

## **Towards a Process View of Adherence**

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### **A B S T R A C T**

Adherence is vital to the success of medical interventions, yet it is around 50% in the developed world and may be lower in the developing world. Research into non-adherence is generally not supported by theory, but if it is then those theories are usually expectation-value models which do not reach to the point of consumption, only intention. There is therefore a gap in adherence research. Having analysed the limitations of several such models, this paper explores the use of Service-Dominant Logic as a way to understand adherence as a process which reaches right into the act of consumption. Referring to research which used qualitative interviews, it explores the experiences of people in both the developed and developing worlds and confirms that Service-Dominant Logic, extended with the Integrative Framework of Value and Service Ecosystems, can be used to understand people's adherence decisions from the point of need through the consumption decision to the post-consumption assessment of results. It then draws insights into the steps in the process. Finally, it concludes with thoughts on how these insights can be used by pharmaceutical manufacturers to enhance their products to make adherence more likely.

**Keywords:** Adherence; Sub-Saharan Africa; Service-Dominant Logic

### **1. Introduction**

Simplistically, adherence is consumption in accordance with instructions. This hides significant complexity in how adherence comes to be. Despite the use of behavioural theories in some papers, adherence is not well-defined theoretically. There are many practitioner-led operational definitions of the adherence process but these have a practical focus on issues which inhibit consumption or affect frequency of consumption rather than providing a theoretical basis for why consumption may or may not occur.

These theories and definitions tend to be specific to their environments and they offer few proposals as to how they might be extended to apply more widely. Yet, the fact that adherence is researched in many areas of medicine indicates its importance. Indeed, in his seminal report for the World Health Organisation (WHO), Sabaté<sup>1</sup> (p.xiii) said: "[Increasing adherence] may have a far greater impact on the health of the population than any

improvement in specific medical treatments" and stated that adherence is around 50% in the developed world and may be lower in the developing world. Access to medication is necessary but is not sufficient for successful treatment of disease. Therefore, the opportunities for health improvements delivered through improved adherence could be significant. Adherence therefore deserves greater and more widely applicable theorization.

This paper explores adherence as a process using Service-Dominant (S-D) Logic<sup>2-4</sup> as the lens to understand how adherence actually happens. It considers definitions of adherence, explores themes in adherence papers and behavioural models, before considering the act of consumption which is adherence. It builds a model for adherence based on S-D Logic and then tests it using the results of qualitative interviews. The output of this is a process view of adherence which it is hoped will support moves towards a more robust understanding of adherence that can contribute to future adherence interventions.

## 2. Definitions of Adherence

A simplistic concept of adherence is that patients take their medicine as and when they should. The original term was “compliance”, which originated in the 1950s as the importance of the concept was beginning to emerge. However, this is hardly used now because of the implied power relationship between prescriber and patient. Therefore, the definition has developed over time to reflect improved thinking on patient empowerment and wider perspectives. The 2012 Ascertaining Barriers for Compliance (ABC) project<sup>5,6</sup> presented its view of the development of thinking around adherence over the last 35 years in table 2.1 on p.22 of its report, reproduced as **(Table 1)** below.

**Table 1:** Development in definitions of adherence<sup>5</sup>.

Definition	Authors - Year
Compliance is the extent to which the patient's behavior [in terms of taking medications, following diets or executing other lifestyle changes) <b>coincides with the clinical prescription</b> .	Sackett DL, Haynes BR; 1976 <sup>64</sup>
Compliance is the extent to which the patient's behavior <b>coincides with the clinical prescription, regardless of how the latter was generated</b> .	Sackett DL, Haynes BR; 1976 <sup>64</sup>
Compliance is the extent to which a person's behaviour [in terms of taking medication: following diets, or executing other lifestyle changes) <b>coincides with medical or health advice</b> .	Haynes R.B., Taylor D.W. and Sackett D.L.; 1979 <sup>109</sup>
Compliance is the extent to which an individual <b>chooses behaviours that coincide with a clinical prescription</b> , the regimen must be consensual, that is, achieved through negotiations between the health professional and the patient.	Dracup K.A., Meleis, A.I.; 1982 <sup>110</sup>
Adherence is the degree to which a patient <b>follows the instructions, proscriptions, and prescriptions of his or her doctor</b> .	Meichenbaum, D., Turk D.C.; 1987 <sup>111</sup>
Adherence is the extent to which a person's behavior - taking medication, following a diet, and/or executing lifestyle changes - <b>corresponds with agreed recommendations from a health care provider</b> .	World Health Organization; 2003 <sup>3</sup>
Adherence is the extent to which a patient <b>participates in a treatment regimen after he or she agrees to that regimen</b> .	Balkrishnan R.; 2005 <sup>112</sup>

This addition of patient participation to the definition of adherence attempts to address the issue of the instructions being imposed on the patient. However, the range of adherence definitions used both in theory and in practice do not fully reflect these enhancements. See examples in Table 2 (definitions used in papers with a practice focus) and Table 3 (from papers with a more theoretical focus). Some of the definitions are so restrictive that it is unlikely that any patient could be deemed adherent, for example the idea that there are five ways that a patient could be non-adherent: “...altered their dose, forgotten to use the medication, stopped taking it for a while, decided to miss out on a dose and taken less than instructed”.<sup>7</sup> On the other hand, some definitions tend in the opposite direction. One definition of non-adherence is a failure to collect medication for two months,<sup>8</sup> while another defines adherence as patient self-reporting as having being adherent.<sup>9</sup> This shows that there are multiple definitions of the term and little agreement as to which should be used.<sup>10</sup>

The problems caused by the range of definitions in **(Table 2 and Table 3)** are stated by van Dulmen et al.,<sup>11</sup> who explain that the large variety of definitions complicates adherence assessments across multiple studies. It is also evident that varied definitions lead to different patients being considered adherent and therefore subject to interventions and so affect measurement of outcomes.

Definitions in these tables attempt to quantify adherence more comprehensively but a common one, for example used by Morrison et al.,<sup>26</sup> simply states that adherence is the ratio of medicine consumed to medicine prescribed. Because this is easy to measure it is often the one used in practical studies even though true adherence may be masked by this. For example, simple ways to falsify true adherence by this definition include taking more than the prescription to make up for gaps, taking the right dose of medication but at the wrong times or simply disposing of the medicine.

**Table 2:** Sample definitions of adherence: practice-focused papers.

Year	Definition	Reference
2002	“The extent to which a patient's behaviour (in terms of taking medication, following a diet, modifying habits or attending clinics) coincides with medical or health advice”	McDonald et al. <sup>12</sup>
2007	“% of Prescribed pills taken... >80% of prescribed pills taken... [non-adherence is] failing to collect medications for 2 consecutive months”	Kripalani et al. <sup>13</sup>
2015	“[non-adherence is] lack of correct behavior”	Tsega et al. <sup>14</sup>
2015	“The extent to which patients follow the instructions given for prescribed medications”	Chew et al. <sup>15</sup>
2015	“Both compliance (proximity to treatment recommendation often simplified as the number of doses taken divided by the number of prescribed doses) and persistence (how long the medication is taken)”	Touskova et al. <sup>16</sup>
2015	“self-reporting to have correctly taken the entire course of treatment”	Gore-Langton et al. <sup>17</sup>
2015	“[non-adherence is] the extent to which [patients] have altered their dose, forgotten to use the medication, stopped taking it for a while, decided to miss out on a dose and taken less than instructed... adherence being defined as answering “never” to all five”	Sandy & Connor <sup>18</sup>

**Table 3:** Sample definitions of adherence: theoretical and review papers.

Year	Definition	Reference
2007	“The extent to which patients follow the instructions they are given for prescribed treatments”	Munro et al. <sup>19</sup>
2009	“The extent to which the patient's behaviour matches agreed recommendations from the prescriber”	Nunes et al. 2009 <sup>20</sup>
2011	“Initiating the prescription, actual dosing in relation to the prescription and persisting with treatment”	Eliasson et al. <sup>21</sup>
2012	“The extent of conformity to treatment recommendations with respect to the timing, dosage, frequency and duration of a prescribed medication”	Gadkari & McHorney <sup>22</sup>
2013	“The process by which patients take their medications as prescribed. Adherence has three components: initiation, implementation and discontinuation”	Kardas et al. <sup>23</sup>
2014	“Correctly taking the full therapeutic course of treatment”	Bruxvoort et al. <sup>24</sup>
2014	“Those who reported to have taken the treatment as recommended (in terms of timing and dosage) with no tablets remaining”	Banek et al. <sup>25</sup>
2015	“a ratio of the number of drug doses taken to the number of doses prescribed over a given time period”	Morrison et al. <sup>26</sup>

This paper therefore aims to take a more theoretical perspective on adherence and the process of being adherent. This is not necessarily to replace operational definitions but to provide a greater understanding of the factors which may determine why adherence is achieved or non-adherence caused. It may be that this theoretical view of the process of adherence could support the development of more rigorous operational definitions.

### 3. Theories and Models Used in Adherence Research

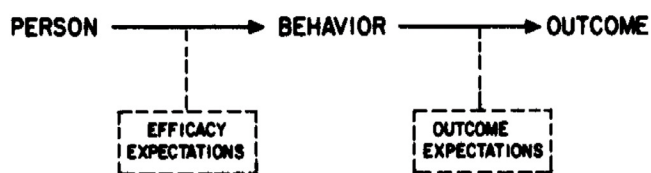
The following theories and models are sometimes invoked by adherence researchers, though often to provide guidance rather than actually being used as a basis for research. Even then, mention of these in adherence-related papers is sparse. Searching the MEDLINE database (the primary component of PubMed) and using Google Scholar revealed the results shown in (Table 4). These theories are discussed below.

**Table 4:** Results of searches for adherence papers.

Search term	MEDLINE	Google Scholar
"Medicine adherence"	18792	1220
+"medicine adherence" +"self-efficacy"	578	216
+"medicine adherence" +TPB	14	31
+"medicine adherence" +TRA	3	22
+"medicine adherence" +HBM	5	30
+"medicine adherence" +"COM-B"	0	3

#### 3.1. Theory of Self-Efficacy

The Theory of Self-Efficacy was propounded by Bandura in 1977.<sup>27</sup> He defined "self-efficacy as one's belief in one's ability to succeed in specific situations or accomplish a task". He considered that behaviour could be explained by a person's "expectations of personal efficacy [which] are derived from... performance accomplishments, vicarious experience, verbal persuasion and psychological states". Diagrammatically, he viewed behavioural expectations as per (Figure 1), from his 1977 paper. This shows that, in his view, expectations of efficacy should be distinguished from expectations of outcome.



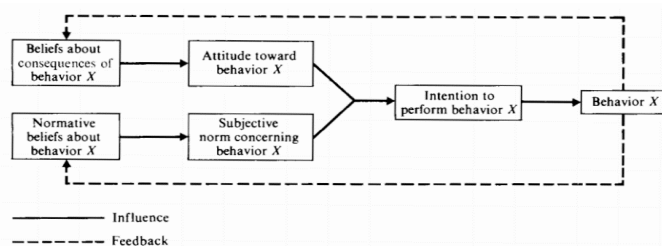
**Figure 1:** Theory of Self-Efficacy<sup>27</sup>.

From the figure it is possible to identify this theory as being based on what has become known as the "expectancy-value" family of models.<sup>28,29</sup> That is, a person's performance in a task can be explained by their expectation of the level of success - their perceived self-efficacy - combined with the expected value to them of the task.<sup>30</sup> This implies that someone who has a task that can be performed easily and which has significant value to them will be more motivated to perform it than if they consider it to be difficult and/or of low value. This theory has subsequently been subsumed into the Theory of Planned Behaviour.

#### 3.2. Theory of Reasoned Action

The Theory of Reasoned Action, often abbreviated as TRA, was developed by Fishbein & Ajzen in 1975.<sup>31</sup> The two authors developed a model which showed how beliefs, attitudes and intentions could be understood to predict behaviour. This model

was illustrated in the book which launched the theory and is reproduced in (Figure 2). As with Self-Efficacy Theory, it is an expectancy-value theory.



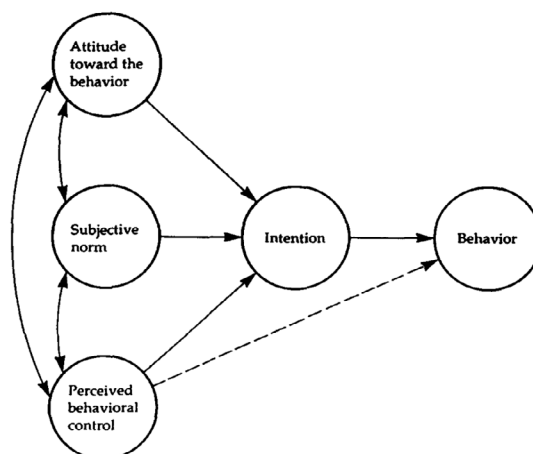
**Fig. 1.2** Schematic presentation of conceptual framework for the prediction of specific intentions and behaviors.

**Figure 2:** Theory of Reasoned Action<sup>31</sup>.

This model was eventually recognised as having several limitations. Its main assumption is that intention must lead directly to behaviour. A drawback is that a person's perception of success and value may not ultimately be accurate. Over time this simple model had to be modified to take account of wider issues not originally considered but which were found to arise in empirical research. Ajzen himself therefore superseded it with the Theory of Planned Behaviour.

#### 3.3. Theory of Planned Behaviour

In 1991 Ajzen<sup>32</sup> looked back at his Theory of Planned Behaviour (TPB) that he had propounded in 1985<sup>33</sup> as a follow-on to the Theory of Reasoned Action. The theory was illustrated in the 1991 paper and is portrayed as he created it in (Figure 3).



**Figure 3:** Theory of Planned Behaviour<sup>32</sup>.

He stated that the key enhancement of this theory over the earlier Theory of Reasoned Action was the incorporation of the person's perception that they had behavioural control over their actions. In his 1991 review, Ajzen stated that this addition to the Theory of Planned Behaviour was required because one of its limitations was that it did not recognise personal freedom to act. He went on to explain that inhibitors to action included time, money, skills and social support and that these vary by time and place. In this enhancement he incorporated elements of the person's resources and their environment. He also continued to accept that the theory measured intentions rather than action.

The theory includes certain elements of behaviour which are relevant to a process of adherence. These are the person's attitudes or beliefs, subjective norms which include perception of social support and behavioural control which is a part of perceived self-efficacy.

As with the Theory of Reasoned Action, the limitation of this theory is that it reaches only as far as the intention to act. There is an implicit assumption that intention leads directly to behaviour but this link is not theoretically justified. By omitting such justification for this assumption, it overlooks the significant possibility that it is not always true. This must also be considered for the theoretical process of adherence.

### 3.4. Health Belief Model (HBM)

The Health Belief Model (HBM) originated as a theory relating to the use of preventive health services in the 1950s before being applied to adherence.<sup>34,35</sup> This is claimed as a major organising framework for understanding adherence. However, it is a typical expectancy-value model in that it is based on two variables, the value of a person's goal and an estimation of whether any particular action will help with achieving it. In the health context, these two variables translate into the importance to the patient of getting well and the patient's expectation as to whether a health action such as taking medicine will contribute to their improvement.

The model mentions three patient beliefs, which later became four dimensions<sup>35</sup>: personal susceptibility to a disease, disease severity, benefit of action and perceived barriers to action. As mentioned, these all relate to beliefs and expectations so the actual value eventually achieved is not explored.

Janz & Becker,<sup>34</sup> in their systematic review of 46 studies of the HBM, emphasise that it is a psychosocial model that relates to attitudes and beliefs, therefore does not reach as far as the act of consumption. They also suggest that some health behaviours are habitual or undertaken for non-health reasons and recognise that there are some circumstances where health behaviours may be prevented by external issues such as medicine cost and issues which exist within the patient's medicine consumption environment. This model, while including the patient's motivations and some elements of environment, does not fully consider either the patient or the environment and does not investigate the attributes of the medicine at all. Becker<sup>10</sup> says that the most powerful dimension is the one relating to barriers and within that dimension the main concerns are social approval and the lack of self-efficacy.

### 3.5. COM-B model of behaviour

"COM-B" refers to the four elements of this simple model: (1) Capacity, (2) Opportunity and (3) Motivation, combining together to produce (4) Behaviour. See (Figure 4) for a diagrammatic representation of the model. This has been derived from the description of the theory in Ripple's 1955 paper,<sup>36</sup> which does not include a diagram of the model. The focus of her paper was on behaviour of Social Services clients in relation to the services being provided to them by their caseworker.

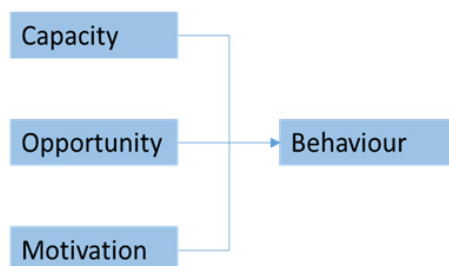


Figure 4: COM-B model after Ripple<sup>36</sup>.

Each of the three input factors was defined in detail in

Ripple's paper. Capacity related to a person's capability to act; Opportunity looked at self-efficacy and support within the environment; Motivation focused on the trigger of discomfort and perceived self-efficacy. This recognises the importance of self-efficacy and social support once again. However, as with other models there is an assumption that readiness for action leads directly to it.

### 3.6. Summary

These theories are typical expectancy-value models with a particular focus on value as relating to a priori expectations and so they relate strongly to expectancy rather than the final realisation of value. By design, expectancy-value models only explain the consumption process up to the point of the decision and it is necessary to go beyond these to get a more holistic perspective of the adherence process and explain a greater proportion of what affects adherence.

Service-Dominant Logic can be used as a lens to explore the action of consumption itself and therefore to gain insights into adherence as a process. The next section describes S-D Logic and adds two recent extensions as a basis for considering adherence.

## 4. Service-Dominant Logic

### 4.1. Overview

There are two competing ideas of value. The mainstream view of value is that value is embedded in goods during manufacture and distribution. Customers acquire that value at the point of purchase - value in exchange.<sup>37</sup> Smith's other view of value - value in use - is the one underpinning this research. It is here that S-D Logic concentrates. In the original paper launching S-D Logic written by Vargo & Lusch,<sup>2</sup> the value in exchange viewpoint was referred to as "Goods-Dominant Logic" to distinguish it from their new (or in their opinion the original) perspective. This is, that value is assessed at the point at which consumption takes place. The basis of S-D Logic is embodied in 11 "Foundational Premises".<sup>3,38-39</sup> The list can be found in Appendix A.

S-D Logic research states that "Service" in S-D Logic is not the same as "services" which are often mentioned in contradistinction to goods. S-D Logic's Service is considered to subsume both goods and services. The process of creating value in use requires the provision of resources from the patient, the medicine and the environment. S-D Logic refers to the value thus created as "value-in-context" because the value in use is created in the consumption environment or context. Because value-in-context is created by the patient from this combination of their own and the medicine's resources plus the resources within the context, the value creation process is referred to as "resource integration".<sup>3</sup> This recognises that the consumer must synchronise the use of resources in order to create value.

S-D Logic claims that, because value-in-context cannot be delivered by medicine suppliers in isolation but has to be created by the patient using their resources, suppliers can only offer "value propositions" to patients.<sup>40</sup> These are provided to patients in the form of medicines or "offerings".<sup>41</sup> It is the patient who determines the value of a medicine as they perform "value cocreation".<sup>2</sup> This implies that each patient may cocreate more, less or different value from the same medicine because of the differing resources of the patient and the context and their differing responses to the resources of the medicine.



S-D Logic states that in the process of generating value-in-context the patient's primary resource is their "agency", which is defined as their skills and competencies or their ability to act. These skills and competencies are referred to as "operant resources". This distinguishes them from the "operand resources" which are resources which need action to be taken on them, such as medicine. The patient's operant resources interact with what the value proposition provides, which are "affordances" manifest as resources.<sup>41</sup> The patient's agency (operant resources) and the resources provided by the value proposition's affordances are integrated by the patient in context to cocreate value.

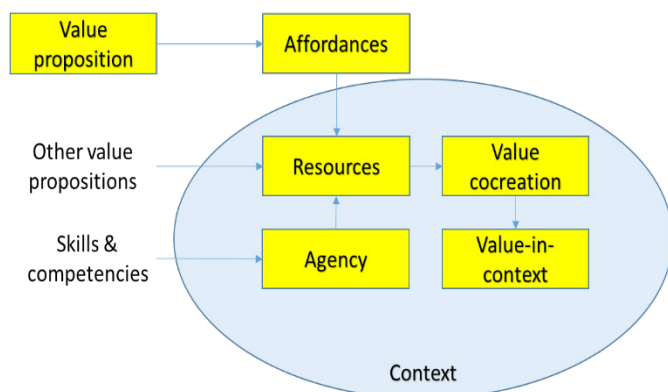
In all this can be seen a triad of patient, medicine and context. Using S-D Logic as the basis for bringing these together can be visualised as follows.

#### 4.2. Visualising S-D Logic diagrammatically

The basis of cocreation of value is that the patient integrates resources from the supplier, the context and themselves.<sup>42</sup> The patient's resources are their skills and competencies, otherwise referred to as agency, which may be enabled or restrained by the consumption context.<sup>41</sup> Resource integration only happens in context. The value created is context-dependent,<sup>43</sup> and is determined in use.

Resources need to be recognised as such before they can become part of the value cocreation process. Until they are so recognised, they remain as "potential resources".<sup>44</sup> Potential resources provided by suppliers are referred to in S-D Logic as affordances and affordances become resources when acted on (consumed) in context. Their source is the supplier's offering or in other words the value proposition of the medicine.<sup>41</sup> Value-in-context is therefore cocreated by the patient in context using the resources provided by the medicine supplier's value proposition plus resources from other providers.

In summary, the supplier's value proposition offers affordances which become resources in the consumption context. Further resources arise from other value propositions which exist in the consumption context. The patient brings skills and competencies, which include beliefs and motivation, to apply their agency on the resources, performing value cocreation activities to produce value-in-context. This is visualised as (Figure 5).



**Figure 5:** Service-Dominant Logic diagrammatically.

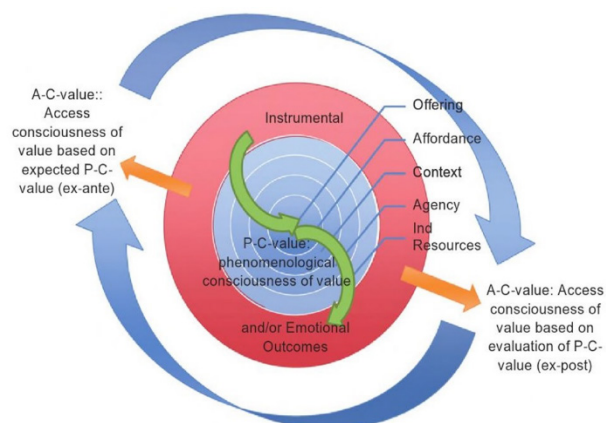
Figure 5 provides several useful insights. Firstly, and obviously is the importance of context to the cocreation of value-in-context. Secondly, agency acts in context on resources but the affordances of the medicine are independent of context

because they are not necessarily recognised as resources until the consumption context becomes apparent. Thirdly, other value propositions also provide resources in context and the patient integrates these resources with the resources of the medicine's affordances arising from its value proposition to create sufficient density to achieve value-in-context through the process of value cocreation. If adherence is to be achieved then the interaction of these multiple service systems,<sup>3</sup> including the patient, the medicine provider, the providers of other resources and elements of context, is needed.

#### 4.3. Extending S-D Logic

However, there are three points which still need clarification. Firstly, in common with the previously investigated behavioural theories and models, S-D Logic does not explicitly recognise the possibility of consumption not taking place. That is, it does not recognise non-adherence. It is already clear from the foregoing that there are potentially many reasons for non-adherence embodied in the patient, the medicine and the context, but more clarity is required in terms of understanding adherence as a process. Secondly, it is obvious that adherence is intended to provide value. However, it is necessary to consider when and what value is cocreated and how it is assessed. Thirdly, the patient's context can include more than one concurrent Service Ecosystem<sup>45</sup> together with their associated institutional arrangements.<sup>39</sup>

To address the first and second points, the "Integrative Framework of Value"<sup>41</sup> can be invoked and added to the visualisation in (Figure 6). This explains that there are two types of value. The first is "Phenomenal-Consciousness value" (P-C value). This is equivalent to the value cocreated in context. The value that is assessed rather than experienced is the second type of value, "Access-Consciousness value" (A-C value). The term refers to the way that value is assessed outside of context, either in advance of consumption or in retrospect. This is described as "...the perception, introspection and memory (or imagination) of P-[C] value before (ex-ante) and after (ex post) ... the perception of goodness that drives choice ex ante and valuation ex post". Figure 6 shows these.



*Fig. 1. The Integrated Value Framework.*

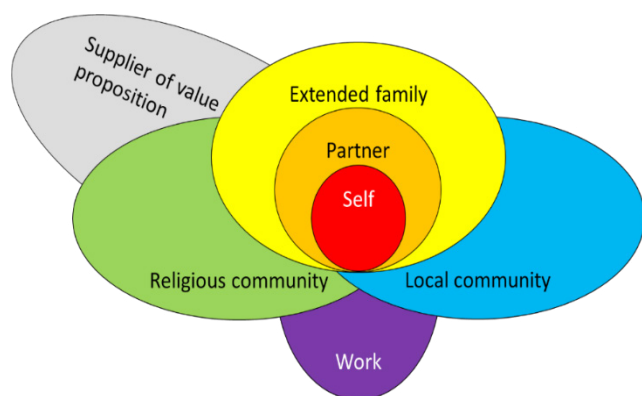
**Figure 6:** Integrative Framework of Value<sup>41</sup>.

A-C Value ex ante is all about perception of what is expected to happen during value cocreation. This mirrors expectancy-value theories; until the moment of consumption all is perception and expectation. A-C value assessments can commence even before the medicine is obtained. However, ex ante assessments of value

cocreation can only ever be perceptions of what might happen rather than the certainty of what will. Because the moment of value cocreation is unknown in advance, advance assessments of agency and affordance may be proven to be misjudgements once value cocreation is attempted in reality. S-D Logic focuses on the moment of value cocreation in situations where everything is in place for adherence, whereas it is important also to consider possible inaccurate advance expectations of P-C value and ex post A-C value. It is also necessary to be aware that there may be contexts where resources are limited or missing. In such circumstances, the value cocreation process may not deliver the expected value-in-context. In addition, expected outcomes may not be achieved even when the planned behaviour commences. In the consumption moment, resources and/or agency may initially be present at a sufficient level to start the process but not be enough to complete it. It therefore seems that A-C value judgements do not just take place before and after the P-C value-cocreating episode, but also during it.

To address the third point, it is useful to visualise what a combination of Service Ecosystems might look like in the patient's consumption context. The concept of Service Ecosystems and their associated institutions refers to "...relatively self-contained, self-adjusting system[s] of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange".<sup>40</sup> These systems are flexible, loosely coupled and may be temporary. A patient can be in several service ecosystems at the same time,<sup>45</sup> and service ecosystems may be nested.<sup>39</sup> Each service ecosystem has its own institutional arrangements or "rules of the game". An idea of one potential combination out of very many possibilities is shown in (Figure 7).

The Service Ecosystem labelled "Supplier of value proposition" represents the ecosystem which defines the institutional arrangements for consuming the medicine. If the patient is fully aligned with only that Service Ecosystem, then it is to be expected, all things being equal, that they will be fully adherent. However, the patient is likely to be at least partially aligned with other ecosystems and these may turn out to be different ones at each adherence opportunity.

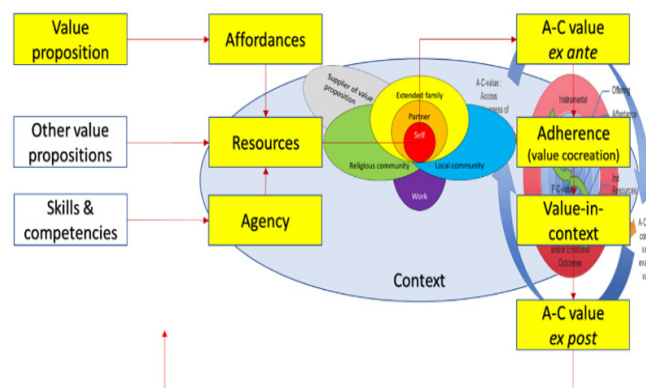


**Figure 7:** Possible service ecosystems represented diagrammatically.

A patient's decision-making will vary depending on which of the Service Ecosystems and their institutional arrangements they have in focus. What is perceived to be good in one service ecosystem may not be in another. For example, a patient's perception of what is accepted in their religious community may be different to what is acceptable to their partner. The decision on whether to be adherent will depend on which service

ecosystem takes precedence during the consumption episode. That might be due to where they are at the time when adherence should occur or who/what they are thinking about at that point. It might also depend on whether they can receive the support of the ecosystem, for example whether a partner is present with them or whether the doctor is watching them.

Combining these two additions with the basic S-D Logic diagram results in Figure 8. This positions the Integrative Framework of Value around the value cocreation activity and Service Ecosystems within the patient's context. It shows a feedback loop from ex post A-C value assessment back into the adherence process, contributing to the patient's subsequent decisions on whether to be adherent in future (Figure 8).



**Figure 8:** S-D Logic enhanced with Integrative Framework of Value and Service Ecosystems.

#### 4.4. Summary

S-D Logic appears to provide a framework for understanding the process of adherence at the point of consumption which goes beyond that which expectancy-value behavioural theories can achieve. Some of what might be considered to be potential limitations of the framework seem to be addressed by the two later additions: a greater understanding of context is provided by the notion of contradictory overlapping and nested Service Ecosystems, while a clearer picture of value assessment is offered by the Integrative Framework of Value. This model is now tested in qualitative research.

#### 5. Method

A series of semi-structured interviews was arranged with people who were willing to talk about their past experience of taking medicines. They were located in various environments ranging from a comfortable urban environment in a developed country through to an impoverished rural environment in a developing country. Interviewees were selected using purposive sampling. Initial interviews were performed with contacts in UK. Following that, interviews were arranged with contacts in a range of developing countries including Kenya, Tanzania, Kazakhstan and Nigeria. These were intended to explore situations in the developing world, primarily sub-Saharan Africa. Over time, further interviews were performed in countries other than those mentioned above in order to build the widest picture and to understand their relationship to the initial findings. Most of the later interviews used snowball sampling, with earlier interviewees encouraging their acquaintances to participate.

A total of 30 interviews were performed over a period of just over 5 months from the end of December 2014 to early June 2015. Details of the interviewees, locations, medicines, questions

and interview analysis have been documented previously.<sup>46</sup> Interviewees, locations and medicines are repeated in Appendix B, while questions are listed in Appendix C.

## 6. Results and Discussion

Interviews were coded and categories derived. Causes of non-adherence were compared to a recognised list created by the American Society on Aging and American Society of Consultant Pharmacists (ASA & ASCP) to confirm good coverage;<sup>47</sup> not only were most causes identified in the interviews, but new causes were found and these are listed in (Table 5). Similar causes of non-adherence were seen in both developing and developed worlds. For example, a lack of food and water for taking tablets was mentioned in both environments yet these reasons were not mentioned in the ASA & ASCP list. This suggests that interviews are of significant importance both to understand non-adherence reasons in detail and also to expand the list of known reasons.

**Table 5:** Causes of non-adherence not found in ASA & ASCP.

Cause
Concern with medicine content
Verbal instructions in foreign language
Written instructions in foreign language
Pharmaceutical industry profits
Herbal medicine industry profits
Feeling better
Lack of food
Lack of water
Concern that medicines is of foreign origin
Lack of faith leading to need for medicine
One medicine being replaced by another
Medicine kept for future occasions
Medicine kept for family need
Instructions misunderstood
Difference between written and verbal instructions
Lack of routine
Lack of safe storage
Forgetfulness
Run out of medicine

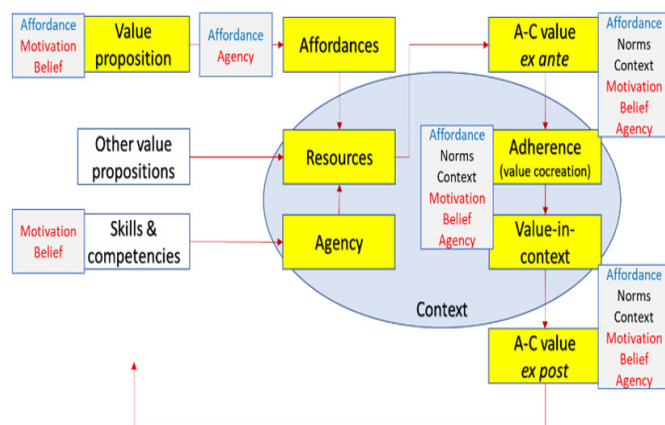
A taxonomy of categories of non-adherence was developed. This is shown in (Table 6).<sup>46</sup>

**Table 6:** Taxonomy of categories of non-adherence<sup>46</sup>.

Taxonomic Entity	Categories
Patient motivation	Motivation
Patient agency	Course, routine, stop
Patient beliefs	Beliefs
Consumption context	People, utensils, reminder, water, food, storage, norms
Product affordance	Content, branding, effects, taste, formulation, size, smell, instructions, regimen, distance, access, cost, diagnosis

In addition, interview content was assessed against each of the adherence factors in the S-D Logic process. Taking this assessment plus the content of Table 6 and comparing it with Figure 8 showed that the taxonomy aligns with S-D Logic and therefore supports the assertion that S-D Logic with the two extensions is a valid way to understand adherence as a process.

(Figure 8) can be extended to highlight the presence of each of the taxonomic entities, to deliver (Figure 9). This shows the patient-related entities in red, product-related entities in blue and context in black.



**Figure 9:** Adherence as a process.

This figure provides useful understanding of adherence as a process. A step-by-step analysis of the process leads to the following insights.

The patient must have a way of identifying one or more medicines which could meet their need in context or in other words to know what value propositions are available and to perceive their affordances. Without this knowledge adherence is not possible.

The value proposition of the medicine must be accessible to the patient if it is to be consumed. It must be provided at a cost which the patient can afford and at a location which is attainable. This indicates that the patient's agency includes the means (money and ability to reach the point of supply) to acquire it.

The patient must perceive that they have sufficient agency – operant resources provided by their skills and competencies including motivation and beliefs – to be able to take the medicine or in other words to act on the resources provided by the value proposition of the medicine in order to cocreate value. Without this perception of capability, the adherence attempt may not commence.

The patient must have sufficient motivation and belief to put time, money and effort both into obtaining the medicine at the start of the process and bringing the required skills and competencies to bear to consume it.

The affordance of the value proposition must be sufficient to provide the required resources into the consumption context.

The patient must perceive that they have all of the other value propositions in their context which are required to successfully cocreate value. If the patient does not have or does not perceive that they have, all the co-requisites in context then the adherence attempt is unlikely to commence.

Once the patient has the medicine, is motivated to consume it and perceives that they have the agency, then they must assess the A-C value to decide whether to go ahead and attempt to cocreate value – the assessment must indicate that, all things considered, consuming the medicine is the right thing to do. This assessment will consider the perspectives of the multiple Service Ecosystems in which they exist and their connectedness to those ecosystems and will weigh up the pros and cons of being



adherent within each one of them. If their assessment is negative in relation to their most important Service Ecosystem at that point in time then it is unlikely that adherence will commence.

Once a decision has been taken to consume, the patient moves to execute the process of value cocreation in order to cocreate value-in-context or, in other words, to be adherent. At this point the perceptions of agency and resources are tested against reality. If agency is lacking or resources are missing or are exhausted, then adherence will commence but will not be successful. If the instructions are accurate and followed correctly then consumption is adherent and the supplier of the medicine would expect the patient, all things being equal, to cocreate the offered value-in-context from the medicine. However, if instructions are incorrect or are not followed correctly then value cocreation may not be successful.

At the point at which consumption takes place, all the required factors are positively aligned and remain so for the duration of the event.

Following value cocreation, the patient will assess the A-C value ex post to determine the nature and level of value created. This assessment will feed back into future decisions to consume (ex ante A-C value assessment) and will contribute to the patient's experience for future adherence opportunities. This ex-post A-C value assessment must be made at a legitimate time, depending on how long it takes for the effects of the medicine to be seen.

It is also possible to consider the effect of this approach on changes to adherence over time. While adherence is a point-in-time opportunity to consume or not, consideration of the feedback loop within the Integrative Framework of Value provides the chance to raise some questions relating to adherence over time based on A-C value assessments. All changes over time may be assessed at any place in the adherence process, but perhaps there are three key places. Firstly, through A-C valuation ex post after adherence is attempted. Secondly at the point of ex ante assessment before an adherence attempt. But thirdly, changes may only be identified at the point at which adherence is attempted or in other words at the point of value cocreation.

If the patient's agency changes then that may drive change over time. Such change may lead to higher or lower adherence and therefore affect the level of adherence at each opportunity to adhere.

If the medicine's affordances change then this may lead to change. As before, this may increase or decrease point-in-time adherence at different times.

If the context or norms change then this may lead to change. Changes to either of these could lead to an increase or decrease in point-in-time adherence at different times.

It is profitable to think of adherence as an individual opportunity to consume since the many variables which contribute to being adherent are as constant as they can be at a point in time. Taking adherence to mean being compliant over the period of the course of treatment is also valuable, but of necessity it must average all the factors over time. This means that the detail of what happens at each adherence opportunity is inevitably missed. Building a greater understanding of what drives adherence requires deep knowledge of individual adherence attempts.

## 7. Conclusion

This research has evaluated S-D Logic and confirmed that it can form the basis for understanding the act of adherence. In addition, it can provide insights into the end-to-end adherence process. This permits theorisation of adherence beyond the existing use of expectancy-value theories and models.

It has also indicated that the Integrative Framework of Value can explain not only decision-making leading up to adherence, therefore potentially replacing those theories in this process view of adherence, but can also shed light on the thinking which takes place after the adherence attempt.

The inclusion of Service Ecosystems and their institutions has helped in understanding the complexity of decision-making due to the patient occupying multiple ecosystems simultaneously.

In summary, the use of Service-Dominant Logic as a lens which encompasses the full adherence process from absence to post-consumption value assessment significantly extends the theories currently applied to adherence research. It also shows some of the irreducible complexity innate in adherence when it is understood as a complex interaction of service systems. Through this depiction it can be understood just why adherence is so hard to pin down empirically and perhaps explains why there is so much inconclusive research. Using a view of the process like this can provide a basis for future empirical research since it can illuminate reasons for results.

Adherence is critical to clinical outcomes. There are two key implications emerging from this research. Firstly, it is clear that there are several factors affecting adherence and that understanding adherence as a process can help in understanding their interrelationships and where they act. These insights should help pharmaceutical manufacturers to make their medicines more applicable to the patients in their contexts whom they are targeting with each medicine. In particular, medicines which more completely address contextual challenges could be more successful in raising adherence than those which at present might be perceived as "one size fits all". There is much discussion about manufacturers becoming more patient-centric; this provides a means by which it might be possible to deliver on that commitment.

Secondly and extending the first, some adherence factors are effectively "mirror images" of each other. For example, a patient's context may not be contributing sufficient resources to permit adherence, but if the medicine's affordance were to be enhanced then consumption might still be able to occur. Perhaps a patient's context cannot provide food or water, but if these could be incorporated into the medicine in some way then the patient may still be able to be adherent. Similarly, the patient's agency may be limited – perhaps not being able to open the bottle or to swallow large pills - but enhancements to the medicine's value proposition might address such limitations. This is potentially a very valuable area to investigate as manufacturers aim to deliver outcomes rather than simply focus on inputs.

## 8. Declarations

**Funding:** This research was funded by the UK EPSRC as part of its funding of PhD students.

**Institutional Review Board Statement:** The study was



conducted in accordance with the Declaration of Helsinki and approved by the Biomedical and Scientific Research Ethics Sub-Committee of the University of Warwick Medical School on 26 January 2016 with code REGO-2014-1295.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

## 9. Appendices

### Appendix A: Foundational Premises of Service-Dominant Logic

**Table 7:** Foundational Premises of Service-Dominant Logic <sup>3,38-39</sup>.

FP	Foundational Premise (axioms highlighted)	Comment/explanation
1	<b>Service is the fundamental basis of exchange</b>	The application of operant resources (knowledge and skills), “service”, as defined in S-D logic, is the basis for all exchange. Service is exchanged for service
2	Indirect exchange masks the fundamental basis of exchange	Because service is provided through complex combinations of goods, money and institutions, the service basis of exchange is not always apparent
3	Goods are a distribution mechanism for service provision	Goods (both durable and non-durable) derive their value through use – the service they provide
4	Operant resources are the fundamental source of strategic benefit	The comparative ability to cause desired change drives competition
5	<b>All economies are service economies</b>	Service (singular) is only now becoming more apparent with increased specialization and outsourcing
6	<b>Value is co-created by multiple actors, always including the beneficiary</b>	Implies value creation is interactional
7	Actors cannot deliver value but can participate in the creation and offering of value propositions	Enterprises can offer their applied resources for value creation and collaboratively (interactively) create value following acceptance of value propositions, but cannot create and/or deliver value independently
8	A service-centered view is inherently beneficiary-oriented and relational	Because service is defined in terms of customer-determined benefit and co-created it is inherently customer oriented and relational
9	<b>All social and economic actors are resource integrators</b>	Implies the context of value creation is networks of networks (resource integrators)
10	<b>Value is always uniquely and phenomenologically determined by the beneficiary</b>	Value is idiosyncratic, experiential, contextual and meaning-laden
11	<b>Value co-creation is coordinated through actor-generated institutions and institutional arrangements</b>	“[S-D Logic] is a narrative of cooperation and coordination in ecosystems, as well as the reconciliation of conflict between them. Institutions are instrumental in these cooperation and coordination activities by providing the building blocks for increasingly complex and interrelated resource-integration and service-exchange activities in nested and overlapping ecosystems organized around shared purposes” <sup>39</sup>

### Appendix B: Interviewee details

**Table 8:** Interviewee details <sup>46</sup>.

Country	Sex	Age range	Medicine
Egypt	F	20-40	Cough medicine
Kenya	M	20-40	Antibiotics
Kenya	M	40-60	Amoxycilin
Kenya	M	20-40	Malaria tablets
Kenya	M	60+	Coartem
Kenya	F	20-40	Malaria tablets
Kenya	M	20-40	Pain killer, curatives
Kenya	M	40-60	Malaria (AL)
Kenya	M	20-40	Panadol
Kenya	M	40-60	Chroton B
Kenya	F	20-40	Quinine
Kenya	F	20-40	Panadol
Kenya	F	20-40	Flugone
Kenya	M	40-60	Cold Cups

Country	Sex	Age range	Medicine
Kenya	M	20-40	Ibuprofen
Kazakhstan	F	20-40	Repronact
Nigeria	M	40-60	Artesunate
Tanzania	M	40-60	Coartem
Tanzania	M	60+	Paladrin
Tanzania	M	60+	for Stomach Abscess
Tanzania	F	40-60	Malafin, Panadol, Maleratab
Uganda	M	40-60	Quinine
UK	F	<20	Roacutane, Erythromycin
UK	M	40-60	(multiple)
UK	F	>60	Metformin
UK	M	>60	Antibiotics
UK	M	>60	for Angina
UK	F	>60	Sulfasalazine, Methotrexate
Zimbabwe	F	20-40	Amoxycilin
Zambia	M	40-60	Coartem

## Appendix C: Interview questions

**Table 9:** Interview questions <sup>46</sup>.

Number	Question
1	What medicine do you wish to share your experiences of?
2	Is this your first time with this medicine or is it a repeat prescription?
3	How far was it to a pharmacy?
4	How much did it cost you to buy the medicine?
5	Did you obtain the medicine?
6	If you obtained the medicine, how did you feel about it at the time?
7	Did you actually plan to consume it in line with the prescription?
8	Did you know how to take this medicine? How do you know?
9	Please describe your physical surroundings on various occasions when the prescription said you should consume. Who and what was there and not there?
10	What were you thinking and feeling?
11	How were your physical and mental health?
12	Did you actually consume at that time?
13	What helped you to consume or prevented you from consuming?
14	Is there anything about the medicine that makes it hard for you to take it? What would make it easier for you?
15	If you had the choice, how would you like to take this medicine?
16	Anything else you want to say about what makes it easy or difficult to take medicines for you personally?

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