Appendix 1

Extended examples of Action Effect Diagram Features – Related to COPD AED in Figure 2 and 3

Diagram overview (Section 3.2)

Example 1: *Reading the diagram from left to right answers the question 'What changes can we make that will result in an improvement?'*

Following a single cause/effect chain from the aim *to improve the health, quality of life, and experience of care for patients' post-exacerbation of COPD* it can be seen that one factor influencing the aim is a patient's self-management of their lifestyle including *whether the patient smokes*. One factor influencing patient smoking behaviour is *attendance at and engagement with a smoking cessation service*, which in turn is influenced by *appropriate referral of patients to smoking cessation*. It is anticipated that a *COPD care bundle* could be used as an intervention to improve referral rates, and that a *patient video* would increase staff awareness of the bundle.

Example 2: *Reading the diagram from right to left answers the question 'What are we trying to accomplish?'*

Following a single cause/effect chain from the implementation activity *patient video* it can be seen that this is intended to increase staff awareness about the use of a COPD care bundle and therefore increase *patient referral to smoking cessation clinic*. It is anticipated that this will influence a patient's *attendance at a smoking cessation class*. This will influence whether they smoke and their overall self-management, which will improve their health, quality of life, and experience of care.

Aim (Section 3.3)

Example 3**:** *The aim should be high-level and patient-focused but specific enough to guide the improvement initiative and subsequent evaluation.*

A general aim, improving quality of care for patients with COPD, could be specified as: *To improve the health, quality of life and experience of care for patients from Hospital X who are discharged following an acute exacerbation of COPD*.

Example 4: *The aim should not include details of the intervention(s).*

The aim to *implement a care bundle for patients with COPD* is a statement of intention to implement a specific intervention rather than of a desired impact of that intervention. This can inhibit an objective consideration of other potential solutions to the problem at hand and can disengage people who do not agree with that solution, as well as hindering effective evaluation design.

Example 5: *The aim should not include measure concepts.*

The aim *to reduce readmissions for patients with COPD* can be contentious. Whilst *readmission rate* is a measure associated with health outcomes of a patient, by making it the focus of the aim it is placed (with perception of associated cost savings) above the overall health of a patient and can therefore be contentious. Using the outlined AEM criteria, *reduced readmissions* would be one of several measures associated with the aim.

Contributing Factors (Section 3.4)

Example 6: *The major contributing factors in Column 1 should be of a similar type and form a logical group.*

Major factors should ideally be relevant for achievement of the aim in any comparable setting and at any point over time. In general we see the further left on the diagram as less likely to change over time and therefore should be based on factors for which there is a great logical or evidence based

rationale. A powerful way to obtain this is by structuring the major contributing factors as high level stages of patient care (thereby ensuring a logical grouping of factors that are sufficient to achieve overall aim). This helps to keep the patient at the centre of QI conversations and, in turn, supports the engagement of diverse stakeholders.

For example a patient will nearly always need some level of assessment, diagnosis, treatment and transfer, therefore these will stay relevant no matter how or where they are delivered or what the intervention is. In the COPD example we use the stages of patient care *appropriate care in-hospital, self-management post-exacerbation,* and *quality of additional clinical care post-exacerbation*. The three factors are all of a similar type and form a logical group (in this case, contexts which determine the constraints and influences on factors affecting COPD-related health and quality of life post-exacerbation). Given the initiative was based in a hospital this will stay relevant whilst treatment remains in a hospital, however in the future such care could be deliver in the community which would change the major contributing factors.

Example 7: *Major contributing factors of different types or with no logical grouping make it difficult to assess whether the factors listed are sufficient to achieve the overall aim.*

The three factors *discharge process, variations in care,* and *staff awareness of national guidance* are an example of disparate factors that we have observed in first column of a programme theory diagram. The first factor relates to a touch point between patients and healthcare providers, the second to a property of the way a healthcare system delivers care, the third to healthcare providers' knowledge. This illogical grouping makes it difficult to assess whether the project is considering a set of factors which are sufficient to achieve the aim.

Interventions and Implementation activities (Section 3.5)

Example 8: *Interventions are intended to become part of routine service delivery.*

In considering what intervention could be used in order to refer a patient for pulmonary rehabilitation:

Improving consistency of current service: A pulmonary rehabilitation service exists near Hospital X, however the criteria used to refer patients are determined by individual clinicians and need to be standardised to increase consistency and equity of services. An associated implementation activity is *staff training for rehabilitation assessment and referral*.

Modifications to current service: The referral process could be changed to streamline pulmonary rehabilitation referral process and reduce the need to duplicate information entry. An associated implementation activity could be *redesign of referral form*.

New practice*:* An on-screen reminder could be added to prompt staff for referral to pulmonary rehabilitation. An associated implementation activity could be *IT system design*.

Example 9: *Definitions of contributing and intervention factors and implementation activities are subjective.*

The distinction between contributing and intervention factors is subjective and blurred. The main intervention being tested in the example project was the COPD care bundle which included demonstration of inhaler technique. As the project progressed it became clear that a contributing factor to the success of the aim was staff having the appropriate skills and competencies to provide inhaler technique training to patients. As a result the QI team wanted to ensure staff had appropriate training to perform this task. In this instance the QI team did not consider staff inhaler training to be part of the main intervention, but it could be argued that inhaler training is part of the core intervention as it is necessary to reliably achieve the intervention. Such distinctions regarding the naming of intervention parts are subjective, and may be influenced by local historical issues, clinical boundaries and leadership roles or interests. Knowing that staff training in inhaler technique

is necessary to successfully achieve the aim is more important that whether it is named as a contributing or intervening factor.

There is clearer distinction between implementation activities (carried out by QI team) and intervention factors (intended to be part of routine practice) although this again can be subjective and change over the course of a project (e.g. training staff in inhaler technique may be seen initially as the role of the QI team but as the project progresses this may been seen as a necessary part of staff induction and become part of the intervention (routine practice)).

Example 10: *Some contributing or intervention factors may not have implementation activities preceding them.*

One of the benefits of the AED is capturing all relevant factors which are seen as influential (through cause/effect relationships) to the overall aim. Whilst these may not be in scope of project (e.g. the COPD project team did not work on improving referrals to outpatients) nor under the influence of the project (the provision of community services was not under the direct influence of the QI team) they are none the less important to the success of the overall work and therefore is important to capture them in the diagram (and if possible monitor what is happening in reality) even if there are no direct plans to influence by QI team. These factors remain on the diagram as recognition that should the initial proposed implementation activities be insufficient to achieve progress against the aim, these interventions may need to be revisited and new implementation activities devised to support them. In building programme theory this is important to explain why interventions may not have worked if negative results are obtained. The AED can also act as a powerful tool to highlight overlap or complementarity between different improvement initiatives (e.g. if a separate local initiative was being run to improve outpatient referrals).

Cause/Effect Chains (Section 3.6)

Example 11: *Factors connected by an arrow must be clearly related with no illogical leaps.*

The casual link between *Referral to smoking cessation* and *whether the patient smokes* makes a illogical leap. It is not just the referral itself which influences whether a patient smokes in the future; it also matters what happens following a referral, including whether a patient is motivated to attend or able to complete a smoking cessation programme. Adding an additional factor to the middle of this cause/effect chain, *attendance at and engagement with smoking cessation programme*, helps unpack this connection. Identifying such factors is important in developing programme theory so that the rationale of how an intervention is intended to work is clear. This helps to inform the design and collection of data to evaluate the success of an intervention against hypothesised benefits.

Example 12: *Guidance for the vertical alignment of factors*

Some guidance which has proved useful in our experience: the first column of major contributing factors are patient centred (*Appropriate care in hospital* or *Self-management* of a condition refer to a patients care); subsequent columns focus on interactions between patients and healthcare professionals (health care touch points e.g. *assessing a patient for pulmonary rehabilitation needs* requires interaction between patients and healthcare professionals); following this subsequent columns reflect staff-staff interactions (e.g. *effective hand-over between members of staff regarding a patients care*) or organisational level issues (e.g. *availability of pulmonary rehabilitation services*). All of these factors can be influenced directly or indirectly by the actions taken by the QI initiative team (implementation activities). This convention should not influence the decision as to what order factors enter cause/effect chains, but rather can aid in vertical alignment of factors into similar groups once the order has been established by cause and effect.

Evidence, Predictions, Assumptions and Measures (Section 3.7)

Example 13**:** *Cause/effect relationships may be supported by existing evidence.*

An evidence-based cause/effect relationship exists between *Attendance at and engagement with smoking cessation* and *Whether the patient smokes.*(43)

Example 14**:** *Lack of measures or evidence relating to a cause/effect chain implies an assumed relationship. This may point to an area of potential weakness in the overall programme theory.*

An assumed cause/effect relationship often encountered is the relationship between staff education and specific improvements. If no measures are put in place to test this assumption, then there is an inability to determine whether the cause/ effect relationship is true. It may be deemed that the relationship between staff education and a specific improvement requires testing, and therefore measures must be put in place to evaluate this link. For example, to determine whether increased *specialised staff training* results in an increase in *patient education on inhaler technique,* measure concepts must be identified and operationalised.

Example 15: *Measure concepts must be clearly associated with the relevant factor or aim.*

The success of *staff training* to influence *patient education for inhaler technique* can be measured by the proportion of staff designated as inhaler-technique providers who have attended the specialised staff training sessions (indicating extent to which intervention took place) and the impact this training had on percentage of patients who received inhaler education. Further work with the improvement initiative is necessary to expand each measure into a full operational definition

Example 16: *To inform decision making on a regular basis it is often necessary to select process measures (right hand side of the diagram) to provide feedback on the progress of an improvement initiative.*

Staff awareness surveys and *observations of patient inhaler technique* can be measured in real-time and reviewed by the initiative team on a weekly or even daily basis. However, measures associated with the aim, such as *readmission rate* or *Quality Adjusted Life Years (QALYs)*, will take much longer to show after the intervention has taken place.