Care"[Mesh] OR "Resuscitation Orders"[mesh] OR "Terminal Care"[tw] OR "Hospice Care"[tw] OR "Hospice Programs"[tw] OR "Hospice Program"[tw] OR "Bereavement Care"[tw] OR "End-of-Life Care"[tw] OR "Life Care End"[tw] OR "supportive care"[tw] OR "terminally ill"[tiab] OR "Terminally Ill"[Mesh] OR "advanced illness"[tiab] OR "advanced disease"[tiab] OR "Death"[mesh:noexp] OR "dying loved one"[tiab] OR "dying patient"[tiab] OR "dying patients"[tiab] OR "dying people"[tiab] OR "dying person"[tiab] OR "dying"[tiab] OR "last year of life"[tiab] OR "end of life"[tiab] OR "end-of-life"[tiab] OR "terminal illness"[tiab] OR "terminal illnesses"[tiab] OR "death and dying"[tiab] OR "limited life expectancies"[tiab] OR "limited life expectancy"[tiab] OR "limited life span"[tiab] OR "limited lifespan"[tiab] OR "limited life spans"[tiab] OR "critical illness"[tiab] OR "Critical Illness"[Mesh] OR "frail elderly"[tiab] OR "Frail Elderly"[Mesh])}
Table S2: Operationalizations of palliative care domains

| Domain                      | Operationalization                                                                 |
|-----------------------------|-----------------------------------------------------------------------------------|
| Identification              | Early and proactive identification of the palliative care phase.                   |
| Advance care planning       | A continuous and dynamic process of discussions on life goals and choices, and on which care is an appropriate fit, now and in the future. |
| Individual care plan        | A document which is kept with the patient in which the agreements focusing on physical, psychological, social and spiritual well-being are recorded. |
| Informal caregiver support  | Support to a family member who plays an important role in caring for the patient and is actively involved in this. |
| Interdisciplinary care      | Involvement of several disciplines working together in an interdisciplinary team. |
| Coordination                | People approaching the end of life receive consistent care that is coordinated effectively across all relevant settings and services at any time of day or night, and delivered by practitioners who are aware of the person's current medical condition, care plan and preferences. |
| Physical dimension          | Assessment and management of physical needs.                                      |
| Psychological dimension     | Assessment and management of psychological needs.                                 |
| Social dimension            | Assessment and management of social needs.                                        |
| Spiritual dimension         | Assessment and management of spiritual, religious and existential needs.           |
| End-of-life care            | Patients at the end of life are identified at an early stage. The individual care plan is updated accordingly, or the End-of-life care pathway is started. |
| Bereavement support         | People closely affected by a death are offered bereavement support.                |

Table S3: Operationalizations of implementation outcomes

| Domain          | Operationalization                                                                 |
|-----------------|-----------------------------------------------------------------------------------|
| Acceptability   | The perception among implementation stakeholders that a given treatment, service, practice, or innovation is agreeable, palatable, or satisfactory. |
| Adoption        | The intention, initial decision, or action to try or employ an innovation.        |
| Appropriateness | The perceived fit, relevance, or compatibility of the innovation for a given practice setting, provider, or consumer. |
| Costs           | Implementation costs.                                                             |
| Feasibility     | The extent to which a new treatment, or an innovation, can be successfully used or carried out within a given agency or setting. |
| Fidelity        | The degree to which an intervention was implemented as it was prescribed in the original protocol or as it was intended by the program developers. |
| Penetration     | Integration of practice within a setting.                                         |
| Sustainability  | The extent to which a newly implemented treatment is maintained or institutionalized. |
Table S4. Codebook for extraction of determinants of implementation
Codes from the Measurement Instrument for Determinants of Innovations (MIDI)(1). Inductively added codes based on the Consolidated Framework for Implementation Research (CFIR)(2) in green and other inductively added codes in orange.

| Determinants associated with the innovation | Description |
|-------------------------------------------|-------------|
| 1. Procedural clarity                      | Extent to which the innovation is described in clear steps / procedures. |
| 2. Correctness                             | Degree to which the innovation is based on factually correct knowledge. |
| 3. Completeness                            | Degree to which the activities described in the innovation are complete. |
| 4. Complexity                              | Degree to which implementation of the innovation is complex. |
| 5. Compatibility                           | Degree to which the innovation is compatible with the values and working method in place. |
| 6. Observability                           | Visibility of the outcomes for the user, for example whether the outcomes of a particular treatment are clear to the user. |
| 7. Relevance for patient                   | Degree to which the user believes the innovation is relevant for his/her patient. |
| 8. Accessibility                           | Degree to which the innovation is accessible for the patient. |

| Determinants associated with the adopting person (user) | Description |
|---------------------------------------------------------|-------------|
| 9. Personal benefits/drawbacks                          | Degree to which using the innovation has advantages or disadvantages for the users themselves. |
| 10. Outcome expectations                                 | Perceived probability and importance of achieving the patient objectives as intended by the innovation. |
| 11. Professional obligation                              | Degree to which the innovation fits in with the tasks for which the user feels responsible when doing his/her work. |
| 12. Patient satisfaction                                 | Degree to which the user expects patients to be satisfied with the innovation. |
| 13. Patient cooperation                                  | Degree to which the user expects patients to cooperate with the innovation. |
| 14. Social support                                       | Support experienced or expected by the user from important social referents relating to the use of the innovation (for example from colleagues, other professionals they work with, heads of department or management). |
| 15. Descriptive norm                                     | Colleagues' observed behaviour; degree to which colleagues use the innovation. |
| 16. Subjective norm                                      | The influence of important others on the use of the innovation. |
| 17. Self-efficacy                                        | Degree to which the user believes he or she is able to implement the activities involved in the innovation. |
| 18. Knowledge                                            | Degree to which the user has the knowledge needed to use the innovation. |
| 19. Awareness of content of innovation                   | Degree to which the user has learnt about the content of the innovation. |
| 20. Previous experience with similar innovation          | Degree to which the experience of a user with a similar innovation in the past has influence on implementation of the current innovation. |
| 21. Publicity                                            | Degree to which publicity and marketing activities have led to implementation and use of innovation. |
| Determinants associated with the organisation |
|---------------------------------------------|
| **22. Tension for change**  |
| **Description**: Degree to which stakeholders perceive the current situation as intolerable or needing change. |
| **23. Disease specific characteristics**  |
| **Description**: Degree to which disease specific characteristics hampers implementation. For example, the unpredictable disease trajectory which makes predicting the palliative phase difficult. |
| **Determinants associated with the organisation** |
| **24. Formal ratification by management**  |
| **Description**: Formal ratification of the innovation by management, for example by including the use of the innovation in policy documents. |
| **25. Replacement when staff leave**  |
| **Description**: Replacement of staff leaving the organization. |
| **26. Staff capacity**  |
| **Description**: Adequate staffing in the department or in the organisation where the innovation is being used. |
| **27. Financial resources**  |
| **Description**: Availability of financial resources needed to use the innovation. |
| **28. Time available**  |
| **Description**: Amount of time available to use the innovation. |
| **29. Material resources and facilities**  |
| **Description**: Presence of materials and other resources or facilities necessary for the use of the innovation as intended (such as equipment, materials or space). |
| **30. Coordinator**  |
| **Description**: The presence of one or more persons responsible for coordinating the implementation of the innovation in the organisation. |
| **31. Unsettled organisation**  |
| **Description**: Degree to which there are other changes in progress (organisational or otherwise) that represent obstacles to the process of implementing the innovation, such as re-organisations, mergers, cuts, staffing changes or the simultaneous implementation of different innovations. |
| **32. Information accessible about use of innovation**  |
| **Description**: Accessibility of information about the use of the innovation. |
| **33. Performance feedback**  |
| **Description**: Feedback to the user about progress with the innovation process. |
| **34. Leadership engagement**  |
| **Description**: Commitment, involvement, and accountability of leaders and managers with the implementation of the innovation. |
| **35. External policy & Incentives**  |
| **Description**: A broad construct that includes external strategies to spread innovations including policy and regulations (governmental or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting. |
| **Determinants associated with the socio-political context** |
| **36. Legislation and regulations**  |
| **Description**: Degree to which the innovation fits in with existing legislation and regulations established by the competent authorities (examples being financial structures, or substantive legislation and supervision from the Dutch Health Care Inspectorate or the Dutch Care Authority). |

References
1. Fleuren MA, Paulussen TG, Van Dommelen P, Van Buuren S. Towards a measurement instrument for determinants of innovations. International Journal for quality in health care : journal of the International Society for Quality in Health Care. 2014;26(5):501-10.
2. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci. 2009;4:50.
### Table S5. Quality assessment of included studies.

| Reference          | Study design | Screening questions | 1. Qualitative | 2. Quantitative randomized controlled trials | 3. Quantitative non-randomized | 4. Quantitative descriptive | 5. Mixed methods | Score |
|--------------------|--------------|---------------------|----------------|---------------------------------------------|---------------------------------|----------------------------|------------------|-------|
| Aiken (2006)       | RCT          | Y                   | Y              | Y                                           | Y                               | N                         | Y                | ⭐⭐⭐⭐ |
| Lockhart (2003)    | Unclear      | N                   | N              | Y                                           | Y                               | N                         | Y                | ⭐    |
| Bove (2018)        | Q            | Y                   | Y              | Y                                           | Y                               | Y                         | N                | ⭐⭐⭐⭐ |
| Bove (2019)        | Q            | Y                   | Y              | Y                                           | Y                               | Y                         | Y                | ⭐⭐⭐⭐ |
| Buckingham (2015)  | RCT +Q (pilot/feasibility) | Y | Y | Y | Y | Y | Y | N | N | ⭐⭐⭐⭐ |
| Duenn (2017)       | CCT          | Y                   | Y              | Y                                           | Y                               | Y                         | U                | ⭐⭐⭐⭐ |
| Edes (2006)        | BA           | Y                   | Y              | N                                           | Y                               | N                         | Y                | ⭐⭐⭐⭐ |
| Farquhar (2016)    | RCT +Q       | Y                   | Y              | Y                                           | Y                               | Y                         | Y                | ⭐⭐⭐⭐ |
| Farquhar (2009)    | RCT +Q (pilot/feasibility) | Y | Y | Y | Y | U | U | Y | U | ⭐⭐⭐⭐ |
| Farquhar (2010)    | BA +Q (pilot/feasibility) | Y | Y | Y | Y | U | U | Y | U | ⭐⭐⭐⭐ |
| Booth (2006)       | Q            | Y                   | Y              | Y                                           | Y                               | Y                         | Y                | ⭐⭐⭐⭐ |
| Higginson (2014)   | RCT          | Y                   | Y              | Y                                           | Y                               | Y                         | Y                | ⭐⭐⭐⭐ |
| Reilly (2016)      | Q            | Y                   | Y              | N                                           | Y                               | Y                         | Y                | ⭐⭐⭐⭐ |
| Horton (2013)      | BA (pilot/feasibility) | Y | Y | Y | Y | Y | Y | N | N | ⭐⭐⭐⭐ |
| Janssens (2019)    | RCT (pilot/feasibility) | Y | Y | Y | U | Y | Y | N | U | ⭐⭐⭐⭐ |
| Iupati (2016)      | BA           | Y                   | Y              | Y                                           | Y                               | Y                         | Y                | ⭐⭐⭐⭐ |
| Johnston (2016)    | Q            | Y                   | Y              | Y                                           | Y                               | Y                         | Y                | ⭐⭐⭐⭐ |
| Long (2014)        | BA +Q (pilot/feasibility) | Y | Y | Y | Y | Y | N | Y | N | ⭐⭐⭐⭐ |
| Qian (2018)        | BA +Q (pilot/feasibility) | Y | Y | Y | U | Y | Y | N | U | ⭐⭐⭐⭐ |
| Rabow (2003a) /    | CCT +Q       | Y                   | Y              | Y                                           | Y                               | Y                         | N                | ⭐⭐⭐⭐ |
| Rabow (2004)       | Q            | Y                   | Y              | Y                                           | Y                               | Y                         | N                | ⭐⭐⭐⭐ |
| Rabow (2003b)      | Q            | Y                   | Y              | Y                                           | Y                               | Y                         | N                | ⭐⭐⭐⭐ |
| Rocker (2014)      | BA +Q        | Y                   | Y              | Y                                           | N                               | U                         | Y                | ⭐    |
| Gillis (2017)      | BA +Q (pilot/feasibility) | Y | Y | Y | U | U | N | N | N | ⭐⭐⭐⭐ |
| Rocker (2017)      | BA +Q        | Y                   | Y              | N                                           | Y                               | N                         | Y                | ⭐⭐⭐⭐ |
| Verma (2017)       | Non-comparative +Q | Y | Y | Y | Y | Y | N | N | N | ⭐⭐⭐⭐ |
| Scheerens (2018)   | RCT +Q (pilot/feasibility) | Y | Y | Y | Y | Y | Y | N | Y | ⭐⭐⭐⭐ |
| Smallwood (2018)   | BA           | Y                   | Y              | Y                                           | Y                               | N                         | Y                | ⭐⭐⭐⭐ |
| Steinel (2003)     | BA           | Y                   | Y              | N                                           | U                               | N                         | U                | ⭐    |
| Van Dam (2014)     | BA           | Y                   | N | Y | Y | Y | U | Y | N | ⭐⭐⭐⭐ |
| Vitacca (2019)     | BA +Q (pilot/feasibility) | Y | Y | Y | N | Y | Y | Y | Y | ⭐⭐⭐⭐ |

Abbreviations: RCT = Randomized controlled trial; BA = Before-and-after study; CCT = Non-randomized clinical controlled trial, Q = Qualitative study design, +Q = Qualitative data additional to quantitative study design, Y = Yes, N = No, N+Y = for first part of research question answer No, for second part answer Yes, U = Can’t tell.
Table S6. Barriers and facilitators for implementation (determinants) for referrers, providers and patients.

| User type | Determinant                                               | References                  |
|-----------|-----------------------------------------------------------|----------------------------|
| **Referrer** |                                                           |                            |
|           | Relevance for patient                                     | Booth (2006)                |
|           |                                                           | Buckingham (2015)           |
|           |                                                           | Rabow (2003a)               |
|           | Awareness of content of innovation                        | Lockhart (2003)             |
|           |                                                           | Gillis (2017)               |
|           |                                                           | Johnston (2016)             |
|           | Disease characteristics                                   | Rocker (2017)               |
|           |                                                           | Johnston (2016)             |
|           |                                                           | Rabow (2003a)               |
|           | Publicity                                                 | Lockhart (2003)             |
|           | Professional obligation                                  | Lockhart (2003)             |
|           | Patient satisfaction                                     | Booth (2006)                |
|           | Correctness                                               | Booth (2006)                |
|           | Personal benefits/drawbacks                              | Booth (2006)                |
|           |                                                           | Rabow (2003a)               |
|           | Compatibility                                             | Booth (2006)                |
|           |                                                           | Gillis (2017)               |
|           | Tension for change                                        | Booth (2006)                |
|           |                                                           | Buckingham (2015)           |
|           | Time available                                            | Gillis (2017)               |
|           | Complexity                                                | Gillis (2017)               |
|           | Completeness                                              | Johnston (2016)             |
|           | Procedural clarity                                        | Johnston (2016)             |
|           | Financial resources                                       | Rabow (2003a)               |
| **Provider** |                                                           |                            |
|           | Time available                                            | Gillis (2017)               |
|           |                                                           | Rocker (2017)               |
|           |                                                           | Verma (2017)                |
|           |                                                           | Johnston (2016)             |
|           |                                                           | Rabow (2003a)               |
|           |                                                           | Scheerens (2019)            |
|           | Staff capacity                                            | Lockhart (2003)             |
|           |                                                           | Horton (2013)               |
|           |                                                           | Rabow (2003a)               |
|           | Compatibility                                             | Buckingham (2015)           |
|           |                                                           | Verma (2017)                |
|           | Financial resources                                       | Verma (2017)                |
|           |                                                           | Johnston (2016)             |
|           | Material resources and facilities                         | Rabow (2003a)               |
|           |                                                           | Scheerens (2019)            |
|           | Knowledge                                                 | Lockhart (2003)             |
|           |                                                           | Rocker (2017)               |
|           | Correctness                                               | Buckingham (2015)           |
|           |                                                           | Scheerens (2019)            |
|           | Information accessible about use of innovation            | Buckingham (2015)           |
|           |                                                           | Verma (2017)                |
|           | Leadership engagement                                     | Rocker (2017)               |
|           |                                                           | Verma (2017)                |
|           | External policy & Incentives                              | Verma (2017)                |
|           | Completeness                                              | Verma (2017)                |
|           | Performance feedback                                      | Verma (2017)                |
|           | Complexity                                                | Verma (2017)                |
|           | Formal ratification by management                         | Verma (2017)                |
|           | Tension for change                                        | Horton (2013)               |
| Patient                                                                 |
|------------------------------------------------------------------------|
| **Unsettled organization**                                             | Rabow (2003a) |
| **Publicity**                                                          | Rabow (2003a) |
| **Accessibility**                                                      | Buckingham (2015) |
|                                                                        | Rocker (2017)  |
|                                                                        | Horton (2013)  |
|                                                                        | Long (2014)    |
|                                                                        | Rabow (2003a)  |
| **Relevance for patients**                                             | Buckingham (2015) |
| **Personal benefits/drawbacks**                                       | Buckingham (2015) |
| **Previous experience with similar innovation**                        | Buckingham (2015) |
| **Compatibility**                                                      | Buckingham (2015) |
| **Financial resources**                                                | Long (2014)    |
| **Unsettled organization**                                             | Rabow (2003a)  |