Assistive Technology Device Use in Patients With Rheumatic Disease: A Literature Review

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Key Words: self-help devices

Assistive technology devices (ATDs) are often used by persons with rheumatic disease to improve their functional capabilities (Kulp, 1988; Spiegel et al., 1986). Such devices substitute for impairments in range of motion, muscular strength, endurance, manual dexterity, and mobility. Sock aids and bathtub benches, for example, are often recommended to facilitate dressing and bathing, respectively, in persons with limitations in lower extremity range of motion. Patients with arthritis often obtain these ATDs upon the recommendation of occupational therapists. Prescription is based on an appraisal of patients’ functional needs and their motoric, cognitive, and attitudinal capabilities for using the device. Therapists sense, however, that many devices are being prescribed but not obtained or being obtained but not used appropriately. With this in mind, we reviewed the literature with the goal of providing a perspective on the use and effectiveness of ATDs. The specific objectives were to (a) document usage rates, (b) identify factors contributing to use and disuse, and (c) devise a conceptual framework for systematically evaluating the therapeutic use of ATDs. The target population for the literature review was patients with osteoarthritis and rheumatoid arthritis. Literature pertaining to ATD use in other populations was reviewed when applicable. The exploration of ATDs was limited to devices for personal self-care tasks.

ATD Use

Patients with osteoarthritis and rheumatoid arthritis have physical impairments that hamper the performance of daily living tasks. Dysfunctions in performing these tasks can often be lessened or overcome through the use of ATDs. Multidiagnostic surveys suggest that more ATDs are prescribed for patients with osteoarthritis and rheumatoid arthritis than for patients with other chronic diseases (Chamberlain, 1979; Chamberlain, Thornely, & Wright, 1978; Shipman, 1987; Stowe, Thornely, Chamberlain, & Wright, 1982; Thornely, Chamberlain, & Wright, 1977). The high rate of ATD prescription for these patients makes them an ideal target population for the examination of device use.

Estimates of overall ATD usage range from 82% at a variable follow-up time up to 17 months after discharge (Bynum & Rogers, 1987) to 41% at a 2.5 month follow-up (Haworth, 1983). In regard to the use of specific types of ATDs, Haworth (1983) reported that 2 weeks after discharge only 82% of toilet devices, 81% of walking devices, 74% of dressing devices, and 64% of bathing devices were in use. Thus, while research indicates that the majority of ATDs are used, it also suggests that a substantial proportion are never used or are discarded shortly after they are obtained. The mean number of ATDs actually used per person is about 2 to 3 (Chamberlain, Thornely, Stowe, & Wright, 1981; Haworth, 1983; Haworth & Hopkins, 1980;
American patients is hazardous, because device usage is and societal mechanisms for providing and paying for (Kulp, 1988; Pfister, 1984; Yasuda & Hanten, 1985). The most extensive ATDs are highly used by patients with rheumatoid arthritis (Kulp, 1988). Raised toilet seats, bathtub and shower benches, and long-handled dressing devices are popular with these patients (Kulp, 1988; Pfister, 1984; Yasuda & Hanten, 1985). Patients having hip arthroplasties make use of reachers, sock cones, elastic laces, bath sponges, bathtub benches, raised toilet seats, and long-handled shoe horns, with reachers and raised toilet seats being ranked as most useful (Seeger & Fisher, 1982).

There are several reasons why it is difficult to draw firm conclusions regarding ATD usage from the accumulated data. One reason is the shifting meaning of the term usage. ATD usage has been variously defined as (a) in use at the time selected for follow-up (Bynum & Rogers, 1987; Caudrey & Seeger, 1983; Chamberlain et al., 1978; Chamberlain et al., 1981; Haworth, 1983; Haworth & Hopkins, 1980; Hollings & Haworth, 1978; Stowe et al., 1982; Thornely et al., 1977); (b) frequency of use (e.g., always, frequently, seldom) (Geiger, 1990; Kulp, 1988; Seeger & Fisher, 1982; Smith, 1984); (c) duration of use per day (Caudry & Seeger, 1983); (d) used at any point postdischarge (Seeger & Fisher, 1982); (e) average use (Kulp, 1988); and (f) used at least three times since prescription (Shipman, 1987). Furthermore, usage rates have not been adjusted to accommodate appropriate discard of devices due to changes in functional status. These variations in measuring ATD usage make it difficult to compare studies and identify trends.

A second reason why usage estimates should be appraised with caution relates to the social and economic relevance of the findings. Few studies have sampled adult Americans, and of those that have, ATD usage is often a minor aspect of the research (Bynum & Rogers, 1987; Feinberg & Brandt, 1984; Geiger, 1990; Kulp, 1988; Pfister, 1984; Smith, 1984; Seeger & Fisher, 1982; Spiegel et al., 1986; Yasuda & Hanten, 1985). The most extensive research on ATD usage has been done in foreign countries, especially Great Britain (Caudrey & Seeger, 1983; Chamberlain, 1979; Chamberlain et al., 1978; Chamberlain et al., 1981; Haworth, 1983; Haworth & Hopkins, 1980; Hollings & Haworth, 1978; Shipman, 1987; Staisey, 1984; Stowe & Chamberlain, 1980; Stowe et al., 1982; Thornely et al., 1977). Extrapolating from these results to American patients is hazardous, because device usage is likely to be associated with cultural values concerning use and societal mechanisms for providing and paying for them.

A third reason for caution in interpreting usage statistics involves the specific populations studied. To date, research has concentrated on patients having hip replacement surgery (Haworth, 1983; Haworth & Hopkins, 1980) and multidiagnostic samples (Bynum & Rogers, 1987; Chamberlain et al., 1978; Chamberlain et al., 1981; Geiger, 1990; Thornely et al., 1977; Shipman, 1987; Stowe et al., 1982). Patients with hip surgery represent only one faction of those with rheumatic disease. ATD usage in patients with other types of arthritic problems has been neglected. In the case of multidiagnostic samples, the usage patterns of one diagnostic group (e.g., persons with stroke) may be obscured by those of another (e.g., persons with spinal cord injury).

ATD Use and Disuse

Despite shortcomings in the definition of ATD usage, the literature suggests some fruitful areas for one to explore in devising a conceptual model to guide empirical research. Concepts identified as pertinent to ATD usage have been grouped under the categories of person, environment, and ATD.

Person

Evidence suggests that ATD usage is associated with age, sex, type of disease, disease severity, capability, and multiple diseases. Some results support a differential age effect, while others do not (Haworth, 1983; Shipman, 1987). When found, age effects have been confined to walking devices, with older people making more use of these devices than younger people (Haworth & Hopkins, 1980). The findings regarding sex differences are also equivocal (Haworth, 1983; Haworth & Hopkins, 1980; Shipman, 1987). In terms of disease, patients with rheumatoid arthritis tend to make more use of ATD than do those with osteoarthritis (Haworth, 1983; Haworth & Hopkins, 1980) as well as those with orthopedic conditions and neurological conditions, excepting stroke (Chamberlain et al., 1978). Device usage also increases when rheumatic disease is complicated by other medical problems (Haworth, 1983). Correlations have also been found between impairment severity and ATD usage (Kulp, 1988). For example, patients with bilateral osteoarthritis use devices more than do those with unilateral osteoarthritis (Haworth & Hopkins, 1980). Similarly, rheumatoid arthritis patients having surgery use more equipment than do those not having surgery, and those with more functional limitations use more equipment than do those with fewer functional limitations, although these differences are not statistically significant (Kulp, 1988). Changes in functional capacity reflecting either improvement or deterioration precipitate changes in ATD usage (Bynum & Rogers, 1987; Chamberlain et al., 1978; Hollings & Haworth, 1978; Kulp, 1988; Seeger & Fisher, 1982; Shipman, 1987). Patients who are able to carry out an activity without using a device, even when it is more difficult or an alternate method is needed, are inclined to do so (Haworth, 1983; Shipman, 1987).

Person variables span psychological as well as demographic and physical realms. Despite frequent mention of...
attitudes, values, and cognition in the literature, these factors have been largely ignored in research. One study found that if patients valued being independent in an activity, they were more likely to be independent in that activity than if independence was not valued (Bynum & Rogers, 1987). Another study noted that having confidence in an ATD facilitated its use (Chamberlain et al., 1978). Fear associated with performing the device-related activity, a personal preference for human help as opposed to technical help, and concern about an ATD inconveniencing others were found to decrease usage (Chamberlain, 1979; Geiger, 1990; Haworth, 1983; Kulp, 1988; Shipman, 1987). Interestingly, no differences in usage were found between patients who paid for ATDs themselves and those who received them free of charge (Shipman, 1987).

Environment

In terms of environmental variables, ATD usage has been considered from the perspective of both physical and social factors. The negative effects of housing conditions on usage have been documented (Chamberlain, 1979; Chamberlain et al., 1978; Shipman, 1987; Thornely et al., 1977). Of particular concern, for example, are narrow doorways, doors opening into the bathroom, and multi-level homes. By precluding access to bathing and toileting facilities for wheelchair users and those with mobility dysfunctions, these architectural barriers also preclude the use of ATDs prescribed to assist with these activities. Conversely, these same architectural barriers may also make ATD use a necessity, such as when a commode is put in the bedroom because the standard toilet in the bathroom is inaccessible (Bynum & Rogers, 1987). Also of concern are prescribed devices that are incompatible with the physical features of patients' homes (Chamberlain et al., 1978; Shipman, 1987; Thornely et al., 1977). Items like raised toilet seats that are the wrong shape for the commode aperture and ill-fitting bath seats are illustrative of prescriptive errors.

Somewhat conflicting results have emerged in regard to the effect of the social environment on ATD usage. Shipman (1987) found that living alone or with others did not influence device usage. Although almost 94% of those who lived alone used their bath seats, compared with 79.6% of those who lived with others, the difference between users and non-users was not statistically significant. Pfister (1984) ascertained that those who lived alone were more compliant with usage. Several researchers have emphasized that even when devices fail to enable totally independent activity, they are still of value in promoting independence and in assisting caregivers (Bynum & Rogers, 1987; Chamberlain, 1979; Chamberlain et al., 1978; Seeger & Fisher, 1982; Shinnar, 1983; Thornely et al., 1977). Human help may still be needed for the device-related step of an activity (e.g., transferring using an extended-seat bathtub bench) or for another step of the activity (e.g., washing the body). In this regard, Chamberlain (1979) reported that 25% of the subjects required help in getting to the bathroom, 50% in bathtub transfers, and 70% in washing and drying. Withdrawal of a helper may also spur ATD usage (Chamberlain et al., 1978).

ATD: Prescription and Characteristics

In addition to personal and environmental variables, factors more directly related to the ATD have also been linked to ATD usage. These involve the prescription and provision of ATDs and their technical and ergonomic features. ATD prescription involves the selection of an ATD that matches the patient's functional needs and capabilities. ATD prescriptions commonly aim at preventing impairment, facilitating task performance, enabling independent task performance, and easing caregiver burden (Staisey, 1984). An ATD may be prescribed to compensate for different types of impairments. The main reason for prescribing walking devices after total hip replacement surgery is to improve the pattern of walking: for prescribing dressing devices, to manage pain and range of motion restrictions and joint protection; for prescribing bathing devices, to promote safety; and for prescribing toilet devices, to manage pain and range of motion restrictions and to promote safety. Research shows that walking, dressing, and toileting devices given to hip replacement patients to compensate for non-hip-related joint problems were used longer than those given to promote confidence in doing the activity, reduce pain, manage insufficient range of motion, or protect the new hip. Bathing ATDs supplied for safety alone or in combination with managing pain and range of motion deficiency were used longer than those supplied for other reasons (Haworth, 1983). Feeding, dressing, bathing, and toileting ATDs are prescribed to protect joints, increase safety, and improve body mechanics (Rogers, Poole, Holm, Kwoh, & Stofko, 1989).

ATDs may be recommended by various human service professionals who come in contact with patients. One study examined user satisfaction with ATDs based on whether ATDs were recommended by a hospital-based occupational therapist who did not visit patients' homes, a community-based occupational therapist who did visit patients' homes, social services personnel, or patients themselves. Of the ATDs recommended by community-based occupational therapists, 1.5% were seen as unsatisfactory, and of those recommended by hospital-based occupational therapists, 6.9% were seen as unsatisfactory. Most ATDs were supplied by social services personnel, and 30.9% were regarded as unsuitable. Of the self-recommended ATDs, 7.7% were judged similarly unsuitable. Most of the dissatisfaction centered on ill-fitting bathing ATDs. Having access to ATDs through mail order
is of particular benefit to homebound patients. However, difficulties are encountered in both self- assessing the functional problem correctly and in installing the ATD properly (Stowe & Chamberlain, 1980). The use of allied health professionals to monitor the functional health of patients with rheumatoid arthritis increases both the prescription rate and use of ATDs (Feinberg & Brandt, 1984).

Once prescribed, ATDs may be provided immediately or ordered later. Although most patients appear to receive ATDs immediately or within weeks of prescription, a substantive minority (e.g., 28% to 37%) wait months (Chamberlain et al., 1978; Haworth, 1983; Stowe et al., 1982). Delays in obtaining devices pose particular problems if they are prescribed for temporary use, because by the time they are obtained they may no longer be needed. Loaning devices to patients and obtaining them through mail order are efficient mechanisms for promptly providing ATDs to patients (Haworth & Hopkins, 1980; Stowe & Chamberlain, 1980; Stowe et al., 1982). The prompt provision of an ATD was a critical element of a patient training program that increased ATD usage (Chamberlain et al., 1981; Stowe et al., 1982).

From a technical and ergonomic perspective, ATDs are generally rated by patients as reliable, safe, sturdy, comfortable, and acceptable (Caudry & Seeger, 1983; Chamberlain et al., 1978; Thornely et al., 1977). Few studies, however, have been as scientifically sound as that conducted by Pugh and Stansfield (1989) on drinking equipment. The findings from this study are particularly noteworthy because they indicated that the cups most popular with patients were the least known and least prescribed by therapists. The findings further indicated that the drinking equipment most prescribed by therapists was the most disliked by patients with arthritis because they felt insecure in using it and because it was unattractive. ATDs that are difficult to operate, unreliable, or fail to achieve their purpose are often discarded (Bynum & Rogers, 1987; Haworth, 1983).

It is often not possible to ascertain from the research if user dissatisfaction pertains to the ATD per se or its use by a patient. Of the reasons given by patients with rheumatoid arthritis for not using their ATD 100% of the time, the following are suggestive of technical or ergonomic origins: (a) device is too awkward to use, (b) device is defective, (c) device is too heavy to use for the activity, and (d) patient substitutes another device (Kulp, 1988). In the survey conducted by Haworth (1983), bathing ATDs were subject to more complaints than dressing and toileting ATDs. Accident reports, although low, have pinpointed bath seats, mats, and rails (Chamberlain et al., 1978; Thornely et al., 1977). Users expressed a lack of confidence in raised toilet seats and toilet safety rails that were not secured to the commode or floor (Chamberlain, Thornely, & Wright, 1978). Dissatisfaction with dressing ATDs has also been evident and is of particular interest, because these comprised 30% of the devices that patients prescribed for themselves (Geiger, 1990; Haworth & Hopkins, 1980; Hollings & Haworth, 1978; Stowe & Chamberlain, 1980). Devices for donning hosiery and reachers that damage clothing were particular targets of complaint (Haworth, 1983; Stowe & Chamberlain, 1980).

A relationship between ATD training and usage has also been found. In a series of experimental studies (Chamberlain et al., 1981; Stowe et al., 1982), bath device training programs resulted in higher device usage rates, improved satisfaction, and safer bathing practices. The salient features of the training program were the prompt provision of ATDs posthospitalization and ATD prescription and training by a hospital-based occupational therapist followed by training of patients and their caregivers in the home immediately after discharge. One study involving primarily children (Caudry & Seeger, 1983) indicated that most patients had received ATD training and that this training was perceived as adequate. Studies involving adults have been less optimistic and indicate that training is not done consistently and is available to slightly more than 50% of patients (Bynum & Rogers, 1987; Chamberlain et al., 1978). Except for walking devices, one or two training sessions are customary (Bynum & Rogers, 1987; Haworth, 1983; Rogers et al., 1989). Haworth (1983) ascertained that the number of training sessions did not influence postdischarge usage, whereas Tyson and Strong (1990) found an association between training sessions and usage and perceived benefit of ATDs. Rogers et al. (1989) found that device training involved primarily demonstration and supervised practice. Mastery of an ATD was generally determined by observation of patients using the ATD or verbal description of ATD use by the patients, if the ATD was not available. Staisey (1984) ascertained that instruction in technical ATD maintenance was less common than usage training.

In summary, little is known about the prescription, provision, and use of ATDs by American adults with impairment secondary to rheumatic disease. Research has focused on usage rates, with only scattered and rudimentary attempts to elucidate factors that facilitate or inhibit compliance with ATD prescriptions. Nonetheless, the available data point to the fruitfulness of increasing our understanding of the therapeutic value of ATD prescription through a comprehensive approach, including person-, environment-, and ATD-related factors. No study has examined these factors in a multivariate manner to generate a model to predict technical ATD usage. This model would be useful in distinguishing those patients who would be expected to have high rates of usage from those who would be expected to have low rates of usage. Once identified, patients expected to have low usage rates could be targeted for specific interventions to increase their usage of prescribed ATDs or to increase functional independence without ATDs.
Proposed ATD Usage Prediction Model

Concepts identified as relevant to ATD usage from the literature and from clinical experience make up the proposed model for predicting ATD usage. In the model, prediction of ATD usage is made during hospitalization after the device has been prescribed and training has been completed. Thus, the model is a qualified one and is not intended to be applicable to all practice settings or at all points in the treatment process. The predictor variables involve factors that are measurable during occupational therapy assessment and intervention conducted in a hospital setting. The point at which ATD usage is predicted may be any time for which usage is appropriate, that is, the prediction interval ends just before the time at which a prescription specifies that ATD usage be discontinued.

In the prediction model, ATD usage is envisioned as influenced by variables pertaining to the patient, the patient's living environment, the therapist prescribing the device, and the device itself. The variables constituting the prediction model are depicted in Figure 1.

In the prediction model, ATD usage is viewed as conditioned by four descriptive (i.e., age, sex, living situation, socioeconomic status) and three disease (i.e., diagnosis, severity, coexisting diagnoses) characteristics. These characteristics are commonly accepted as influencing a wide range of human behavior. Although they are aspects of the human condition that are relatively hard to change, they are readily obtainable in the clinical setting and are easily measured.

Our model proposes that ATD usage will be improved by a functional assessment that is geared toward evaluating a patient's capacity to use the ATD. Our conceptualization of the functional assessment considers the traditional physical status areas of movement capability and self-care competence. It includes an evaluation of functional status and the ability to carry out activities with and without human and technical help. Functional assessment goes beyond basic movement and self-care abilities, however, to encompass a number of psychological variables. Thus, we have included a rating of self-care values in our functional assessment to determine the overall significance to the patient of independence in the ATD-related activities. The survey of attitudes toward ATDs is intended to provide an indication of the patient's openness toward using ATDs to solve self-care problems. It encompasses patients' perceptions of items such as device utility, confidence in an ATD, fear associated with the device-related activity, preference for human help, the extent to which a device inconveniences others, and cosmetics. Because ATD usage requires the active cooperation of patients and is influenced by their overall willingness to engage in activity, we have added measures of depression, pain, and anxiety to the assessment, because these factors often limit activity (Holm, Rogers, Poole, Kwoh, & Stofko, 1990; Rogers, Holm, Poole, Kwoh, & Stofko, 1990). Perceived self-efficacy was selected as the psychological variable to represent the facilitation of activity, because it focuses on beliefs about the self as a doer (Lorig, Chastain, Ung, Shoor, & Holman, 1989). Lastly, because ATD usage requires the patient to learn a new way of doing a familiar task, we included ATD mastery in the assessment as an index of the extent to which the patient learned to use the ATD. In contrast to the descriptive and disease variables, which are relatively unalterable, these functional variables are amenable to intervention and change.

A number of therapist-related variables are also posited as having an impact on ATD usage. The therapist's skill in prescribing devices is seen as associated with general educational level, continuing education in rehabilitation technology, and the number of years of experience working with arthritis patients. The therapist's reason for prescribing a particular ATD (e.g., to reduce pain) provides a rationale for device usage based on patients' needs. This in turn enters into the therapist's judgment of the extent to which a specific device matches a patient's needs and capabilities, that is, the ergonomic aspects of the device. The extent to which a patient is trained to use a particular device and the methods used for training are under the control of the therapist and relate to the mastery the patient achieves in operating a device. Therapists also exercise some control over ATD provision by stockpiling devices and recommending suppliers who are effi-
cient in responding to ATD prescriptions. Delays in obtaining devices reduce the efficacy of device training. Like the functional variables, the therapist-related variables are amenable to change, although change may be more readily accomplished in some areas than in others.

In terms of the ATD itself, technical adequacy is a critical quality. It is reasonable to assume that features such as device durability, dependability, safety, and efficiency affect usage. Technical adequacy may be modified through design improvements.

Measurement of the outcome variable, ATD usage, is approached in two basic ways. The *simple use index* is the number of ATDs used divided by the number of ATDs prescribed. The *extent use index* reflects actual usage in relation to usage opportunity. Usage opportunity is based on the number of times the patient usually does an activity over the defined time period. This frequency reflects the usage potential of all ATDs related to an activity like bathing or dressing. For example, if a person bathed five times each week, the usage opportunity for a bathtub transfer bench and a long-handled sponge would be 5. By summing the usage opportunity ratings for all prescribed ATDs, an ideal ATD score is obtained. Actual usage is the number of times an ATD is used over a defined time period (e.g., a day, a week). By summing the patient’s reported usage for each ATD, one can calculate an actual ATD score. The extent use index is the actual ATD score divided by the ideal ATD score. Although both the simple and extent use indexes account for multiple ATDs, the first considers usage only, whereas the second considers frequency of use and corrects for ATDs with differential opportunities for use. These indexes can be validated by relating them to self-care outcome, because the high ATD user is expected to be more independent than the low ATD user. Simple and extent use indexes would also be created using the number of ATDs obtained versus the number prescribed.

According to the model, ATD usage would be measured in four ways, as is illustrated in the following example, and in Figure 2. While in the hospital for an exacerbation of her rheumatoid arthritis symptoms, Mrs. Tappen was prescribed a lightweight mug, a rocker knife, an elevated toilet seat, and a long-handled bath sponge to facilitate her independence in daily activities. Although four ATDs were prescribed, Mrs. Tappen did not purchase the lightweight mug. However, she used the three ATDs that she obtained every day. Therefore, as shown in Figure 2, the simple use usage rate for all prescribed ATDs is 75%, whereas the simple use usage rate for all obtained ATDs is 100%. Because extent use is device dependent and specific to personal habits, it is calculated based on Mrs. Tappen’s estimates of usage opportunities. She predicted that she would use the lightweight mug five times a day, the rocker knife two times, the elevated toilet seat seven times, and the long-handled bath sponge one time each day. The ideal usage opportunities for Mrs. Tappen for the prescribed ATD would be 15 times a day, but since she did not obtain the lightweight mug, the actual ATD usage would be 10 times a day. Therefore, the extent use usage rate for all prescribed ATDs is 67%, but the extent use usage rate for all obtained ATDs is 100%.

The proposed model identifies variables that could be used to predict ATD usage based on in-hospital assessment and intervention. The specific instruments or pro-

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<th><strong>Usage Rates</strong></th>
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<td>#ATDs used</td>
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<td>Ideal usage – obtained</td>
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**Figure 2.** Calculation of assistive technology device (ATD) usage rates based on the predictive model outcome variables.
cedures for measuring the variables and testing the model are left undefined and would need to be operationalized in each clinical setting or for each patient population. Self-care competence, for example, might be measured with the Health Assessment Questionnaire (Fries, Spitz, & Holman, 1982) or the Arthritis Impact Measurement Scales (Meenan, Gertman, & Mason, 1980). The combining of the statistical prediction of ATD usage with a therapist's judgment of ATD usage would increase the scientific yield of the study. This would enable a comparison of the accuracy of predicted ATD usage that emerged from the regression equation and from the therapist's clinical reasoning. Future research could then be guided by the outcome of this comparison.

Conclusion
Our technology-oriented society is increasingly viewing ATDs as a means of improving the functional independence and quality of life of persons with disabilities. A review of the literature focused on a patient population known to be high ATD users, namely, persons with arthritis. The reviews suggested that little theoretical or empirical research has been done on ATD prescription, provision, or evaluation. Concepts relevant to ATD usage identified from the literature and from clinical practice were organized into a model designed to predict patients who will use and who will not use ATDs prescribed by occupational therapists. Use of the model will foster an understanding of the factors that contribute to device usage and hence benefit patients with arthritis (ATD users) and therapists (ATD prescribers).

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