A PILOT INVESTIGATION INTO TRAINING VOLUNTARY CONTROL OF THE
URINARY MUSCULATURE FOR THE MANAGEMENT OF CHILDHOOD ENURESIS

TIM GOLDING

Submitted in partial fulfilment of the Degree of Master of Clinical Psychology,
The Australian National University.
December, 1984.
Declaration

I declare that this thesis reports my original work, that no part of it has been previously accepted or presented for the award of any degree or diploma by any University, and to the best of my knowledge no material published or written by another person is included, except where due acknowledgment is given.

Tim Golding
Acknowledgments

Thanks are due to my supervisor, Dr. Mark Dickerson, for advice and encouragement throughout, and to Mr. Ross Cunningham for guidance in the analysis of data.
ABSTRACT

Enuresis usually becomes defined as a problem as its consequences for the child and/or parents manifest.

Some current therapies attempt to address those social and psychological factors which are thought to contribute to and maintain patterns of enuretic behaviour. These include the urine alarm, Retention Control Training, and Dry Bed Training.

Since the acquisition of continence for most children parallels the maturation of other physiological and psychological processes, enuresis can also be considered within a framework of developmental delay.

It is argued that, with maturation, the musculature associated with urinary processes come largely under voluntary control, and that a major effect of the treatments mentioned may be to enhance that control through indirect manipulation of that musculature. To date the effects of direct exercising of the urinary musculature have not been investigated.

Since exercising the pelvic floor muscles has been shown to be effective in women who become incontinent post partum, adapting a similar approach may be beneficial for enuretic children.
The principal hypothesis of this study was that Muscle Training (MT) exercises would be effective in reducing the wetting frequencies of enuretic children. A programme was offered which included MT and Retention Control Training (RCT). The RCT component was included as a comparative measure and to provide a simple but potentially useful approach as a backup treatment.

Ninety-three children were divided into four treatment groups, differing in the order in which the two treatments were administered (MT-RCT, RCT-MT), and the degree of therapist contact afforded to parents during the programme (Postal, Visited). Thirty children completed the entire programme. No significant treatment effects were found for MT or RCT. For MT it was found that, on the whole, exercises were not carried out in the manner prescribed, and that the available records were of limited value for drawing conclusions about evidence of learning during MT. Significant differences were found between measures of maximum bladder capacity pre- and post-treatment, but procedural difficulties cast doubt on the validity of the measures obtained.

Results are discussed in terms of the potential usefulness of MT, especially with regard to a more intensive treatment regimen, and some implications for multi-faceted treatment approaches to enuresis.
Contents

TITLE PAGE i
DECLARATION ii
ACKNOWLEDGMENTS iii
ABSTRACT iv
CONTENTS vi

1.0 INTRODUCTION

1.1 Enuresis 1
1.2 Incidence 4
1.3 Etiology 6
1.4 The Acquisition of Continence 9
1.5 Treatment Approaches to Enuresis 15
1.5.1 The Urine Alarm 17
1.5.2 Pharmacotherapy 28
1.5.3 Retention Control Training 31
1.5.4 Dry Bed Training 37
1.5.5 Muscle Training 41
1.6 Aims and Hypotheses 47

2.0 METHOD

2.1 Subjects 48
2.1.1 Assessment 49
2.1.2 Interview and Report Form 50
2.1.3 Guidelines 50
2.2 Treatment Programme 51
2.2.1 Observation Period 52
2.2.2 Muscle Training 53
2.2.3 Retention Control Training 54

3.0 RESULTS

(Resume) 56
3.1 Response and Completion Data 56
3.2 Demographic Details 58
3.3.1 Differences within Groups between Phases 61
3.3.2 Differences between Groups within Phases 62
3.4 Bladder Volumes 63
3.5 Acquisition of Control 66

4.0 DISCUSSION 68

5.0 REFERENCES 84

APPENDICES 93

APPENDIX A Advertisement
APPENDIX B Parental Guidelines and Record Sheets
APPENDIX C1 Report Form
Appendix C2 Report Form Summary
Appendix D Data Summary
1.1 Enuresis

The term enuresis is derived from the Greek "enourein": to void urine, but the word itself conveys little by way of definition. Among myriad attempts to define enuresis the following are typical:

- "the involuntary and unconscious passing of urine after an arbitrary age limit of three years, in the absence of significant congenital or acquired defect or disease of the nervous and urogenital systems, and in the absence of significant psychological defects." (Crosby, 1950)

- "the uncontrolled, unintentional voiding of urine at one expulsion usually occurring during sleep; it may be considered to be present if bedwetting occurs past the age of three, a liberal time for control of urination to have been established in so-called normal individuals" Michaels (1955).

The definitions put forward illustrate the major problem inherent in arriving at a suitable minimum age at which "dryness" can be expected. Having an arbitrary watershed, such as 3 years of age, implies that any intermittent wetting thereafter should be termed enuresis. Yet, as pointed out by Yates (1970), urinary control can be considered a skill, and as such its acquisition can be expected to follow a normal curve of learning, with recurrent "relapses" before control is achieved.
In the literature enuresis has been considered in terms of several types and dimensions which are not always mutually exclusive.

a) Primary and secondary (persistent and acquired).

The most frequent contrast made between types of enuresis concerns those children who have always wet more or less constantly (primary, or persistent) and those who have achieved suitable urinary control at some stage but have relapsed (secondary, or acquired).

This difference between primary and secondary enuretics was first proposed by Thursfield (1923). The distinction was deemed sufficiently important to be accorded a separate editorial in The British Medical Journal of 1960, where it was suggested that there were contrasts in etiology, personality characteristics and prognosis. However to date few studies have pursued such questions and on the whole it would appear that little has emerged of practical or prognostic importance (Novick, 1966; Doleys, 1977).

On the other hand, several studies are of clinical interest. For instance, Hallgren (1957) found that primary enuretics tended to wet more frequently and to be associated with a higher proportion of familial (ie parents and/or sibling) cases, while Gunnarson and Melin (1951) showed that primary enuresis could be associated with a more abnormal EEG pattern, and to have twice the heredity incidence compared with secondary. In adults secondary enuresis has been found to be the more responsive type to placebo treatment (Adler, 1959).
A better controlled study by Novick (1966) found that when 22 primary and 23 secondary enuretic children were treated with the standard urine alarm, the secondary group took less time overall to achieve criteria dryness (24 versus 47 days), wet less frequently, decreased faster, but relapsed at a higher rate at 10 month follow up.

More recently primary and secondary enuresis have been accorded etiological differences, primary being said to arise from inadequate neuromuscular maturation and secondary to be associated with elevated levels of psychological stress (Doleys, 1977).

b) Nocturnal, diurnal, and day and night wetting.
As implied by Michaels' (1955) definition above, most cases of enuresis involve poor nocturnal control. Some may occur both by day and night, while relatively few children will wet exclusively by day.

Some experimental data suggest that children who wet both by day and night are less likely to respond as well as nocturnal enuretics to urine alarm treatment. (Lovibond and Coote, 1970). Such children are also likely to relapse earlier than nocturnals following successful treatment, to drop out earlier from treatment, and to report a higher incidence of daytime urgency to urinate (Fielding, 1980).

c) Regular and intermittent.
While the frequency of inappropriate wetting is a possible dimension for consideration, no specific point of differentiation
suggests itself, although when wetting appears to become periodically more frequent, environmental or psychological factors may make some contribution.

The above illustrates the difficulties in narrowly defining enuresis. Unless otherwise qualified or indicated in the text, hereafter the term will be used to imply that to be labelled enuretic a child is wetting at a frequency deemed inappropriate for time, setting and age by his/her care-givers and that to the best of available knowledge there are no underlying anatomical abnormalities nor disease pathogens.

1.2 Incidence

Bearing in mind recurrent problems with the validity of the defining criteria and the reliability of the measures used, reports about the incidence of enuresis appear reasonably consistent across sources.

According to Doleys and Dolce (1982) persistent nocturnal enuresis occurs in 15% to 20% of 5 year olds, 5% of 10 year olds, and about 2% of those from 12 to 14 years of age. "Spontaneous remission" of enuretic children entering treatment has been variously estimated at 13.5% for nocturnally wetting children between 7.5 and 12 years of age (De Jonge, 1973) and 14% to 16% for 5 to 9 year olds ((Forsythe and Redman, 1974). Similar figures are found elsewhere, with a peak incidence of enuresis, broadly defined, at 7 years (Rutter, Tizzard and Whitmore, 1973) and 3% of 10 year olds and 1% of 14 year olds wetting. (Rutter, Yule and Graham, 1973).
Doleys and Dolce (1982) point out that such high incidences, together with unsystematic and often punitive treatment measures by parents, ridicule by peers, and attendant social restrictions, highlight the necessity of early treatment by suitable methods. Several authors have reported sex differences in the incidence of enuresis. (eg. Stalker and Band, 1946; Blomfield and Douglas, 1956; Rutter et al, 1973). Up to 11 years of age the problem tends to occur more in boys at a ratio approaching 2:1, after which similar proportions of boys and girls are enuretic (Rutter et al, 1973).

Information is scant concerning the differential incidence of primary and secondary enuresis. However, ratios of 5:1 for 'younger' children, 1:1 for 12 to 14 year olds (Doleys and Dolce, 1982), and about 1:4 across the board (Freyman, 1963; Weiner, 1982) have been suggested.

Family history has been also considered an important factor in the incidence of enuresis. Bakwin (1961) reported that 70% of all enuretic children have or have had a 'close relative' who has had a similar problem. Whether a hereditary factor can be inferred is uncertain, with only limited evidence suggesting that it is more likely for both of monozygotic twins to be enuretic than dizygotic twins (Hallgren, 1956; Bakwin, 1973).

Early findings have suggested a higher incidence in lower socio-economic class strata (Blomfield and Douglas, 1956; Hallgren, 1956). However later studies have tended to discount those assertions (Rutter et al, 1973; Stein and Susser, 1967).
1.3 Etiology

A wide range of causes have been put forward in the literature to account for enuresis. Primary enuresis in particular has been attributed to genetic, infectious, circadian, behavioural and psychological disturbances, as well as small functional bladder capacity, central nervous system immaturity and dysfunction, and delayed development (Shaffer, 1977).

Pathogenic and organic origins

A small number of cases of enuresis can be traced to a urinary tract infection or to anatomical abnormalities (Hinman and Baumann, 1973). However, since such complications are usually absent and the problem is yet so clear cut, the field has long been a "happy hunting ground" for theoretical formulations (Yates, 1970).

Sleep patterns

One of the more popular assertions found in the literature is that aspects of a child's sleep pattern, such as 'depth' (ie. ease of awakening: Graham, 1973) or abnormalities in the recognised stages (Broughton, 1968) are implicated in nocturnal enuresis. Such thinking has moulded some therapeutic approaches, for example the use of amphetamines to 'lighten' sleep, or the use of a loud urine alarm to overcome poor arousability (See Doleys, 1977). Two recent studies have examined the relationship of sleep and enuresis. Mikklesen, Rapoport, Nee, Gruenau, Mendelson and Gillin (1980) found that although enuretic boys had less total sleep time, stage 4 sleep, and sleep efficiency, compared with available norms, no specific association between a stage of sleep and an enuretic episode could be affirmed. A subsequent report
by Gillin, Rapoport, Mikkelsen, Langer, Vanskiver and Mendelson (1982) suggested that severely enuretic boys do have a more shallow sleep (ie increased intermittent wakefulness and stage 1 percentage, and a reduced percentage of stage 4 and delta sleep).

However, those authors observed that enuretic episodes were not associated with sleep stages so much as being time-dependent, and wetting could be expected approximately 4 hours after sleep onset, or a prior wetting. It would therefore appear that 'deep' sleep, defined in electrographic rather than behavioural terms, is not necessarily associated with enuretic episodes.

Traditional medico-psychiatric view.

Where no organic pathology is evident, the traditional medico-psychiatric view has been that enuresis is symptomatic of a generalized emotional disorder (Kanner, 1955; Yates, 1970). A similar "syndrome" view comes from Rutter et al (1973) who suggest that in some circumstances enuresis may be found to be diurnal, occur more often with girls, and be associated with other behavioural or emotional disturbances. However, investigations of possible associations of enuresis and a generalized emotional disorder have found little experimental support (Ackerson, 1942; Hallgren, 1956; Lapouse and Monk, 1958; Lovibond, 1964).

Since there appears to be an obvious relationship between age and the incidence of enuresis, it is arguable that the problem, in the absence of co-occurring difficulties, is best viewed in a developmental or maturational framework. Support for this viewpoint comes from a number of cases which propose a rel-
relationship between enuresis and a delayed acquisition of speech, onset of puberty, and a shortness of age-related stature (Edvardson, 1972).

Reduced functional bladder capacity
Since nocturnal bladder input is the same for enuretics and non enuretics (Vulliamy, 1956) the suggestion that enuretic children often have a reduced functional bladder capacity (Zaleski, Gerrard and Shokai, 1973) would seem to have some validity. Whether such reduced capacity is anatomically determined, or reflects a hypersensitivity to detrusor contraction cues is not clear, as evidence concerning the ability to change functional bladder capacity is equivocal. This issue is dealt with at greater length below.

Learning
It has been suggested that where the child may be physiologically mature enough to exercise urinary control an absence of consistent control may be attributable to the failure of physiological and psychosocial factors to interact appropriately (Lovibond, 1964; Yates, 1970; Yates 1975). That is, where there is adequate maturation, developing continence may need to come about through learning diverse contingencies concerned with urination and its control. An understanding of how such developments may proceed requires, in part, an acquaintance with some of the interrelated anatomical structures and physiological processes which underlie the production, retention and expulsion of urine.
1.4 The acquisition of continence

Anatomical and physiological factors

The muscular portion of the bladder wall is known as the detrusor muscle. As the bladder is fed urine from the kidneys via the ureters the tonus of the detrusor adjusts to the changing volume, such that there is little initial internal pressure change. Located within the bladder wall are sensory end organs which signal when intramural tension exceeds a certain threshold. In adults, tonal adjustment ceases at an approximate volume of 200 millilitres, at which point voiding may be initiated unless otherwise inhibited.

The process by which urine is stored in and expelled from the bladder is mediated by several spinal and brain reflexes (See Table 1). However, with maturation, these reflexes become subject to modification by higher suprapontine centres, according to the environmental appropriateness of voiding or, conversely, the pain experienced (Bors & Comarr, 1971; Stephenson, 1979).

Once the bladder volume threshold is passed the detrusor begins to contract rhythmically. Emptying is facilitated by a reflexive contraction of the lower abdominal musculature and relaxation of the pelvic floor muscles, principally the pubococcygeal. Respectively, those movements increase intra-abdominal pressure and tilt the bladder neck (Muellner, 1958; Vincent, 1964; Warwick & Williams, 1973). As voiding is completed the detrusor relaxes, and the internal and urethral sphincters contract in turn.
Conversely, voiding reflexes may be inhibited by the lower abdominal muscles relaxing and the pelvic floor muscles contracting. The internal and urethral sphincters are constricted reflexively, and detrusor contractions are inhibited, while intra-abdominal pressure is relieved mechanically. However, should volume build such that bladder pressure become so great as to signal pain, the voluntary inhibition of voiding is only carried out with effort.

Table 1. Reflexes associated with urinary inhibition and voiding.

<table>
<thead>
<tr>
<th>Reflex</th>
<th>Activating Stimulus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhibition</strong></td>
<td></td>
</tr>
<tr>
<td>1 Perineobulbar detrusor inhibitory reflex</td>
<td>Contraction of perineal and pelvic floor muscles</td>
</tr>
<tr>
<td>2 Sympathetic detrusor inhibitory reflex</td>
<td>Increasing detrusor mural tension</td>
</tr>
<tr>
<td>3 Sympathetic sphincter constrictor reflex</td>
<td>Increasing detrusor mural tension</td>
</tr>
<tr>
<td>4 Urethrosphincteric guarding reflex</td>
<td>Tension of trigone or entry of urine into proximal urethra</td>
</tr>
<tr>
<td><strong>Elimination</strong></td>
<td></td>
</tr>
<tr>
<td>1 Perineobulbar detrusor facilitative reflex</td>
<td>Perineal and pelvic muscle relaxation</td>
</tr>
<tr>
<td>2 Detrusodetrusor facilitative reflex</td>
<td>Increasing detrusor mural tension</td>
</tr>
</tbody>
</table>

(Adapted from Stephenson, 1979)
Urine from the kidneys is contained in the bladder by the contraction of muscle tissue around the proximal outlet confluent with the urethra. There is some controversy as to whether those proximal muscle fibres constitute a true sphincter (Bors & Comarr, 1971; Warwick and Williams, 1973). But although those fibres may not meet all neurological or histological criteria, they can be considered to act functionally as an internal sphincter (Tanagho, Meyers and & Smith, 1968).

The overall length of the urethra differs in males and females, since in males the distal portion also travels the length of the penis. However, in both sexes the external urethral sphincter is only a few centimetres from the internal, and is said to function by the combined actions of the spiral and longitudinal muscles of the urethral wall. Although the external sphincter normally comes under voluntary control, evidence for direct voluntary control of the internal sphincter is still equivocal (Bors & Comarr, 1971).

Behavioural and psychosocial factors
In a developmental context inhibitive control is largely absent up to 6 months of age, with the bladder filling and emptying by reflex. By 4 years of age, having passed through a stage of awareness of the need to urinate without having control, the child usually has the ability to retain for a short period, and is generally conscious of socially appropriate times and places for voiding. However the process of acquisition is not necessarily straightforward, even when age-appropriate continence is achieved.
Fielding (1982) has made some interesting observations concerning the variety of limb and body postures available to a child to augment their cortical inhibition of micturition. Thus squeezing the thighs together by 'scissoring' the legs applies upward perineal pressure, one effect of which is to counteract voiding reflexes associated with increasing bladder volumes. Such a manoeuvre would probably raise the bladder neck (Vincent, 1964) to prohibit the leakage of urine into the proximal urethra, and delay the urethrosphincteric reflex which reacts to the presence of urine in that section of the urethra (Stephenson, 1979). The net effect would be to minimize the child's sensory awareness of an impending need to void, and allow attention to be directed to other activities. However as maturation and an increasing sensitivity to social expectations combine to inhibit such strategies, cortical mechanisms eventually exert direct more control (Fielding, 1982).

For the child emerging from infancy there may not be that happy intersection of physiologically mature mechanisms and 'correct' environmental contingencies, such that the acquisition of continence parallels other normally age-related developments.

It is reasonable to assume that the acquisition of continence generally follows repeated (and successful) performances of the control patterns outlined earlier. Additionally, there are likely to be attendant factors which serve to condition continence to meet personal and social expectations (Lovibond and Coote, 1970).
It is also arguable that the development of micturition control is in many ways similar to any coordinated sensorimotor skill. Initially, attention is paid to specific elements of the performance, such as sensory signals, muscle contractions and environmental feedback, and superfluous elements of the performance are discarded. With finer and more appropriate performances, attention is largely faded from individual physiological elements and attention is paid only to the specific environmental demands of voiding or its inhibition.

Viewing micturition control as a skilled activity invites the observation that faulty or absent control could be amenable to remedying by training. That is, by providing circumstances which facilitate increased control over urinary voiding and inhibition, those acts should come to be performed with greater skill, and in more appropriate circumstances. In other words, since the control of muscles can inhibit or facilitate voiding, it should follow that by increasing the voluntary exercise of control over those muscles better control over voiding reflexes will eventuate.

Insofar as urinary control concerns enuresis, it would appear that the obvious focus of training would need to be on practising inhibition. Although most problems of incontinence during childhood are nocturnal, it need not be inferred that training should also take place by night. The development of continence usually follows the pattern of daytime followed by night-time acquisition, although the processes by which such control come about are currently little understood (Yates, 1970)
The foregoing makes a case for considering the acquisition of normal urinary continence in terms of the coordinated interaction of physiological, anatomical, behavioural and social factors. To date the majority of systematic non-surgical approaches to the management of enuresis have focussed on one or more of those interactions, and attempted to manipulate them accordingly. The bulk of such approaches have looked to changing either internal-external events and contingencies, internal biochemistry, or functional bladder capacity. Yet little attention has been given to the direct and systematic training of the urinary musculature of children. This is somewhat surprising for two reasons. First, muscular training has long been used for the management of certain classes of adult incontinence. Second, if considered in detail, one effect of the more popular non-pharmacological approaches used with children is to impose, albeit indirectly, the requirement of some voluntary control during a treatment programme.

Before examining further the question of the applicability for children of manoeuvres which can be taught to adults, it is appropriate to first look at current approaches to the management of childhood enuresis.
1.5 Treatment approaches to enuresis

Historically, treatments for enuresis have been and in many cases still are an enormous, sometimes bizarre rag-bag drawn from traditional pharmacopaeias and herbariums, unsystematically applied to mistaken models of human anatomy and functioning on a basis of guesswork and common sense (Mowrer and Mowrer, 1938; Glicklich, 1951)

Campbell (1970) estimated that there were currently as many as 50 different procedures applied to the problem. Space, however limits discussion to only the more common which have been researched to some degree.

Treatments for enuresis fall into two broad categories, those which address a range of psychological or behavioural factors, and those concerned more with tackling the problem at a physical level. Thus, in the first category, those drawing on principles of classical, instrumental and social conditioning are predominant, although some psychotherapeutic procedures are also used. The second would principally include pharmacological and surgical approaches.

The picture is somewhat complicated by approaches that attempt to take into account individual characteristics, such as age, type of enuresis, or sex, or to combine a number of treatment elements, choice of which has not necessarily been supported by research evidence.
Another way of looking at treatments is in terms of their claimed success. Of the unitary approaches those which could lay claim to the greatest efficacy would include the urine alarm, imipramine medication and Retention Control Training. Of these, the urine alarm and imipramine are by far the most commonly used treatments. (Johnson, 1980; Perlmutter, 1978). Among the combined approaches perhaps the most efficacious is Dry Bed Training (Azrin, Sneed and Foxx, 1974; Bollard & Nettlebeck, 1982).

Some obstacles to assessing the efficacy of treatment programmes for enuresis are the variations among the stated criteria of success or failure offered across studies, different treatment parameters and technologies, and differing baseline, post-treatment and follow up measures. In addition, the less tangible and largely uncontrolled variables of therapist contact, parent involvement, and demand characteristics are also likely to influence treatment outcome.

The following sections review the more extensively used systematic management approaches to enuresis. While the emphasis is on psychological methods, the use of pharmacotherapy is included. However, limited space and the nature of the present project preclude an assessment of other physical procedures, such as surgical intervention.
1.5.1 The urine alarm

Of the non-pharmacological treatments for childhood enuresis perhaps the most widely used and best researched to date is the urine alarm. The principle of the device is to utilize moisture, detected on a pad placed below a sleeping child, to close a low voltage circuit and thus sound an alarm, usually a buzzer or bell.

Procedure.
The usual administrative procedure followed includes having the alarm near the sleeping child, having the child respond to the alarm by ceasing to void if caught in time, switching off the alarm, and voiding any remainder appropriately.

History
The potential of the therapeutic use of a urine alarm was first recognised by Pfaundler in 1904 but its effects were not given a theoretical context until popularized in 1938 by Mowrer and Mowrer. The design has since undergone a number of changes to meet demands of safety, aesthetics and practicality. However, the principle has been preserved.

Theories of alarm conditioning
Classical conditioning.

The first comprehensive explanation of the urine alarm's effectiveness was couched in classical conditioning terms by Mowrer and Mowrer (1938). At that time the most common approach of enuresis management and subsequent control was for the child to be woken during the night before his/her bladder had filled to the point where micturition began. They pointed out that if this
approach rested upon any definite psychological theory, "it would appear to be this, that if the child is repeatedly awakened at a time when the bladder is partially filled, but not so distended as to produce reflex emptying, the attendant bladder distension will become specifically associated with the response of awakening, before the point has been reached at which voiding tends to occur automatically" (Mowrer & Mowrer, 1938).

However, from the point of view of encouraging the best habit formation, they suggested that it would be more efficacious to provide a means of awakening a child when the bladder was fully distended, instead of at arbitrarily determined periods during the night. That way the association would form between waking and the full bladder. Obviously an ideal time would be just before the the onset of micturition. However, then, as probably now, the means of easily discovering the relative distension of the child's bladder were not available.

An attractive alternative was to allow such an association to form between the onset of urination and subsequent arousal, with the expectation that the connection between the contraction of the bladder sphincter, inhibiting the flow of urine upon awakening, and the distended bladder, would become sufficiently well established to "come foward" in time. Thus the child would inhibit micturition in response to the sensory stimulation of the distended bladder, and wake when the bladder distension became too great. It was therefore proposed that a mechanical means should be used for waking the child by an alarm at the onset of micturition.
A slightly more complex model was however given by Jones (1960): Initially, detrusor tension (UCS1) leads to micturition (UCR1) during sleep. With the setting up of the apparatus the alarm (UCS2) initiates both waking (UCR2) and ceasing to void (UCR3). In time the bladder tension cues collectively become the conditioned stimulus (CS1) for both waking (CR1) and inhibiting (CR2).

How inhibition comes forward in time to occur before voiding has been explained by Jones (1960) as an example of a generalization gradient operating, whereby cues of early bladder tension come to evoke inhibition prior to voiding. A thoroughly successful conditioning procedure would also have inhibition occurring before waking, although as Yates (1970) points out, many adults never achieve such control as to be able to sleep the night through with a high degree of bladder distension.

Instrumental conditioning

A critique of the classical conditioning model of the urine alarm put forward by Lovibond (1963, 1964) suggested that a child's responses of waking and inhibition were better conceptualized in terms of instrumental conditioning. The principal argument against a classical conditioning model was that it does not predict continued dryness after treatment. According to Lovibond (1963) the alarm is an "aversive stimulus which provides the basis of a conditioned avoidance response of awakening and contracting the sphincter. The permanent continence following successful treatment is thus accounted for in terms of the well known resistance to extinction of conditioned avoidance responses".
From this point of view
a) detrusor contraction and sphincter relaxation lead to the alarm sounding,
b) sphincter relaxation comes to signal the alarm's imminent sounding, the response to which is immediate contraction, and
c) the process moves back in time such that there is an anticipatory inhibition of micturition, the alarm does not sound and wetting thus remains associated with the aversive alarm stimulus.

Consequently, Lovibond (1963) proposed that a twin signal, whereby an initial brief signal was followed by a more persistent alarm, should come to serve the same ends as a single signal device without inevitably sounding a loud alarm throughout training. However, the twin signal design has not been systematically demonstrated to be of any greater effectiveness than the traditional alarm design (Turner, Young and Rachman, 1970; Turner, Rachman and Young, 1972)

Procedural variations
Since the contribution of Mowrer and Mowrer (1938) a number of procedural variations have been experimentally investigated, principally alarm loudness, schedules of signalling, or the temporal contiguity of wetting to signal.

Alarm loudness
Monitoring of the sound level of the alarm by care-givers would intuitively appear to be important in order to ensure that the child who is a 'deep' sleeper is adequately aroused. However, a study by Young and Morgan (1973) failed to associate alarm sound characteristics (volume, wave form) with treatment efficacy.
Such findings are interesting if considered together with those of Mikkelsen et al, (1980) and Gillin et al (1982) which suggest that 'deep' sleep is not necessarily associated with enuretic episodes. Where the wetting child is considered a 'deep' sleeper there is little evidence to suggest that a loud alarm will be more efficient in waking the child.

Alarm schedules

Schedules of alarm presentation have been experimentally examined in relation to acquisition of continence and relapse. Finlay, Besserman, Clapp and Finley, (1973) and Finlay, Wansley and Blenkarn (1977) placed children on a 70% schedule, while other studies have used a 50% alarm schedule (Abelew, 1972; Taylor and Turner, 1973).

In none of these studies was acquisition of control or the rapidity of acquisition found to be a function of varying the schedule. However, it was found overall that intermittent schedules were associated with the likelihood of diminished relapse in subsequent follow-ups (average 3 month).

Support for those findings comes from a report by Finlay and Wansley (1976) who claimed that 84 of 87 children placed on an intermittent schedule were 'dry' within an average 6.5 weeks. The relapse rate of 17% varied according to age, with 30% of 9-10 year old children relapsing. These results contrast with the 44% relapse rate reported by Taylor and Turner (1975). Doleys (1977) suggested that such differences were principally attributable to variations in alarm schedules, populations, devices used, and length of follow up periods.
More recently Finlay, Rainwater and Johnson (1982) provided further data concerning the effects of schedule variations. Acquisition of control varied according to whether the child wet more than once nightly, with lowest relapse rates for such multiple wetters (42%) attained with a 60 to 69% alarm schedule. This contrasted with the non-multiple wetters minimum rate (10%) being achieved with a 70 to 79% schedule.

Temporal contiguity
An aspect given little attention in the literature concerns the temporal contiguity of wetting to the subsequent alarm signal. A few studies have shown that a minimal delay between voiding and alarm is an important factor in establishing the required response. For instance Peterson, Wright and Hanlon (1969) found that a 3 minute delay gave significantly fewer 'dry' nights than a no-delay group over a 3 week period, both groups being superior to a no-treatment control.

Similarly, Collins (1973) found children in a 5 minute delay group attained significantly less control over a 8 week treatment period compared with those woken without delay, while a higher (80%) relapse rate for those attaining continence in the delay group was also recorded.

Success rates
A review by Doleys (1977) analyzed 12 studies carried out between 1965 and 1975, involving 628 children, 95% of whom were between 4 and 15 years of age. By the different researchers own criteria initial success averaged about 75%, while available follow up data suggested a rate of relapse for those considered successfully
treated in the vicinity of 40% in the 6 months after the cessation of treatment. Doleys' findings seem somewhat more pessimistic than that put forward by Yates (1970). In his analysis of 8 studies (1950 to 1965) which used the urine alarm method, a mean of 77% of the 352 children treated were dry at an average minimum follow-up period of 15 months.

Table 2 sets out a summary of figures collected by Doleys (1977) relating to standard urine alarm treatment.

Failure to gain control
Lack of initial success in gaining micturition control with the urine alarm most often has been attributed to parental non-compliance (Geppert, 1953; Freyman, 1963; Taylor, 1963; Young, 1965).

Young (1965) listed a variety of factors associated with failure in 37 out of 105 cases in his experience. After uncooperative parents, were ranked poor housing and sleeping conditions, the child being frightened by the machine, the child sleeping through the alarm, a preference for hospital treatment, and an excessive distance to travel from home to clinic.

Some suggested remedies have been the giving of adequate instruction to parents, regular feedback, and adequate professional follow up (Doleys and Dolce, 1982).

Relapse
The many cases of relapse reported in urine alarm studies have attracted the observation that too great an emphasis was being placed on external controls (eg the urine alarm) at the expense
<table>
<thead>
<tr>
<th>STUDY</th>
<th>No. Subs</th>
<th>Age Range</th>
<th>Percent Arrested</th>
<th>Percent Relapsed</th>
<th>Follow-up (months)</th>
<th>Controls or comparisons</th>
<th>Arrest Max. Criter. (days)</th>
<th>Mean t'ment time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young and Turner (1965)</td>
<td>105</td>
<td>1-15</td>
<td>65%</td>
<td>13%</td>
<td>6-12</td>
<td>Amphetamine adjuncts</td>
<td>14</td>
<td>2.2 mths</td>
</tr>
<tr>
<td>De Leon &amp; Mandell (1966)</td>
<td>56</td>
<td>6-13</td>
<td>79%</td>
<td>79%</td>
<td>6</td>
<td>no treatment/psychotherapy</td>
<td>14</td>
<td>90 days 54.5 mths</td>
</tr>
<tr>
<td>Novick (1966)</td>
<td>36</td>
<td>6-13</td>
<td>89%</td>
<td>50%</td>
<td>10</td>
<td>routine support</td>
<td>14</td>
<td>36.6 days</td>
</tr>
<tr>
<td>Baker (1969)</td>
<td>27</td>
<td>9-12</td>
<td>74%</td>
<td>20%</td>
<td>6</td>
<td>waking/waiting groups</td>
<td>28</td>
<td>?</td>
</tr>
<tr>
<td>Forsyth &amp; Radmon (1970)</td>
<td>200</td>
<td>5-15</td>
<td>66%</td>
<td>23%</td>
<td>12-36</td>
<td>none</td>
<td>14</td>
<td>30 wks 9.9 weeks</td>
</tr>
<tr>
<td>Turner, Young &amp; Rachman (1970)</td>
<td>15</td>
<td>4-15</td>
<td>80% (12/15)</td>
<td></td>
<td></td>
<td>continuous</td>
<td>14</td>
<td>17.25 trials 6.8 weeks</td>
</tr>
<tr>
<td></td>
<td>15 x=7.5</td>
<td>4-15</td>
<td>65% (11/15)</td>
<td>50% (13/20)</td>
<td>36</td>
<td>Twin sig cont placebo</td>
<td>14</td>
<td>6.2 weeks 14.64 trials</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td></td>
<td>?</td>
<td>27% (3/11)</td>
<td></td>
<td>Twin sig int placebo/ random waken</td>
<td>4 wks</td>
<td>10.2 weeks</td>
</tr>
<tr>
<td>Dische (1971)</td>
<td>79</td>
<td>4-15</td>
<td>89%</td>
<td>30%</td>
<td>19</td>
<td>advice &amp; encouragement</td>
<td>21</td>
<td>12 mths 10.1 months</td>
</tr>
<tr>
<td>Young &amp; Morgan (1972)</td>
<td>144</td>
<td>4-15</td>
<td>70%</td>
<td>35%</td>
<td>12-42</td>
<td>overlearning</td>
<td>14</td>
<td>?</td>
</tr>
<tr>
<td>Finley et al (1973)</td>
<td>10</td>
<td>6-8</td>
<td>90% (9/10)</td>
<td>44% (4/9)</td>
<td></td>
<td>continuous</td>
<td>7</td>
<td>6 wks</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td></td>
<td>80% (8/10)</td>
<td>12% (1/8)</td>
<td></td>
<td>intermittent placebo</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>0% (0/10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sloop &amp; Kennedy (1973)</td>
<td>21</td>
<td>6-18</td>
<td>52%</td>
<td>36%</td>
<td>7.5-11.6</td>
<td>toilet control</td>
<td>14</td>
<td>11 wks 2 months</td>
</tr>
<tr>
<td>Collins (1973)</td>
<td>33</td>
<td>4-12</td>
<td>79%</td>
<td>33%</td>
<td>9</td>
<td>no t'ment &amp; delay</td>
<td>10</td>
<td>10 wks</td>
</tr>
<tr>
<td>Taylor &amp; Turner (1975)</td>
<td>82</td>
<td>4-15</td>
<td>62% (13/21)</td>
<td>69% (9/13)</td>
<td>15.5</td>
<td>con re/force</td>
<td>115 days</td>
<td>68 days</td>
</tr>
<tr>
<td></td>
<td>x=9.0</td>
<td>4-15</td>
<td>50% (9/18)</td>
<td>44% (4/9)</td>
<td>14.3</td>
<td>int re/force</td>
<td>28</td>
<td>132 days 113 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60% (13/22)</td>
<td></td>
<td>24% (3/13)</td>
<td>8.5</td>
<td>overlearning</td>
<td>193 days</td>
<td>86 days</td>
</tr>
</tbody>
</table>

(After Doleys, 1977)
of self-control (Atthowe, 1973). Operant approaches which look to developing and strengthening internal controls are discussed below.

Insofar as alarm treatments are concerned a number of complementary procedures have experimental support, including closer supervision (Dische, 1973), 'overlearning' by the use of increased pre-bed fluid intake (Young and Morgan, 1972), and changing the family focus from 'wet' to 'dry' nights (Turner, Rachman and Young, 1970).

The urine alarm and other treatments
When compared with diverse other treatments the urine alarm emerges as superior across most studies. Alarm treatment has been specifically compared with an inoperative alarm (Baker, 1969), psychotherapy (Werry and Cohrssen, 1965), counselling and unspecified styles of psychotherapy (De Leon and Mandel, 1966), combined parent and child support (Novick, 1966), and placebo tablets (Turner et al, 1970).

Studies by Dische (1971), Meadow, (1970) and White (1968) suggest that "advice and encouragement" may be therapeutically effective. However, Doleys (1977) suggests that methodological flaws and possible real improvement rates disallow an effective distinction between the effects of "advice and encouragement" and spontaneous remission. That is, deciding what should constitute therapeutic advice or encouragement poses a distinct challenge.
A complex approach was taken by Marshall, Marshall and Lyon (1973) who compared groups labelled 'active' or 'passive' according to the treatment they received. Passive groups were treated for enuresis by one of instrumentation, surgery, medication, or urine alarm. 'Active' groups comprised treatments typified by 'responsibility and reinforcement' including reality therapy, response shaping responses by way of positive reinforcement by physician and parents, and sensation awareness such as retention control training. Unfortunately results were reported only in terms of the active or passive group members' collective improvement rate, and then only in percentage terms. (80% active; 40% passive). Since only 7 children received alarm treatment of the total 90 'active' participants, and since their improvement rates were incorporated into the report's only statement of overall results, there is little to indicate the alarm's relative effectiveness one way or the other in those cases.

Notably few comparative studies have looked at the relative usefulness of alarm and drug treatments, since those approaches have been for some time among the most common and successful (Johnson, 1980; Perlmutter, 1978). In most reports of direct comparisons, the alarm has proved the more effective in the long term. Forrester, Stein and Susser (1964) allocated 37 children of 8 years of age or more, to the treatment of either amphetamines or the alarm. At 6 months follow-up the drug group fared no better than could be expected of normal remission rates, while the alarm group performed significantly better.
A more decisive study was conducted by Young (1965). Of 378 children, 105 received treatment by the urine alarm, and 273 were administered a variety of drugs. Those under alarm treatment demonstrated a 65% success rate, of which 13% relapsed, while those in drug treatment demonstrated a 36% success rate, with 28% relapsing.

Since the time of that study, pharmacotherapy has tended greatly towards the use of tricyclic agents, none of which were given in the study by Young (1965). Recently a smaller study by Wagner, Johnson, Walker, Carter and Witner (1982), which compared the effects of the tricyclic imipramine with a urine alarm procedure, found that the 'cure' criterion of 14 consecutive dry nights was attained by 83% of the alarm group and 33% of the drug group. Relapse (3 wet nights or more in the 14 days following treatment termination) was 100% for the drug group and 50% for the alarm group.

In conclusion, it would appear that the popular use of the urine alarm is justified for a number of reasons. Not only is it inexpensive, readily available for non professional use, and largely innocuous, but the theoretical and practical aspects of its use are well within the understanding of care-givers. Further, its demonstrated effectiveness in many experimental and quasi-experimental situations recommends its continued use. However, the rates of failures and relapses often reported suggests that other methods which have positive recommendations in the literature should be considered when constructing a comprehensive enuresis management programme.
1.5.2 Pharmacotherapy of enuresis

Many different drugs have been used in attempts to control enuresis, most with little long-term effect. To date most success has been ascribed to imipramine hydrochloride (Tofranil). It has been suggested that an initial response rate approaching 40% can be expected (Perlmutter, 1978), although that figure may be somewhat inflated (Johnson, 1980). Early problems in assessing the efficacy of imipramine have included a lack of experimental controls or unrepresentative samples, such as the use of retarded children (Lovibond and Coote, 1970).

Most studies indicate that the maximum effect of imipramine can be expected within the first week of administration (Blackwell and Currah, 1973), although a greater delay has been found (Wagner et al., 1982).

A major drawback in the use of imipramine for childhood enuresis is that of relapse. Overwhelmingly, follow-up measures suggest that most children will wet at pre-treatment levels within 3 months of discontinuation of the drug, regardless of the rapidity of withdrawal (Blackwell and Currah, 1973). A report by Poussaint and Ditman (1965) did however indicate that relapse with the 47 children they studied was reduced if withdrawal from medication was graduated over 4 to 6 weeks.

It is unlikely that there is a single action of drugs currently used in the treatment of enuresis since few pharmacological agents ever act solely on specific sites. Stephenson (1979) has pointed out that imipramine in particular may act both centrally
and peripherally. As yet no specific site within the Central Nervous System (CNS) has been identified, while peripheral action could affect afferent impulses to the sacral reflex centre and interfere with a number of different mechanisms, including detrusor intramural tension and the conveying of sensory information from the bladder.

A number of studies have found that mood alterations follow treatment with imipramine (eg. Werry, Aman, Dowrick, and Lampen, 1977; Wagner et al, 1982). However, the relation between mood, drug action and continence remains unclear.

**Treatment comparisons using drugs**

Several studies have been conducted in which pharmacological agents have been used as adjuncts to treatment by other means. Besides the tricyclic imipramine, CNS stimulants have been used experimentally.

An assumption sometimes made is that (CNS) stimulants raise the sleep threshold, allowing swifter reaction to urinary urgency and pre-empting accidents, or facilitating faster reactions to alarms when they are used. Young and Turner (1965) found acquisition of urinary control with urine alarm treatment could be accelerated using the CNS stimulants dextroamphetamine hydrochloride (Dexadrine) or methylamphetamine (Methedrine). Relapse of the Methedrine group was equivalent to that of an alarm only treatment, while significantly higher relapse rates were experienced by the Dexedrine group. Whether the higher relapse rates were related to the rapid acquisition or to the drug's properties is not clear. However, as pointed out earlier the often
repeated assumption that nocturnal enuresis and 'depth' of sleep are related needs some qualification (Mikkleson et al., 1980; Gillin et al., 1982).

MacConaghy (1969) studied 6 groups using: a standard alarm with either imipramine or amphetamine, those drugs alone, random waking, and a placebo group. Of the 14 children who were treated by either drug plus alarm, 11 remained 'dry' at 12 month follow up, while of those 13 given imipramine alone only 2 remained dry. However in retrospect it was found that use of either drug was contra-indicated since 'side effects' attributed to their use included sleeplessness, irritability, reduced appetite, and weight loss.

A pilot study by Philpot and Flasher (1970) found that where imipramine was used in conjunction with a urine alarm, results were better when the drug was introduced after the child's exposure to and experience of the alarm. However the report failed to provide data on treatment duration, wetting frequencies or follow up measures.

Recently, a direct comparison of imipramine, a urine alarm and a waiting list group was made by Wagner and his colleagues (1982). At the end of the 14 weeks of treatment 33%, 83%, and 12% of those groups respectively had reached the criterion of success of 14 consecutive 'dry' nights. Relapse (2 or more 'wet' nights) over the 2 week follow-up period was experienced by all children in the drug and waiting list groups and 50% of the alarm group. However, most wetting frequencies were below pre-treatment levels.
1.5.3 Retention Control Training

A number of reports suggest that enuretic children tend to have smaller functional bladder capacities than non-enuretics (Hallman, 1950; Starfield, 1967; Troup and Hodgson, 1971; Zaleski, Gerrard and Shokai, 1973). Muellner (1960) suggested that a child's bladder must consistently hold 10 to 12 ozs (approximately 290 ml to 350 ml) of urine before it is big enough to comfortably contain the night's output of urine.

One implication is that low bladder capacity might result in a relatively high frequency of voiding and an inadequate bladder stimulus from which to develop micturition control (Muellner, 1960). That idea is supported by report by Esperanca and Gerrard (1969) who found enuretics urinate at almost twice the frequency of non-enuretics by day, although night frequencies and total diurnal volumes voided do not differ.

Vincent (1964) observed that a distinction should be made between those who have "false" and "true" low bladder capacity, whereby the former are capable of normal distension but the latter are not. An obvious strategy is to attempt to increase the "false" functional bladder capacity if enuresis is involved. A solution suggested by Muellner (1960) is to increase the child's fluid intake, with self-restriction of voiding for as long as possible.

The practice of retaining urine in order to expand the functional bladder capacity has become known as Retention Control Training (RCT). However, since continence, when it has ensued, has been attributed to different treatment elements, a number of variations in RCT procedure have been employed in different RCT
studies. The term, therefore, should be understood to refer principally to the basic exercises of systematically retaining urine for a period beyond the time the urge to urinate is first felt.

Although the underlying premise of RCT is that a significant increase in functional bladder capacity should lead to the acquisition of continence, not all published studies have reported on both functional bladder capacity and wetting frequency. The majority of reports published to date are summarised in Table 3

**RCT treatment effects**

The first published recommendations for the use of RCT for enuresis was given by Muellner (1960), although no supporting data were offered. A similar method of "bladder stretching exercises" was taken up by Starfield and Mellits (1968). They required 83 children to withhold voiding to the point of discomfort once a day for 6 months, with their parents allowing fluids to be freely available. Overall results demonstrated significant changes in bladder capacities, when age was controlled for, and significant positive correlations of those changes with reduced wetting frequencies.

Training the control of urine retention for gradually extended periods was first carried out in a study by Kimmel and Kimmel (1970). They noted that increasing bladder capacity should allow a child to sleep through the night, and thus meet the optimal conditions laid down by Mowrer and Mowrer (1938) of having the cues of bladder distension neither wake the child nor lead to voiding.
The Kimmel and Kimmel (1970) approach to RCT involved increased fluid intake, incrementing the retention interval to a maximum of 30 minutes, and the delivery of reinforcers for fluid intake and for completion of the targeted retention period. The treatment was given to only 3 children, 2 of whom ceased to bed-wet after 7 days of training and the third after 14 days. At a 12 month follow-up all were reported to have remained continent.

An almost identical procedure was employed in a later study by Paschalis, Kimmel and Kimmel (1972), where a total of 35 children received RCT. The maximum period of retention was set at 45 minutes, incremented at 2 to 3 minutes daily. The success criterion of 7 dry consecutive days was achieved by 40% of children, with no relapses at a 3 month follow-up.

Other studies employing RCT which have reported significant reductions in wetting frequencies are few, and most have had small subject numbers (Stedman, 1972; Miller, 1973; Doleys and Wells, 1975). On the other hand, several larger and more recent investigations have had less success in lowering wetting rates (Doleys, Ciminero, Tollison, Williams and Wells, 1977; Harris and Purohit, 1977; Fielding, 1980; See Table 3).

Increased bladder capacity
Despite Starfield's (1967) observation that the functional bladder capacity of enuretic children is generally smaller than that of their age-related peers (see Fig 1), surprisingly few studies have measured bladder capacity changes before and after training. Starfield and Mellits (1968) reported a mean change of 62.4 ml for those children who "improved", as against an increase
TABLE 3: Studies using Retention Control Training (RCT), 1968 to 1982

<table>
<thead>
<tr>
<th>STUDY</th>
<th>No. Subs</th>
<th>Age Range</th>
<th>Dependent variable</th>
<th>Results</th>
<th>Treatment duration</th>
<th>Follow-up details</th>
<th>Treatment details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starfield &amp; Mellits (1968)</td>
<td>83</td>
<td>5-14</td>
<td>nighttime wetting amount voided</td>
<td>inc bladder cap corr, w. decr. wetting, pre/post</td>
<td>6 months</td>
<td>none</td>
<td>unrestricted fluids</td>
</tr>
<tr>
<td>Kimmel &amp; Kimmel (1970)</td>
<td>2</td>
<td>4</td>
<td>wet nights</td>
<td>all became dry</td>
<td>7 days; 2 12 months</td>
<td>retention increase 30 min, reinf., incr. fluids</td>
<td></td>
</tr>
<tr>
<td>Paschalis, Kimmel &amp; Kimmel (1972)</td>
<td>35</td>
<td>4-13</td>
<td>diurnal voiding; wet nights</td>
<td>4 dry in base-line; 8 no improv. rest dry @ critia</td>
<td>20 days 90 days no relapse</td>
<td></td>
<td>same, plus self-charting</td>
</tr>
<tr>
<td>Stedman (1972)</td>
<td>1</td>
<td>13</td>
<td>nighttime wets</td>
<td>became dry</td>
<td>14 weeks 3 months w. 4 wets</td>
<td>bladder distension</td>
<td>dicrim training, self-charting</td>
</tr>
<tr>
<td>Miller (1973)</td>
<td>2</td>
<td>13/14</td>
<td>diurnal voiding; wet nights</td>
<td>both became dry</td>
<td>14 &amp; 16 weeks 4 &amp; 7 mths no relapse</td>
<td>no tang. reinf., RCT v. att.-placebo, self-charting</td>
<td></td>
</tr>
<tr>
<td>Rocklin &amp; Tilker (1973)</td>
<td>22</td>
<td>3-14</td>
<td>voiding freq; wet nights</td>
<td>all gps equal improvement</td>
<td>30 days</td>
<td>?</td>
<td>time-cont v. base-rate v. exper. gps, reinf. after voiding</td>
</tr>
<tr>
<td>Doleys &amp; Wells (1975)</td>
<td>1</td>
<td>3.5</td>
<td>mean/occ./day; dry nights</td>
<td>50 days to dry</td>
<td>36 days 14 weeks no relapse</td>
<td>forced liquids, night waking reinf. after voiding</td>
<td></td>
</tr>
<tr>
<td>Doleys et al (1976)</td>
<td>9</td>
<td>4-14</td>
<td>wet nights/week; pre/post t'ment bladder capacity</td>
<td>wets/week @ baseline rates; MBC changes</td>
<td>6 weeks</td>
<td>none</td>
<td>retention to 30 mins, positive practice,</td>
</tr>
<tr>
<td>Harris &amp; Purohit (1977)</td>
<td>18</td>
<td>5-13</td>
<td>wetting freq; bladder capacity</td>
<td>no improv. across gps; MBC increase</td>
<td>35 days 9 days, no sig relapse</td>
<td>points for retent. fluid rel to b/w</td>
<td></td>
</tr>
<tr>
<td>Fielding (1980)</td>
<td>24</td>
<td>5-14</td>
<td>wetting freq</td>
<td>alarm better than RCT; inc MBC (day+night wetters=n=8)</td>
<td>28 days 3, 6, &amp; 12 mths</td>
<td>RCT+alarm v. alarm</td>
<td></td>
</tr>
<tr>
<td>Bollard &amp; Nettlesbeck (1982)</td>
<td>12</td>
<td>x= 9.5</td>
<td>wetting freq</td>
<td>slightly better than alarm only until 14 consec. dry</td>
<td>?</td>
<td>RCT+alarm v. 6 other gps v. DBT</td>
<td></td>
</tr>
</tbody>
</table>

MBC = maximum bladder capacity
of 11.25 ml for those "unimproved". Similarly, Doleys and Wells (1975) demonstrated an increased bladder capacity of 268% (44 ml to 118 ml) over the 21 days of RCT given to their single subject. Doleys et al (1977), however, failed to discover evidence of consistent bladder capacity changes across 9 children following RCT, while those whose capacity increased by 25 ml or more did not demonstrate significantly reduced wetting frequencies.

Procedural variations
The use of reinforcement during RCT has differed across studies. One variation has been to provide reinforcement after urination (eg Rocklin and Tilker, 1973; Doleys and Wells, 1975), an effect of which may have been to reinforce voiding rather than retention (Doleys, 1977).

Whereas the Kimmel method of RCT was to provide promised material rewards (Kimmel and Kimmel, 1970) or tokens (Paschalis et al, 1972), researchers have also relied on less tangible reinforcers. However the use of 'intangibles', such as self-recording by charts or verbal praise (eg Starfield and Mellits, 1968; Stedman, 1972; Miller, 1973; Harris and Purohit, 1977) may be less facilitative to change for younger children (Doleys, 1977).

A possible mechanism for RCT.
A review of the evidence concerning treatments for nocturnal enuresis by Yates (1975) concluded that incontinence could largely be accounted for in terms of a small functional bladder capacity. Interestingly, Yates suggested that by day an enuretic child is hypersensitive, rather than insensitive, to bladder cues, but by night those same cues are below waking threshold.
Further, although RCT did indeed increase functional bladder capacity, it was inefficient in its reliance on a carry-over of control from waking to sleep. However, Yates also argued, the urine alarm directly trains detrusor inhibition, the end effect of which is to increase bladder capacity. Thus increased capacity comes about after the sphincter reflexes are conditioned to respond to bladder distension cues.

Yates' reasoning is appealing since it implies that, if the inefficiency of day-time training could be circumvented by a more rigorous approach, or applied within specific dimensions, and the obvious inconveniences of the alarm apparatus could be avoided. However, Yates fails to account for reports in the literature of improved rates of nocturnal continence in the absence of increased bladder capacity (Doleys, 1977), and fails to explain how secondary (acquired) enuresis occurs.

Evaluation of RCT
Since subject numbers have been generally small and methodologies have varied somewhat, evaluating RCT has proved difficult for the few studies which have attempted it. While appearing to have a reasonable theoretical basis, it may be better administered within specific dimensions such as age or the type of enuresis involved. The value of RCT may prove to be more by way of an adjunct to other treatments. A component analysis of the elements of Dry Bed Training by Bollard and Nettelbeck (1982) found that 11 of the 12 children treated by RCT and alarm became dry. However, a better description of what comprised RCT in that study is wanting. (See section 1.5.4).
1.5.4 Dry-Bed Training

In recent years a number of treatment approaches used for enuresis have been combined into a management procedure for bedwetting called Dry Bed Training (DBT). The rationale for DBT can be traced to the observation by Azrin et al., (1974) that the problem of enuresis may variously involve ease of arousability from sleep, ability to inhibit urination, social motivation to remain dry, and the strength of alternative responses to remaining dry. Thus included in treatment may be found the urine alarm, training in rapid awakening, RCT, self correction for wetting, and enhancing motivation by increased social reinforcement for remaining dry. However, not all studies have included all of these treatment elements, and the evaluation of outcome is thus complicated.

Despite the difficulty of assessing the contribution of individual treatment elements, the research literature generally reflects relatively good initial success rates for DBT (Azrin et al., 1974; Azrin and Thienes, 1978; Bollard, 1982; Bollard and Nettelbeck, 1981, 1982; Bollard and Woodroffe, 1977; Doleys et al., 1977; Griffiths, Meldrum and McWilliam, 1982; Nettelbeck and Langeluddecke, 1979).

Although Azrin et al. (1974) found that all of their 24 subjects were dry at completion of the programme, the relapse rate, with 30% requiring re-treatment at 6 months, is little different to standard alarm rates.
The Azrin et al (1974) procedure was replicated by Doleys et al, (1977) in their comparison of DBT and RCT. However, the period of treatment was longer and fewer children met the dryness criteria. At follow up 2 years later (Williams, Doleys and Ciminero, 1978) 38% had relapsed. Similar findings were reported by Bollard and Woodroffe (1977) who used a parent-administered procedure.

Better results were reported by Azrin and Thienes (1978) where 50 children (3 to 14 years of age) who allocated to either an alarm-only group or a modified DBT approach, notable for having dispensed with an alarm. All achieved dryness after an average of 2 weeks. In the 1 month following treatment 20% of the children relapsed, but subsequently responded positively to further treatment. The authors attributed the high success rate to their modifications on previous programmes. Besides eliminating the alarm, other changes included concentrating training over a single afternoon and night, and adding bladder-awareness training and copious fluid intake during the all-night intensive. Post-training supervision required parents to continue praise for nightly dryness, encouraging the child to take responsibility for cleaning up after wetting accidents, and reducing the number of waking times, according to the child's progress.

However, in one of two experiments conducted by Bollard and Nettelbeck, (1981) it was found that where the DBT was carried out by parents without the adjunctive urine alarm, results were only marginally better than no treatment at all. The discrepancy could possibly be attributed to differing intensities of administration or to a lack of closeness of supervision.
An investigation of DBT by Griffiths et al (1982) found that all 11 children treated took a median of 4 weeks to achieve dryness. At follow-up 9 months later 2 children (18%) had relapsed.

Relapse data

Few studies on DBT have provided data on extended follow-up beyond 6 to 9 months. Williams et al (1978) treated 12 children, 8 of whom achieved continence. Five subsequently wet regularly once a month or less, 2 four times, and 1 six.

A more substantial study of relapses after DBT was made by Bollard (1982), who re-examined after 2 years the children reported on by Bollard and Nettelbeck (1981). Of the 98 children contacted who had originally achieved the criterion dryness of 14 nights, 39% of those treated by DBT and 41% treated only by alarm had relapsed. Bollard (1982) concluded that apart from having a history of day and night wetting, none of the independent variables examined were associated with relapse (ie. age, sex, pre-treatment wetting frequency, number of wets during treatment, type (primary versus secondary) of enuresis, and a history of daytime urination problems).

Bollard's findings contrast with observations by Lovibond and Coote (1970) and Fielding (1980) that relapse was more prevalent among children who wet frequently, and had diurnal urgency and/or a high frequency of micturition.
Contribution of DBT elements

Comparisons of many of the elements which have been included in DBT can be found in a number of studies. However, to date only one investigation has attempted to make a specific component analysis. Bollard and Nettelbeck (1982) allocated 127 children to different groups using an alarm together with either a waking schedule, RCT, and positive practice and cleanliness training, or with three combinations of those elements, as well as DBT in toto (based on a previous study of Bollard and Nettelbeck, 1981), giving a comparison of eight groups in all. Following a one month baseline the various treatments were administered by parents. The criterion of success was 14 consecutive dry nights.

Although the single-component groups each proved effective, with success rates above that of the alarm-only treatment, those differences were not significantly different. Effects were found to be cumulative, so that the more components added the more effective the treatment. Of the components the waking schedule appeared to be the most useful. Significant differences were found between the alarm treatment group (n=35) and DBT (n=20) with latter superior (89% versus 100%).

It was concluded that of the components examined positive practice, cleanliness training, and RCT were the least effective and could probably be eliminated from DBT without greatly affecting the outcome. However, the report does not make it clear how similar the practice labelled RCT was to that in earlier studies, nor if it was continued beyond the first night's training.
In summary, the research on DBT suggests that the management of enuresis can be substantially enhanced by the inclusion of a number of components, and that individual components can be tailored to suit circumstances. However, it also appears that methods of assessment currently do not have the sophistication to indicate which procedure or set of procedures would suit a particular child.

1.5.5 Muscle Training

According to Griffiths et al (1982) wetting "is most effectively eliminated when the child is specifically taught that he is the locus of control". While that is the rationale for employing "active" procedures in DBT such as social learning and self-correction rather than relying solely on more "passive" methods such as the urine alarm, little research has focussed on practices which emphasise to the child his/her role in or responsibility for bringing about control. Incontinence in adults has however been so addressed.

Although incontinence is largely a problem of childhood, 50 to 60% of women will at some time suffer from urinary stress incontinence (Hurd, 1980), and approximately 5% will be so personally or socially inconvenienced as to seek treatment. The problem is more prevalent during middle life when past physical trauma of the pelvic floor, usually derived from vaginal childbirth, interacts with pelvic floor laxity stemming from sedentary lifestyle or a lack of exercise related to the pelvic area (Hurd, 1980; Maly, 1980).
For some time it has been known that women who suffer urinary stress incontinence, but no gross structural deficits, can be trained to develop the voluntary muscles of the urethra by interrupting urination midstream (Davies, 1938; Miller and Hyde, 1949). One advantage of this method is that by starting and stopping the flow there is feedback of specific sensory information to facilitate the process. It should be noted however that training midstream interruption necessarily exercises the pubococcygeal.

According to Kegel (1951) the maintenance of continence depends largely on the balance of reflexes governing the functions of the internal and external sphincters, which balance is maintained by the activity of the pubococcygeal muscle and its visceral extensions.

Kegel (1951) noted that virtually all women for whom urinary stress incontinence is a major problem also have poor tonality of the pubococcygeal. He found, however, that training in perception and voluntary contraction of the pubococcygeal led to improved sphincteric functioning (Kegel, 1948, 1949, 1951; Kegel and Powell, 1950;) and recommended training to "draw up, draw in and retract the perineal muscles" (Kegel, 1951).

Since many women initially are unable to isolate and control the perineal area, an alternative requires the patient to exert herself as if stopping a bowel movement or the flow of urine. Once it is understood which muscles are involved in the exercise, frequent repetitions are encouraged over some weeks (Kegel 1951).
Exerting as if to inhibit bowel and bladder movements has the advantage of not being confined to periods of voiding. However, since both that exercise and midstream interruption employ more or less the same musculature, there is probably little difference in their effects on the pelvic floor or sphincter muscles.

Between 1948 and 1956 the literature of obstetrics and gynecology gave some attention to pelvic muscle and midstream interruption exercises which were designed to overcome pelvic floor laxity and concomitant incontinence. Although such exercises have found little inclusion in major texts (Maly, 1980) they have entered into the literature as an accepted part of treatment for adult female incontinence in some circles (Hurd, 1980) as well as becoming adjunctive to the treatment of some female sexual dysfunctions (Kaplan, 1974; Annon, 1974, 1975).

The only recent report concerning Kegel-type exercises and their role in treatment for incontinence comes from Maly (1980) who reported that of her 69 gynecological patients the incidence of urinary stress incontinence was 20% among those who did not practice Kegel-type exercises, as against 6% of those who did. The report is given only in percentage terms, and there is no further analysis or commentary on the procedures employed, nor is any follow-up data offered.

Since there is some evidence to suggest that suitable exercises can reverse urinary stress incontinence, an obvious comparison with childhood enuresis is invited. However, incontinence in women is traceable to physical trauma and/or age-related atrophy and it might seem inappropriate to compare the condition with
prolonged incontinence during childhood, where developmental factors are likely to be involved. On the other hand, since it is being argued here that, in both instances, urinary control may follow increased control and tone of voluntary urinary musculature and increased perception of bladder distension cues, the comparison may have some validity.

As yet no programme has been devised for children exploring the usefulness of direct and voluntary exercise of control of the urinary process. This is surprising if the acquisition and maintenance of urinary control can be considered a skill (Yates, 1975) and since a model for training that skill has existed for some decades in adult treatment approaches.

A method which obviously suggests itself for investigation is one derived from Kegel-type exercises, such as having the child practice control over urination to provide enhancement of muscle tone and of his/her perception of the control mechanisms. It could be argued that different procedures such as RCT or the urine alarm do exercise the urinary musculature, and that such exercise contributes to ensuing continence. For instance, by encouraging the child to retain urine during RCT, voluntary control of the external sphincter is almost certainly exercised beyond previous limits. However, in the RCT procedure, the only controls demanded are those of extended contraction of pelvic floor and sphincter muscles, and their subsequent relaxation.
During the urine alarm treatment sphincter control is thought to be a response to increased sensitivity to bladder distension cues. However, during the initial stages of treatment there must be some degree of exercising of the musculature in response to the alarm and in order to inhibit wetting.

Nonetheless, neither the rationale of RCT nor the urine alarm treatment is designed to specifically address control of the urinary musculature, although the end result may nevertheless be increased muscle tone (Yates, 1975) as well as enhanced muscular perception and control.

While both RCT and the urine alarm may actually serve to exercise the urinary musculature, it is questionable whether the amount of exercise would itself account for the acquisition of continence following those treatments. On the other hand, since an end result of such treatments may be increased muscle tone and an enhanced awareness of urinary mechanisms, as well as some realization on the child's part that he/she can be the locus of urinary control, the possibility that such exercise contributes to continence should not be dismissed.

Muscle Training for Children
The foregoing review has attempted to summarize principal treatment approaches for childhood enuresis, and has examined briefly muscle training exercises for adult incontinence. The focus of this report is on the question of whether enuretic children can be helped toward continence by systematically training them in the use of manoeuvres which exercise the
musculature associated with urinary processes. (That question, and others generated by the structure of the present project are set out more fully in section 1.6.)

Therefore, an appropriate course of action is to devise and institute an exercise programme for children with the aim of enhancing in the long term a child's control of his/her micturition. Although for the moment such exercises can be termed Muscle Training (MT), it should be understood that, during the period he/she would be required to carry out the appropriate exercises, a variety of co-related processes would continue to operate and impinge on attempts to change wetting patterns. That is, training the urinary musculature of children to adequate levels of tone and control is not likely to be a simple process, and would appear to involve an interacting range of behavioural, cognitive, affective, physiological and maturational components.

A conceptual model which attempts to predict the usefulness of a programme for an enuretic child must therefore take account of such a range of 'secondary', contributing variables. Although some would appear relatively easy to define or quantify, such as frequency of accidental wetting, bladder volume, or age, factors such as the level of a child's motivation or his/her "depth" of sleep appear less easy. Other considerations likely to be important to the control of enuresis, such as the degree of perception of urinary-associated sensory input, or the stability of his/her social milieu, are difficult to define, let alone control for during an investigation into treatment effects, and must remain beyond the scope of this project.
1.6 Aims and Hypotheses

The present study intends to explore the usefulness of Muscle Training (MT), (that is, a series of midstream interruption exercises) in the control of childhood enuresis. A co-ordinated programme using MT will be administered primarily by parents. It is considered ethically and methodologically adviseable to include in the overall programme a second form of treatment, since there is no reliable predictor of the effectiveness of muscle training exercise programme alone.

The treatment which appears to be the most accessible for the purposes of this project is RCT which, although having equivocal results to date, is expected to provide a more useful degree of efficacy if combined into a programme with MT than may otherwise occur. The inclusion of RCT is also intended to give a basis against which to compare MT, as well as allowing the question of RCT's efficacy to be re-examined.

Hypotheses for the programme are

1. That Muscle Training (MT) will have a significant effect in reducing the wetting frequency of enuretic children.

2. That Retention Control Training (RCT) will have a significant effect in reducing the wetting frequency of enuretic children.

3. That the combined treatments of MT and RCT will be more efficacious in terms of reduction of wetting frequency than either treatment alone.
METHOD

2.1 Subjects

Selection and allocation to groups.

65 boys and 28 girls who, at the commencement of the study fell in an age range of 4.5 to 12 years of age, were included in the present study. The bulk of subjects were obtained by placing an advertisement in the Canberra Times, the local daily newspaper advising "parents of bedwetting children" of the programme, and providing mail and telephone contact (Appendix A).

As a direct result of the advertisement, and of an identically worded article which appeared in the same paper the previous day, parents or guardians of children thought to be eligible for inclusion in the study made contact over the following 5 weeks.

Children were allocated at random to one of two groups upon first contact. The groups differed only in the order in which the two treatment procedures were to be administered.

Prior to the placing of the advertisement it was proposed to visit all parents and children in order to gain preliminary data and to meet the children. However, owing to the large response to the advertisement, and to the wide geographic distribution of those interested, it was necessary to create different levels of contact. Thus approximately one third (32) were visited while the remaining respondents (61) agreed to maintain contact by post and telephone as far as possible. The decision to differentiate children into Visit and Postal subgroups was made after it became apparent that the number of children available for inclusion in
the programme would far exceed original estimates. Consequently, most of those who applied for inclusion at the programme's beginning were visited, while most of the remainder were contacted by telephone only, and received guidelines by post. However, of those who sought inclusion during the latter part of the induction period, a small number were included in the Visit group by virtue of their close proximity to the university. Since parents came to hear of the programme by a number of different routes, it was considered that the method of allocation was unlikely to reflect subject or trainer characteristics which might affect subsequent treatment, or to introduce bias into later data analyses.

Although face-to-face contact was removed in many cases it was not considered necessary to modify the programme's guidelines as they appeared sufficiently comprehensive (see Appendix B).

2.1.1 Assessment

The criteria of eligibility for inclusion in the study were broad, requiring only that children

i) were between 4.5 and 12 years of age

ii) had no history of organic urinary problems

iii) were not currently undergoing systematic treatment for enuresis

iv) were available for the proposed duration of the programme's administration

v) wet at a frequency of 2 or more days per week.

Over 100 respondants were assessed before the final 93 candidates were selected.
2.1.2 Interview and Report Form

Final selection followed an interview and information gathering session with interested parents as soon as it was convenient for all parties. The interview was conducted face to face, or by telephone. Information concerning a child's

- sex
- age
- estimated current wetting frequency
- current systematic and unsystematic domestic management procedures
- past treatments and their outcome
- depth of sleep
- history of wetting
- familial history of childhood wetting

was noted on a report form (Appendix C1) which was constructed for that purpose. The report form served the additional functions of recording the group to which a child was allocated, subsequent contacts with parents, and the receipt of record sheets.

During the interview the rationale for the two principal treatment approaches employed in the present research was explained to parents. Those who affirmed a willingness to supervise the administration of the programme to their child or children and whose child met selection criteria were put in possession of the appropriate guidelines (Appendix B).

2.1.3 Guidelines

A guidelines package for administration of the programme was distributed according to the sex of the child, and according to the group to which the child was randomly allocated. The sex of the wetting child was deemed relevant only in relation to the gender wording of the guidelines package. The group to which the child was allocated was relevant to the package's distribution in
that the administration of the treatments contained within it required one of two possible orders.

The guidelines package included
- a brief re-introduction to the programme and its purpose,
- instructions for the obtaining of maximum bladder volumes at the start and end of the programme's administration,
- instructions for the supervising parent to convey information and instruction to the child,
- record sheets for charting progress through the two consecutive treatments
- record sheets for the charting of wetting frequencies over 24 hour periods throughout the first three phases of the programme.

2.2 Treatment programme
The programme was divided into three phases:
- Pre-treatment period of 14 days, during which
  i) baseline measures of the child's maximum bladder capacity were taken
  ii) preparation of treatment apparatus was undertaken
  iii) the daily frequency of wetting was recorded
- First treatment interval, during which one of the two treatment procedures was carried out, according to which treatment group the child had been allocated;
- Second treatment interval, during which the other treatment procedure proceeded. At the conclusion of the second treatment three bladder capacity measures were again made.

The two treatment procedures were carried out consecutively. The order was determined according to a random distribution determined prior to the issuing of the guidelines.
The original intention of the overall programme was to allow sufficient time to carry out follow-up measures. However, the response rate following the publicizing of the programme far exceeded estimates, such that follow-up procedures have been set aside.

2.2.1 Observation Period
- Apparatus preparation

Parents were invited to find a container which:
(a) could be easily marked with a waterproof pen;
(b) hold the contents of the child's bladder without spillage;
(c) was narrow enough to allow judgment of fluid levels by eye, but wide enough to urinate into without difficulty. A container with a 10cm to 15cm base was recommended.

- Maximum Bladder Volume Estimation

At a time when the child reported urinary urgency, he/she was asked to urinate fully into the container. That procedure was carried out on three separate occasions during the 2 week observation period, and the results recorded on the 'wetting' record sheet. It was stressed to parents, both verbally and again in the guidelines (Appendix B), that all measurements should be as accurate as possible, and ideally that they should use measuring containers with gradations of 10cc (or an imperial equivalent) or less.

Parents were instructed to measure bladder volumes three times, in the same fashion, at the programme's end. The three baseline and three final volumes were recorded on the "Wets Record Sheet" (Appendix B).
Following the baseline bladder volume estimations parents were required to calculate the average maximum bladder volume, to draw a line around the inside wall of the container approximating the level of half that volume, and to then set the container aside until the Muscle Training period.

- Recording of wetting frequencies
Parents were asked to record whether or not children wet by day or night, ie over any 24 hour period, the approximate time, and any comments they thought relevant. It was also suggested that as far as possible the children should keep the frequency records.

2.2.2 Muscle Training (MT)
The term Muscle Training which was given to the procedure highlights the interest of the present enquiry: direct manipulations of the urinary musculature during voluntary midstream interruption by the child.

The child was shown the previously prepared container, with the line drawn at a level approximating half of the maximum functional bladder capacity. The procedure was explained to him/her, whereby he/she was required to announce when the desire to void was felt on two separate occasions daily.

The child was encouraged to place the container on an even surface and to void into it until the level of urine reached the drawn line, and then to inhibit voiding to the best of his/her ability. A second attempt to fill to the line and to interrupt was then made.
The MT period extended over 14 days, such that a maximum of 56 inhibition manoeuvres could be expected.

Results of MT were recorded on the sheet provided, indicating whether the level reached was 'above', 'on' or 'below' the line. If during any one training occasion the result of the second inhibition was recorded as 'below', it was assumed that the bladder was emptied before inhibition could be effected, and the result was discounted as constituting a trial.)

During MT parents (or children) continued to keep records of wetting frequency on a daily basis.

2.2.3 Retention Control Training (RCT)

The RCT used in the programme was drawn on procedures described earlier. The principal requirement for the child was to voluntarily inhibit urinary reflexes for periods which were to be incremented daily. Thus on the announcement that he/she wished to void he/she was encouraged to 'hold on' until the designated period had expired. The periods of retention ranged from 1 minute on the first day to 60 minutes after 21 days.

Times for retention were as follows:

<table>
<thead>
<tr>
<th>Day</th>
<th>Period to hold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 min</td>
</tr>
<tr>
<td>2</td>
<td>3 min</td>
</tr>
<tr>
<td>3</td>
<td>6 min</td>
</tr>
<tr>
<td>4</td>
<td>9 Min</td>
</tr>
</tbody>
</table>

and 3 minutes more per day thereafter, to a maximum of 1 hour at day 21.
In order to be able to loosely predict the time when onset of urgency could be expected, and thus facilitate supervision by parents, the child was asked to drink a reasonable quantity of a preferred fluid. Since it was likely that the passage of time could escape notice as retention periods reached the required upper limits, parents were encouraged to use a timing device.

It was emphasised to parents that they should avoid the use of material rewards for appropriate retention. Apart from the poor control which could be exercised over external reinforcers, it was envisaged that strong external incentives to retain could prove to be counterproductive in terms of facilitating physical trauma, or in setting a precedent for the management of other 'problem' behaviours.

Parents were advised to be sensitive to the possibility of a child attempting to inhibit and override pain signals, and were encouraged to permit the child to void at signs of excessive discomfort.

If children were incapable of retaining for the designated period parents were advised to return to the previous day's retention period on the following day. If the child repeatedly appeared to be unable to withhold beyond a certain period it was suggested that the goal for the remaining RCT days be set at "a comfortable maximum".

Results of RCT, indicating the RCT day number, the date, and the corresponding retention period, were recorded on the sheet provided. During RCT parents (or children) continued to keep records of wetting frequency on a daily basis.
RESULTS

3.0 Resume.

The principal dimensions of the project were: - four groups of children took part in a programme which was conducted over three consecutive phases for each child. The groups differed by the degree of contact parents had with the study's co-ordinator, (Postal or Visited) and the order in which the two treatments were administered, ie Muscle Training followed by Retention Control Training (MT-RCT) or Retention Control Training followed by Muscle Training (RCT-MT). During the first phase baseline records of accidental bedwetting were kept. In addition, three measures of the child's full bladder capacity were taken. The second and third phases were treatment periods in each of which one or the other of the treatments were administered by parents. Following the last phase parents again took three measures of their child's full bladder capacity. The principal data for analyses, generated by the record and information sheets of those who completed the project, were completion rates, demographic details, wetting rates, bladder volumes, and the results of muscle training trials, expressed as discrete variations of urine levels from a line within a prepared receptacle.

3.1 Response and completion data

Over the period during which admissions were made into the programme, the parents of 93 children (65 boys, 28 girls) agreed to participate. Sixty-one (66%) children were allocated to one of two Postal contact only, and the remaining 32 (34%) were allocated to one of two Visited groups. Of the children in the two Postal groups, 31 were allocated to the treatment order of
Muscle Training followed by Retention Control Training (MTRCT), and 30 were allocated to the reverse order of treatment (RCTMT). Of the children in the two Visited groups, 16 were allocated to the treatment order of Muscle Training followed by Retention Control Training (MTRCT), and 16 were allocated to the reverse order of treatment (RCTMT). Thus of the 93 enuretic children, 47 (51%) were allocated to the order of MT-RCT and 46 (49%) to RCT-MT.

At the final date for completion of the programme record sheets for 21 boys and 9 girls had been returned. Analysis indicated that there was no significant relationship between a child's sex and completion of the programme ($\chi^2 = .05, \ p > .05, \ df = 1$, corrected for continuity). That is, the sex of a child did not significantly affect whether or not finalized record sheets were submitted upon completion of the programme. Record sheets indicating completion of the treatment phases were submitted for 18 children in the Postal groups and for 12 in the Visited groups. Analysis indicated that there was no significant relationship between the degree of parent - coordinator contact and completion of the programme ($\chi^2 = .11, \ p > .05, \ df = 1$, corrected for continuity). That is, the degree of contact maintained between parents and the coordinator did not significantly affect whether or not finalized record sheets were submitted upon completion of the programme. Record sheets indicating completion of the treatment phases were submitted for 17 children in the MT-RCT groups and for 13 in the RCT-MT groups.
Analysis indicated that there was no significant relationship between the order in which treatment was administered and completion of the programme ($\chi^2 = .14, \ p > .05, \ df = 1$, corrected for continuity). That is, the order in which treatment was carried out, regardless of contact level, did not significantly affect whether or not finalized record sheets were submitted upon completion of the programme.

3.2. Demographic details

Prior to admission to the programme, data relevant to each child and his/her enuretic problem was recorded and collected on the information sheet.

- Age.

The average age of wetting children was 7.6 years (boys 7.8yrs; girls: 7.3 yrs; range 5 to 11 yrs).

Owing to the imprecise nature of most of the rest of the demographic information, it is presented in Appendix C2, and there more by way of background than for specific analyses, and refers to those who completed the programme.

3.3 Wetting Rates (Main dependent variable)

Across the treatment programme, each child's wetting rate during a specific phase (i.e. Baseline, or treatment 1 or treatment 2) was derived from the final 4 days of that phase (see Appendix D). It was decided to analyse wetting on the final 4 days of each phase only for two reasons. In the case of baseline data it was considered that the later that measures of wetting were taken the less likely that the data would reflect reactivity to the
recording procedures, children having become used to records being kept. In the case of the treatment phases, it seemed plausible that changes attributable to that particular intervention were more likely to be apparent by the end of a treatment phase.

A systematic analysis of the data required: a) Three analyses of variance of wetting rates for the 3 phases of the programme across the the 4 groups. If an overall analysis of the data within a phase suggested specific differences between groups within that phase further analysis was to be considered; b) Four analyses of variance of wetting rates for the 4 groups across the 3 phases. If an overall analysis of the data within a group suggested specific differences between phases within that group further analysis was to be considered.

Mean wetting rates for each group across the programme are set out in Table 4 and illustrated in Figure 2.

***************

**TABLE 4. Summary of groups' averaged wetting rates for final 4 days of each phase.**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>PHASE 1</th>
<th>PHASE 2</th>
<th>PHASE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 P/MT-RCT</td>
<td>2.67</td>
<td>2.83</td>
<td>2.25</td>
</tr>
<tr>
<td>2 V/MT-RCT</td>
<td>3.00</td>
<td>2.60</td>
<td>2.20</td>
</tr>
<tr>
<td>3 P/RCT-MT</td>
<td>3.00</td>
<td>2.67</td>
<td>2.17</td>
</tr>
<tr>
<td>4 V/RCT-MT</td>
<td>2.86</td>
<td>2.43</td>
<td>2.43</td>
</tr>
</tbody>
</table>

P = Postal V = Visited
MT = Muscle Training RCT = Retention Control Training
Figure 2. Groups' wetting rates (mean of final 4 days of each phase) across programme.

Baseline Phase 1 Phase 2
Programme Stage

P = Postal V = Visited
MT = Muscle Training RCT = Retention Control Training

**************
3.3.1 Differences between Groups within Phases

Results of the respective analyses of variance data for three phases of the programme are set out in Table 5. The results of these analyses of wetting rate data suggest that

a) there were no differences between the group's wetting rates at the end of the baseline period;

b) there were no differences between the group's wetting rates at the end of the first or the end of the second treatment periods;

Since no differences were found between groups within each phase further comparisons within the data from each phase were not indicated.

TABLE 5. Summary of analyses of variance of wetting rate data for stages of the programme.

<table>
<thead>
<tr>
<th>STAGE (t'ment)</th>
<th>SOURCE</th>
<th>SS</th>
<th>Df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASE</td>
<td>BETWEEN</td>
<td>.64</td>
<td>3</td>
<td>.21</td>
<td>.26</td>
</tr>
<tr>
<td></td>
<td>WITHIN</td>
<td>21.52</td>
<td>26</td>
<td>.83</td>
<td></td>
</tr>
<tr>
<td>PHASE 1</td>
<td>BETWEEN</td>
<td>.75</td>
<td>3</td>
<td>.25</td>
<td>.22</td>
</tr>
<tr>
<td>(t'ment 1)</td>
<td>WITHIN</td>
<td>29.91</td>
<td>26</td>
<td>1.15</td>
<td></td>
</tr>
<tr>
<td>PHASE 2</td>
<td>BETWEEN</td>
<td>.27</td>
<td>3</td>
<td>.09</td>
<td>.06</td>
</tr>
<tr>
<td>(t'ment 2)</td>
<td>WITHIN</td>
<td>33.60</td>
<td>26</td>
<td>1.29</td>
<td></td>
</tr>
</tbody>
</table>

**************

**************
3.3.2 Differences within Groups Between Phases.

Results of analyses of variance of wetting rates for each group across the programme are set out in Table 6.

Results of these analyses of wetting rate data suggest that for each of the 4 groups there were no significant differences in wetting rates between phases. Thus for no group was it suggested that Baseline rates differed significantly from wetting rates at the end of subsequent treatment phases. Consequently, further comparisons within data of each group were not indicated.

***************

TABLE 6. Summary of analyses of variance of wetting rate data for groups.

<table>
<thead>
<tr>
<th>GROUP</th>
<th>SOURCE</th>
<th>SS</th>
<th>Df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 P/MT-RCT</td>
<td>BETWEEN</td>
<td>2.17</td>
<td>2</td>
<td>1.08</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>WITHIN</td>
<td>30.58</td>
<td>33</td>
<td>.93</td>
<td></td>
</tr>
<tr>
<td>2 P/RCT-MT</td>
<td>BETWEEN</td>
<td>2.11</td>
<td>2</td>
<td>1.06</td>
<td>1.56</td>
</tr>
<tr>
<td></td>
<td>WITHIN</td>
<td>10.17</td>
<td>15</td>
<td>.68</td>
<td></td>
</tr>
<tr>
<td>3 V/MT-RCT</td>
<td>BETWEEN</td>
<td>1.60</td>
<td>2</td>
<td>.8</td>
<td>.8</td>
</tr>
<tr>
<td></td>
<td>WITHIN</td>
<td>12.00</td>
<td>12</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>4 V/RCT-MT</td>
<td>BETWEEN</td>
<td>.86</td>
<td>2</td>
<td>.43</td>
<td>.24</td>
</tr>
<tr>
<td></td>
<td>WITHIN</td>
<td>32.29</td>
<td>18</td>
<td>1.79</td>
<td></td>
</tr>
</tbody>
</table>

P = Postal
V = Visited
MT = Muscle Training
RCT = Retention Control Training

***************
3.4 **Bladder Volumes**

Bladder volumes were measured three times during baseline and three times after the programme's completion. The largest volume of the three within each of the two sets of measures was designated as a child's Maximum Bladder Capacity (MBC), pre- and post-treatment. The records of two children who completed the treatment programme did not include sufficient bladder volume measures for an estimate of Maximum Bladder Capacity to be made for them. Mean MBC's for each group, pre- and post-treatment, are set out in Table 7 and illustrated in Fig 3. The children's complete MBC data is set out in Appendix D.

*----------------------*

**TABLE 7. Summary of Groups' Maximum Bladder Capacity Data.**

<table>
<thead>
<tr>
<th>MAXIMUM BLADDER CAPACITY (mls)</th>
<th>PRE-T'MENT</th>
<th>POST-T'MENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 P/MT-RCT</td>
<td>159.40</td>
<td>169.50</td>
</tr>
<tr>
<td>2 V/RCT-MT</td>
<td>194.40</td>
<td>227.80</td>
</tr>
<tr>
<td>3 P/MT-RCT</td>
<td>207.50</td>
<td>226.67</td>
</tr>
<tr>
<td>4 V/RCT-MT</td>
<td>114.00</td>
<td>130.43</td>
</tr>
</tbody>
</table>

P = Postal  
V = Visited  
MT = Muscle Training  
RCT = Retention Control Training
FIGURE 3. Groups' Pre- and Post-Treatment Maximum Bladder Capacity

Millilitres

Baseline End programme

P = Postal  
V = Visited  
MT = Muscle Training  
RCT = Retention Control Training

***************
An analysis of the MBC data comparing Postal (Gps 1 and 2) and Visited (Gps 3 and 4) children indicated no significant difference between measures taken at Baseline ($t = .12, df = 26, t \text{ crit } = 2.056, p > .05, df = 26$), or post-treatment ($t = .14, df = 26, t \text{ crit } = 2.056, p > .05$).

Since no significant differences were evident at baseline, the Postal and Visited data were combined for an analysis of the pre- and post-treatment MBC data. Post-treatment measures showed a significantly greater MBC that those taken at Baseline ($t = 2.37, df = 26, t \text{ crit } = 2.056, p \leq .05$).

The Maximum Bladder Capacity data was examined for possible relationships with changes of wetting rates, and with age. A correlation was completed on the bladder volume data and the changes in the wetting rates for all groups across the programme. No significant relationship was found. ($r = .07, df = 26, p > .05$).

A correlation was completed on the Baseline MBC data and the children's ages. However no significant association was found ($r = .05, df = 26, p > .05$).

A correlation was completed on the Post-treatment MBC data and the children's ages. However no significant association was found ($r = .08, df = 26, p > .05$). A correlation was completed on the MBC measures, Pre- to Post-treatment, and the children's ages. However no significant association was found ($r = .08, df = 26, p > .05$). Differences between pre- and post-treatment MBC data were correlated with the ages of the children. However, no significant association was found. ($r = .05, df = 26, p > .05$).
3.6 Acquisition of control

Parents recorded whether their child, when interrupting midstream the emptying of a full bladder, managed to stop 'above', 'on', or 'below' the line drawn in the prepared vessel. As training proceeds, one measure of learning the appropriate urinary muscle control may be an increased accuracy in voluntarily stopping 'on' the line, despite continued bladder pressure. Thus evidence for learned control may be inferred where a child's was stopping more 'on' the line during the second half of training than the first.

However, without evidence of continued bladder pressure, records of 'on' the line could be attributed to simply emptying the bladder rather than a voluntary midstream interruption. Therefore a voluntary and accurate stop was counted only if it was 'on' the line, and was recorded as being the first of two trials. The MT data which was therefore subject to analysis was 38% of the totals 'on's recorded for the first half and 36% for the second.

Results of the analyses of the 4 groups' MT data are set out in Table 8 and illustrated in Figure 4.

The only group to show significant improvement across the MT period was the Visited RCT - MT group. ($t = 2.01$, $t_{crit} = 1.89$, $p \leq .05$, $df = 7$).
### TABLE 8. Summary of groups' mean accurate voluntary midstream 'stops' across Muscle Training.

<table>
<thead>
<tr>
<th>GROUP</th>
<th>n</th>
<th>Mean 1st half</th>
<th>Mean 2nd half</th>
<th>Range 1st half</th>
<th>Range 2nd half</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 P/MT-rct</td>
<td>12</td>
<td>4.5</td>
<td>4.8</td>
<td>0 - 13</td>
<td>3 - 10</td>
<td>.48</td>
</tr>
<tr>
<td>2 P/rct-MT</td>
<td>6</td>
<td>3.3</td>
<td>6.5</td>
<td>2 - 6</td>
<td>4 - 12</td>
<td>1.88</td>
</tr>
<tr>
<td>3 V/MT-rct</td>
<td>5</td>
<td>2.2</td>
<td>2.4</td>
<td>1 - 4</td>
<td>0 - 6</td>
<td>.27</td>
</tr>
<tr>
<td>4 V/rct-MT</td>
<td>7</td>
<td>3.0</td>
<td>6.0</td>
<td>0 - 6</td>
<td>3 - 11</td>
<td>2.87*</td>
</tr>
</tbody>
</table>

*sig

P = Postal  
MT = Muscle Training  
RCT = Retention Control Training

---

**Figure 4.** Groups' mean accurate voluntary midstream 'stops' across Muscle Training

![Graph showing 'stops' across Muscle Training](image)

P = Postal  
MT = Muscle Training  
RCT = Retention Control Training
DISCUSSION

Response Data

Ninety three children commenced the programme, with 30 completing and submitting record sheets for both the Muscle Training and Retention Control Training segments. Reasons for the 70% rate of attrition are not immediately apparent. Neither the sex of a child, nor the order in which treatment was administered, nor the degree of contact between the programme's co-ordinator and parents were found to be significant predictors of completion. Due to an oversight the age of each child was recorded only on the record sheets which were dispatched or handed to parents. Therefore the only available information about the ages of participants was restricted to those who completed and returned record sheets, such that a comparison of the mean ages of those who commenced and those who completed was not carried out.

It is doubtful, however, that a simple relationship existed between a child's age and the likelihood of finishing. Following the programme's completion, 12 parents who had failed to return record sheets were canvassed by telephone for reasons for their child dropping out of the programme. For some of the older children attempts to remember to include the requisite exercises and recordings into daily routines proved difficult, or the exercises themselves were considered too disruptive of daily routines to persevere with. Likewise, some parents found that they failed to remember to supervise or keep records. A third problem appeared to be that some younger children who were probably more closely supervised sometimes refused or were unable to perform the Muscle Training exercises, or to increment retention times for
RCT. While probably not a full account of reasons for abandoning the programme, similar problems were probably encountered by other parents and children who did not complete.

The main aim of the project was to examine the potential for Muscle Training, and issues such as the value of parent training, or the relevance of components such as the level of therapist contact or the use of written guidelines were of secondary interest. However, some comment is warranted insofar as they may be implicated in the apparent lack of treatment effect.

The high rate of attrition compares unfavourably with other parent-administered programmes, from which some expectation of return rates could be derived. For instance, Bollard and Woodroffe (1977) appear to have retained all 24 children undergoing treatment, while Bollard and Nettelbeck (1981), who similarly handed the administration of their programme to parents lost only 3 of their 15 children. The principal benefits of having parents taught to administer a procedure such as DBT are stated as eliminating the expense and inconvenience of having an outside trainer conduct the initial training session (Bollard and Nettelbeck, 1981). The strategy of training parents by way of guidelines, along with a verbal outline, was thus considered adequate to the task of catering for the originally intended number of thirty or so children in the study. Although the levels of 'therapist contact' did not significantly differ, both levels of contact were probably inadequate. The incorporation of so many parents and children into the programme was in retrospect too ambitious, since the increased numbers greatly reduced the time available to keep in contact with families. The use of such
numbers appears particularly to have been at the expense of remaining sensitive to issues of motivation, and capitalizing on the impetus which prompted parents initially to seek help. More concretely this can probably be thought of in terms of participants' willingness to overcome practical problems of carrying out and recording the exercises, and thereby tolerating disruptions to daily routines.

Of course the style and type of intervention of the particular parent-trained DBT studies mentioned differ markedly from the present one. Since there was little from which to predict a high rate of attrition, training parents to administer MT and RCT was considered a useful approach in the present circumstances, given the numbers involved. With variations in instruction, treatment, record keeping and supervision, between and within studies, it is difficult to isolate any one variable for particular attention.

The nature of the different parent-child populations is however worthy of note. Unlike the present children, most of whose parents had not sought help, children in the other studies mentioned were mainly referrals made by medical or other professionals to a clinic, while a substantial proportion had other behavioural problems. It is reasonable to infer that parents in the latter instances, having been prepared to take their children for professional intervention, possibly were more motivated than those involved in this study, and were more inclined to insist that their child adhere to the programme. To some extent, insofar as such parents had been prepared to take their children in for
clinical intervention, it could also be assumed that in some instances the children would be mindful of parental concerns and be more inclined to stay with the programme. However it would be premature to suggest how much variance in the differences between the populations under study might account for differing attrition rates. It also could be surmised that in some cases discouragement was experienced as it became apparent that the exercises were not discernibly effective in the allotted month of treatment. However, in light of the foregoing, the point could be made that future investigators who might make use of training for parents of enuretic children (those who might otherwise not have presented clinically) should be encouraged to maintain a relatively high degree of contact between with parents in order to monitor practical and psychological impediments as they arise.

Guidelines

The guidelines were designed from scratch without specific reference to other documents, with a view to standardizing parents' approaches to intervention as well as record keeping within the programme. Ideally, if written instructions are to support an intervention, it would seem necessary to have them assessed for their utility and to adjust them accordingly. In the present circumstances no steps were taken to assess them for their supervisory and instructional value. The records which were submitted by and large followed the suggested format, and it can be assumed that for some they fulfilled their intended organizing function in relation to data. It also seems reasonable to infer that having written outlines structured the implementation of the interventions which generated that data. On the other hand, how
significant a contribution was made by the guidelines to the final return rate of completed record forms cannot be determined. If similar untested instruments are used in future investigations it would seem advised to incorporate into any assessment process a mechanism for a later analysis of its usefulness.

Muscle Training

At the core of the project was an enquiry into the possible efficacy of training children to exercise direct control over their voluntary urinary musculature via midstream interruption. It was hypothesized that the physiological and psychological mechanisms activated in learning that process would help enuretic children towards gaining control over involuntary micturition. Although a number of children did appear to reduce wetting over the period of the programme, overall the Muscle Training exercises, as they were carried out, were not effective. It would be premature however to dismiss poor voluntary control of the urinary musculature as being unrelated to enuresis since the hypothesis was not subjected to a particularly rigorous test.

The idea that training the urinary and associated musculature could be useful stemmed from a number of observations gleaned from the literature and put forward earlier. These contributed to a 'strong' and a 'weak' account of how Muscle Training might prove useful for the enuretic child. (While recognising their potential import to a comprehensive assessment and intervention, other factors which might be contributing to the manifestation or maintenance of the enuresic condition have been given secondary attention for the purpose of this inquiry).
The 'strong' version suggests that most non-organic approaches to enuresis control such as urine alarm treatment, Dry Bed Training, or RCT, necessarily involve exercising the voluntary urinary musculature, and that control generalizes to states of sleep or inattention. Thus exercising the musculature associated with the inhibition of urination, in a voluntary manner, at a rate equivalent to that which could be expected from a more established treatment, should result in a reduced wetting equivalent to other treatments. Hence the proposed number of MT trials was designed around an estimate of voluntary inhibitions which studies using the urine alarm might have initiated to induce continence. (The estimate arrived at was one alarm action per night over six weeks).

Overall, the average of 25 putative trials did not achieve what was considered an equivalent to the number of inhibitions derived from a successful alarm procedure (42), although the guidelines had recommended 56 trials to allow for a 25% potential shortfall. When the relevant constraints discussed earlier concerning the analysis of trial data are put into the present context, realistic estimates of how many trials were carried out are further reduced. In any event the records indicate that the 'strong' version of a theory of Muscle Training was obviously not subject to testing. A 'weak' version of Muscle Training, which this project did not directly attempt to test, suggests that exercising voluntary control of the urinary musculature by intensive application of exercise is probably necessary to bring about continence.
It is unfortunate that midstream interruption exercises the urinary musculature with such a low frequency relative to those muscles' potential for contraction, since stopping and starting urinary flow is fairly easily to monitor. Massed 'dry' pelvic floor exercises, as an alternative, would seem to be a more intensive approach than repeated midstream interruption. Although a significant difference between first and second halves of the MT accuracy trials was found only in one group (V/RCT-MT), 17 of the 30 children nevertheless improved their scores from the first to the second half. Proportionally more of those for whom MT was preceded by RCT improved (10 of 13), which could be interpreted as evidence, albeit tenuous, that RCT might provide some form of practice effect. Despite possible learning of control as reflected by accuracy of stopping 'on' the line, reductions in wetting rates did not reach significance in any group, although several children demonstrated marked reductions in wetting across the programme.

As stated, two problems arose in relation to teaching voluntary control. First, insufficient trials were carried out to match the number of 'inadvertent' stops and starts which other treatments might engender. Second, it was necessary to discount many trials regardless of their potential validity. Both problems would militate against using midstream interruption if a future study were to examine the relationship of learned control to enuresis. By default, the alternative approach of intensive 'dry' exercises would therefore seem indicated. There appears to be at least two obstacles to employing massed practice in such a way: designing a suitable exercises with which children are likely to persevere,
despite onerous frequency and duration of practice; and devising appropriate means for that information to be conveyed to the children via parents. One tentative solution to the first problem might be to marry microelectronics and external perineal electromyography, incorporating that into a non-intrusive portable biofeedback device. Such an instrument might allow a child access to information about the strength and duration of pelvic floor contractions, and facilitate the practice of many 'dry' trials over short or prolonged periods. The second obstacle would probably be better tackled through a short but intensive period of parental instruction to allow the conceptual basis of the treatment to be made clear.

Retention Control Training
The returned records suggest that 54% of the children who completed had reached the requisite maximum of 60 minutes of retention time, with 79% achieving at least 45 minutes, and it would appear that most children did learn to tolerate increased bladder volumes or pressures. Additionally, maximum bladder capacities obtained from measures taken by parents indicated a mean significant increase at the end of the programme. With no significant reductions in wetting rates, but increased MBC subsequent to longer retention times, the present results resemble those of Harris and Purohit (1977). However there are several reasons for supposing that the validity of the data is questionable.
Although retention mostly appears to have been taken to the full 60 minutes, it is likely that, in some cases, the records reflect parental intention rather than actuality as the practice of time incrementation was unlikely to have been carried out by children with a view to accuracy. Several parents reported that they thought that as the RCT segment proceeded their child began to announce a need to urinate well before bladder pressure could have been expected to have built up to any significant extent following fluid intake. Thus, by the time voiding was being requested, real tolerance may not have been reached. In other instances, as the time of retention increased, supervision of older children in particular became more difficult if they strayed from the parents' vicinity after announcing bladder urgency. So although an elapsed time might have been recorded, it was probably inaccurate if a child voided without parental supervision. How such a problem could be overcome is not clear, and although the validity of RCT has itself come under question elsewhere potential benefit associated with incrementing retention times would seem threatened if the latter were largely unmonitored or left to the child's judgment.

On the whole, measures of bladder capacity taken by parents were generally lower than in other studies (eg Starfield, 1967). No reason is apparent for this, although accuracy tied to the different levels of therapist contact do not seem to be implicated since no significant differences were found between measures taken from Visited and Postal groups.
The guidelines instructed parents to measure their child's full bladder three times before and three times after the programme, but did not specify that any quantity of fluid should first be taken in. It was reasoned that if a child could indicate when his or her bladder was full, then the precise amount of fluid consumed beforehand was probably irrelevant if the report was based on a felt need to urinate. Thus, in terms of tolerated pressure rather than actual physical capability, the three different measures taken from each child were thought to provide a fair estimate of bladder capacity. It is probable however that the measuring methods suggested to or used by parents were not reliable. Most volumes were recorded in millilitres, with some measures being returned in less precise fluid ounce units, requiring conversion before analysis, although the volumes submitted in the different units did not appear greatly dissimilar in magnitude. Regardless of the units submitted, the volumes were somewhat less than could have been expected, assuming that the population of enuretic children sampled did not differ greatly from others studied elsewhere. From Starfield's (1967) study (illustrated earlier) it could be expected that children with an average age of 7.3 years would have a mean maximum bladder capacity of about 205 ml, whereas in the present study the obtained measures averaged 165 ml.

Nor did the present results suggest that there was a significant correlation between age and baseline bladder volumes, although Starfield's data, and assumptions about children's normal developmental patterns, might lead one to expect otherwise.
Similarly, age was not found to correlate significantly with post treatment maximum bladder volumes, or with pre-post changes (which is not surprising when 9 of the obtained 28 pre-post MBC changes were recorded as reductions). As a whole, the bladder volume data may have given a false view of both mean baseline capacities and degrees of change.

Looking at individual children few cases suggest an association between clinically significant increased MBC and reduced wetting rates. Only two children (Ss 11 and 24: Appendix) failed to wet over the final 4 days of the RCT segment. Records of volume measures were not kept for the first while the capacity of the second increased by only 10%. The two greatest increases of MBC of 120ml and 100 ml (Ss 13 and 17) respectively were associated with some reductions in wetting rate at the end of the programme. However this was following MT, the effect of which cannot be discounted. The third highest increase of MBC (S 20) had not changed his wetting rate from baseline at the end of RCT. These cases however should also be viewed in terms of the doubtful validity of the bladder volume data.

An apparently more stringent test of bladder capacity using a known water load has been used elsewhere (eg. Starfield, 1967; Starfield and Mellits, 1968; Harris and Purohit, 1977), with fluid intake prior to any measurement of output being based on body weight. It could be argued that a water load test would give a more accurate method than the present one of arriving at a maximum bladder capacity, and overcome the problem of the child with a propensity to announce urgency before real limits to tolerance were being tested, since the test requires (arbitrarily) that at
least half the ingested quantity be excreted in order to be considered satisfactorily completed. (Starfield, 1967; Harris and Purohit, 1977). However such a contingency was not foreseen, and the test was not incorporated into the instructions. The method which was used, of simply having parents measure volumes after the need to void was announced, was designed, first, in order to spare parents another task, that of calculating a quantity of fluid to be ingested according to bodyweight, and second, because although a water load test might be a reliable method of obtaining a particular measure of capacity or change in capacity under certain conditions, it can be questioned whether that data is of use in determining retention capacity on a day to day basis. That is, although a child might exhibit tolerance to a proportion of a calculated volume of fluid, that need not imply that the volume such a proportion represents is equivalent to volumes normally retained.

It had been stressed to parents that they should not insist that retention should be maintained if complaints about discomfort were made and some of the canvassed parents had withdrawn because of ensuing complaints. A few parents reported that they had been concerned that their children might risk physical damage by not announcing any problems encountered in withholding, and had discontinued the programme during the RCT phase. Others had discontinued incrementing for the same reason and had levelled off at what they thought would be comfortable for the child. What proportion those children represent of the total who discontinued during RCT for reasons of complaint is not known. However, in light of a main assumption of RCT that poor nocturnal tolerance
to bladder pressure is associated with relatively poor bladder
capacity, it could be hypothesized that some those children
removed from the programme for reasons of complaint were those
with poorest tolerance, and were most likely to benefit if a
tolerance to discomfort were to be developed in a sensitive
fashion while awake.

In overview the RCT segment does not appear to have had an effect
on the baseline patterns of enuresis. Because of the design of the
project it is not possible to attribute the changes in bladder
capacity to the practice of retention, although it is difficult to
imagine how MT might have affected changes in bladder volume.
Taking into account the doubts expressed about the validity of
the bladder volume measures, it cannot be said that the efficacy
for obtaining capacity changes by RCT was tested.

The RCT aspect of the project was useful however in relation to
suggestions for future research into the effectiveness of RCT,
and does highlight practical problems in investigating the
relationship of RCT, functional bladder capacity and enuresis.
In particular, obtaining accurate measures of bladder volume
would seem to have been a more difficult task than was expected.
Whereas past researchers have themselves taken volume samples,
the present approach of having parents monitor the child's
capacity would seem to suggest the need for a better form of
instruction for parents, if RCT is found in certain circumstances
to be positively associated with improved enuresis. The present
study, like most which have monitored changes in bladder capacity
across the course of treatment, have looked to MBC measures
usually calculated as the largest volume among a small number
sampled. Perhaps a more valid measure might be to determine an average bladder capacity (ABC) calculated from a larger sample of voidings. Whereas MBC would seem to reflect what a child can tolerate when awake if requested, an ABC could be said to better reflect what he/she prefers to tolerate and perhaps approximates better to nocturnal tolerance.

A number of researchers who have supported the view that increased functional bladder capacity can be associated with decreased wetting rates have suggested that a specific tolerated capacity while awake should be a target for RCT before continence could be expected (eg. Muellner, 1960: 360ml; Hagglund, 1965: 280ml). Starfield (1968) however asserts that it is unreasonable to expect any particular capacity to be associated with a cure of enuresis, but suggests that improvement does seem to be effected by increasing the child's ability to retain larger amounts of urine. That view and its rebuttal by more recent studies are, in the main, made in the context of changes in MBC. Analysing the present volume data in terms of ABC rather than MBC is not indicated since only three baseline and three post-treatment measures were taken, and the reliability of all volume measures appears questionable. However, it would seem pertinent to investigate how useful RCT might be for effecting changes in ABC and the latter's relationship to nocturnal enuresis, and to MBC, before the case against the use of RCT was closed. If particular patterns of ABC change were implicated in reduced wetting rates, a further task might then be to devise simple and reliable monitoring techniques for use by parents who seek clinical assistance.
Conclusions

In light of the resources available for the programme's administration and assessment, it could be said that its design was already ambitious. At the time that the decision was taken to include extra children beyond the intended maximum the parent-training manual was considered reasonably clear, and the creation of the two Postal groups seemed an obvious and not an overly complicated way to cope with the extra children. However, by the creation of extra groups and different levels of contact with parents, co-ordinating the study was maintained at the expense of ensuring adequate control over the more elaborate structure. Since the author had no previous experience in administering either of the treatments to groups, and since the instructions themselves had not been subjected to previous practical scrutiny, it was somewhat optimistic to expect the programme to unfold without major difficulties.

It is unfortunate that methodological and design difficulties combined such that nothing of a conclusive nature emerged from the project with regard to its principal aims. In view of such difficulties it seems appropriate to regard the programme, in retrospect, as a pilot investigation looking to the feasibility of setting up appropriate testing conditions of the primary hypothesis. In that context the study has been of some value by providing information relevant to refining thinking about testing the usefulness of Muscle Training as an intervention strategy. Retention Control Training, despite its equivocal status in the literature, was included in the programme because it was thought better to offer parents a relatively simple intervention which
has had at least some reported success, rather than instruction only in a method with no record whatsoever. Although they were complicating factors, including RCT and having parents guided by verbal and written instruction did underscore some problems associated with providing and assessing both RCT and parent training which may prove of value if further investigations of either are contemplated.

Training parents with little additional active backup was, in particular, a feature of the study which it would have been wiser not to have included. Although the number of MT trials were inadequate to test even the 'strong' hypothesis, it is nonetheless apparent that attempting to train control using midstream interruption is probably too laborious a task for children and parents alike to persist with, unless an adequate level of supervision can be maintained. Although a better designed and managed study might well have had a similar outcome with regard to this particular approach, perhaps an intensive but shorter term approach is indicated. Hopefully a more reliable and rigorous test of the general hypothesis will be devised which anticipates some pitfalls which have been so far highlighted. If a form of Muscle Training does prove to have a place in the management of enuresis, alone or in conjunction with wider interventions such as DBT or the urine alarm, the more complex task might be undertaken of determining conditions and variables which need to be taken into consideration in order for Muscle Training to be used to best effect.
REFERENCES

Abelew, P.H. Intermittent schedules of reinforcement applied to conditioning treatment of enuresis. Dissertations Abstracts International, 1972, 33, 2799B-2800B.

Ackerson, L. Children's Behaviour Problems II; Relative Importance, and Interrelation among Traits, 1942, Chicago: University Chicago Press.

Adler, H.M. Enuresis in recruits: Double blind study with equanil and review of the literature. United States Armed Forces Journal, 1959, 10, 767-786.


Azrin, N.H. Sneed, T.J. and Foxx, R.M. Dry-bed training:: Rapid elimination of childhood enuresis. Behavior Research and Therapy, 1974, 12, 147-156.


Fielding, D. The response of day- and night-wetting children and children who wet only at night to retention control training and the enuresis alarm Behaviour Research and Therapy, 1980, 18, 305-316.


Maly, B.J. Rehabilitation principles in the care of gynecologic and obstetric patients, *Archives of Physical and Medical Rehabilitation*, 1980, 61, 78-81.


Nettelbeck, T., and Langeludecke, P. Dry-bed training without an enuresis machine. Behavior Research and Therapy, 1979, 17, 403-404.


Stephenson, J.D. Physiological and pharmacological basis for the chemotherapy of enuresis. Psychological Medicine, 1979, 9, 249-263.


Taylor, I.O. A scheme for the treatment of enuresis by electric buzzer. Medical Officer, 1963, 110, 139-140.


Vulliamy, D. The day and night output of urine in enuresis. Archives of Disease in Childhood, 1956, 31, 439-443.


White, M.A. A thousand consecutive cases of enuresis: results of treatment. Medical Officer, 1968, 120, 151-155.


Young, G.C. and Morgan, T.T. Analysis of factors associated with the extinction of a conditioned response. Behavior Research and Therapy, 1972, 10, 419-20.


APPENDIX A

Text of advertisement placed in Canberra Times:

Bedwetting?
Parents of children who have a recurrent problem of incontinence by day or night are invited to take part in an ANU research project designed to reduce wetting. The project will entail parental instruction and regular contact with the study's co-ordinator over several weeks. Parents who are interested and would like further details can contact Mr. T. Golding by phone on 498925, or by mail, C/- Psychology Dept., ANU, Canberra.
PARENTAL GUIDELINES AND RECORD SHEETS

Guidelines: The guidelines included here are one of a set of four which differ only in the order in which treatment instructions are given, and in the gender wording.

Record Sheets: Only the first page of the Wets, MT and RCT record sheets are included.
This programme is aimed at improving your son's bladder control during voluntary urination, which in turn should encourage continence.

It is expected that at the conclusion of the programme urine control will have sufficiently improved such that your son's days and nights are 'dry', or at least headed in that direction.

The programme consists of three phases:

1) a preliminary observation period of 14 days,
2) a 2 week period during which the Muscle Training exercise procedure is carried out.
3) a 3 week period during which Retention Control is practiced.

Your part in the programme will be to initially explain to your son what needs to be done, to oversee his progress, and to make sure an accurate record of the programme is kept on a day to day basis.

If progress is in your opinion inadequate, I will do my best to ensure that alternative treatment is provided, if you so desire. Similarly should there be satisfactory improvement but subsequent relapse during the follow up period (during which I shall be in regular contact with you), I will be happy to re-implement the programme or to provide alternative treatment.

Although the following procedures may appear complicated at first sight, they are really quite simple, and are designed to establish a routine which should take only a few minutes daily for the period of the program.

I am asking you to keep simple records throughout the whole programme for two reasons. On the one hand it allows us to get an overall idea of your son's progress. In addition your records, when combined with those of others who have also agreed to take part in the programme, will help me with the wider enquiry into enuresis which I am conducting.

I will be in contact regularly throughout the entire programme in order to discuss any problems which may arise. I can also be contacted most days or evenings on 498925.

I would like to thank you beforehand for helping me, and allowing me to try to help your son with his problem.

Tim Golding.
c/- Dept Psychology, A.N.U.
Phase 1

OBSERVATION PERIOD (14 days)

During this period it is necessary
a) to record the number of times your son wets, and
b) to estimate his current bladder volume.

A: Recording 'Wets'

Mark on the "WETS RECORD SHEET"

i) Day and date

ii) The number of times your son has wet over the last 24hr period.

B: Bladder Volume Estimation

It is necessary to know before embarking on the exercises what can reasonably be expected in the way of normal bladder capacity.

Find a container which:

(a) can be easily marked with a waterproof pen;
(b) can hold the entire contents of your son's bladder without spillage;
(c) is narrow enough to allow you to judge levels, but wide enough to urinate into without much trouble. A container with a 4 to 6 inch base should be adequate.

At a time when your son has a full bladder and wishes to go to the toilet ask him instead to urinate fully into the container. Do this at three different times during the 2 week observation period (Phase 1).

Estimate the volume which he voids on each occasion and write those volumes in the spaces provided on the Phase 1 form. For these 3 measures it may be necessary to transfer to a marked container. Please try to be as accurate as possible and note the volumes taken in the 3 spaces on the sheet provided. At the end of the program I will remind you to measure 3 more times.

Examine the level of filling on the 3 occasions and then estimate the level to which you think half of his usual full bladder would come. Mark a ring around the inside of the container a little below that halfway level. The reason for this is explained on the next page.
Phase 2

MUSCLE TRAINING (14 days)

During this period it is necessary
a) to follow the exercise instructions;
b) record results, and
c) to continue to record wet and dry days.

---------------------

Procedure

By giving attention to the process of actively voiding and retaining urine it is intended that your son will gain better control over the muscles concerned, while at the same time muscle tone should improve.

The container used to estimate bladder volume is used throughout this phase of Muscle Training.

1. Show your son the container now marked with the line and tell him that what you are going to ask him to do is intended to help with the wetting problem.

2. Ask him to urinate into the container, keeping it level, but to stop when the level is as close to the line as he can make it.

Your son may wish to do the exercise in private. Although it is preferable that you supervise the first few attempts to ensure that it is carried out correctly, direct supervision may cause embarrassment and/or a temporary inability to urinate at all.

Please note that it is more important that your son knows what needs to be done, i.e. stopping midstream, and does his best, rather than filling very accurately to the line. Remember what is being encouraged is focussing his attention on the urinary process, and actively exercising the muscles involved to interrupt the flow.

3. When he has filled to the line ask him to show you the container.

Judge by eye whether the level of urine is above, below, or on the line, and fill in the record sheet accordingly.

It would be beneficial if your son were to record the results of each trial himself, with your help if necessary.

It is important that your son doesn't go on to empty his bladder immediately after filling up to the line the first time. Provided the bladder was reasonably full to begin with there probably will be no problem in filling close to the line again.
4. Repeat the exercise, if your son is able and willing, and record the result again in terms of above, below, or on the line. After the second filling he should void any residual urine into the toilet.

If any difficulty is encountered in filling to the line on either occasion make a note to that effect in the 'Comments' column of the Phase 2 record sheet.

5. The exercise just outlined should be carried out at least once daily for two weeks. However twice a day would be preferable, say morning and evening. Thus hopefully he will be filling twice to the line twice a day.

SUMMARY

(Morning)
1. give container to son
2. fill to line
3. record above/below/on line
4. repeat to line if possible

(Evening.)
5. Repeat 1 to 4.

*******

Please remember to mark both the "Muscle Training" and the "Wets" record sheets with the day's results.

*******

When the Muscle Training period is completed I will arrange with you to implement the second treatment phase involving Retention Control.
Phase 3
Guidelines for Parents.

RETENTION CONTROL TRAINING (RCT)

The goal of RCT is to enable your son, at the end of the 3 week training period, to refrain from voiding urine for one hour from when he first feels the need.

The training entails a graduated approach with retention being increased a little longer each day for the 21 days.

Ask your son to drink a reasonable quantity of something he normally likes. Tell him that when he wants to go to the toilet to tell you immediately. Note the time when the urge is first announced and contract with your son that he will hold for the specified period for that day.

Times for retention should be as follows:

<table>
<thead>
<tr>
<th>DAY</th>
<th>Period to hold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 min</td>
</tr>
<tr>
<td>2</td>
<td>3 min</td>
</tr>
<tr>
<td>3</td>
<td>6 min</td>
</tr>
<tr>
<td>4</td>
<td>9 Min</td>
</tr>
<tr>
<td>5</td>
<td>12 min</td>
</tr>
<tr>
<td>6</td>
<td>15 min</td>
</tr>
<tr>
<td>7</td>
<td>18 min</td>
</tr>
</tbody>
</table>

and 3 minutes more per day for each of next 14 days a maximum of 1 hour by the end of the 3 week RCT training period.

If a timer is available have him set it for the required number of minutes.

Try to avoid having any special reward (lollies, TV, etc.) as part of your contract. On the other hand a bit of praise can be a good thing, whether or not holding is maintained for the whole period.

Again, if it is practicable, have him fill in the record sheet on each day after each retention period, whether successful or not.
Please do not insist on retention at the cost of an accident! If it looks as if voiding cannot be genuinely held off for the required period for that day, thank him for trying, and allow him to go to the toilet.

If an accident does occur, or if it is necessary to allow voiding before the required period has elapsed, make a note to that effect in the "comments" column for that day. The following day simply go back to the previous day's retention period. That is, if he could not hold for the 15 minute period on day 6, day 7 requires 12 minutes and day 8 will be up to 15 minutes again.

If your son still cannot hold for the lesser period, whereas he had previously done so successfully, again reduce the period for the next day.

Obviously if a few set-backs are experienced the training period will take some extra days to complete. However, past experience has shown that most children quickly learn to hold for the required period.

************

Please make sure every day during the RCT phase that both the results of training (ie. period retained) and the number of 'wets' for the last 24 hour period are recorded.

The success of the programme depends on completing both phases of training, ie RCT and MT. Bladder and urinary muscle control is not achieved quickly so please do not discontinue the exercises simply because there has been sudden improvement, or conversely, progress seems slow.

Thank you again for your co-operation,

Tim Golding.
Bladder volumes:

Please measure volume 3 times at start of programme, and 3 times at end.

<table>
<thead>
<tr>
<th>DATE</th>
<th>VOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

WETS RECORD SHEET

(This sheet should be filled out throughout the 3 phases of the programme.)

If wetting occurs once or more in any 24 hour period please mark below.

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME (approx)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MUSCLE TRAINING

RECORD SHEET:

Please note the date and time of each exercise period and the result.

For example, a typical sheet might look like this:

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>LEVEL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/5</td>
<td>8am, 7pm</td>
<td>on, above</td>
<td></td>
</tr>
<tr>
<td>6/5</td>
<td>8.15am</td>
<td>above</td>
<td>missed evening</td>
</tr>
<tr>
<td>7/5</td>
<td>8am, 7.30pm</td>
<td>below, on</td>
<td></td>
</tr>
<tr>
<td>8/5</td>
<td>8.15am, 8.30pm</td>
<td>on, above</td>
<td></td>
</tr>
</tbody>
</table>
Name: ____________
Phase: ______

RETENTION CONTROL TRAINING (3 weeks)

RECORD SHEET

<table>
<thead>
<tr>
<th>DATE</th>
<th>DAY No.</th>
<th>HELD FOR</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1 MINUTE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix C1

Report Form for detailing demographic, historical, familial and contact information.
<table>
<thead>
<tr>
<th>PARENTS' NAME</th>
<th>ADDRESS</th>
<th>SUBURB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PHONE WK.</th>
<th>HM.</th>
<th>CHILD'S NAME</th>
<th>AGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DEEP SLEEP</th>
<th>MEDICATION</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nocturnal</td>
<td>YES</td>
<td>NO</td>
<td>Both</td>
</tr>
<tr>
<td>Primary</td>
<td>Diurnal</td>
<td>Secondary</td>
<td>Intermittant</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAST TREATMENTS</th>
<th>ALARM</th>
<th>DRUG</th>
<th>OTHER (Detail)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRESENT T'MENT</th>
<th>WOKEN</th>
<th>APPROX TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Detail)</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>SOMETIMES</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IS WETING SEEN AS A PROBLEM FOR CHILD</th>
<th>CHECKED MEDICALLY OK</th>
<th>SIBLING(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DON'T KNOW</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>WHEN</td>
<td>NO</td>
<td>WHOM</td>
</tr>
<tr>
<td>SEX</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAMILY HISTORY (SIB)</th>
<th>(PAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GROUP ALLOCATED</th>
<th>VISIT</th>
<th>POSTAL</th>
<th>DATE PHONE CONTACT 1</th>
<th>DATE PHONE CONTACT 2</th>
<th>DATE PHONE CONTACT 3</th>
<th>DATE PHONE CONTACT 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSTAL</td>
<td>B/MTRCT</td>
<td>B/RCTMT</td>
<td>G/MTRCT</td>
<td>G/RCTMT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATE</td>
<td>PHONE CONTACT</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>Details of contact</td>
</tr>
<tr>
<td>DATE</td>
<td>PHONE CONTACT</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POST DATES: PHASE 1&amp;2</th>
<th>3</th>
<th>DATE RESULTS RECEIVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISIT DATES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA RECEIVED</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FOLLOW UP FORM POSTED</th>
<th>DATE FOLLOW-UP RC'D</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTHER DETAILS OR COMMENTS</td>
<td></td>
</tr>
</tbody>
</table>
Summary of details of Report Forms.

- Constant/Intermittant.

"Constant" was defined to parents as wetting on at least one occasion, most days of the week, and "intermittant" wetters as those who tended to remain dry for longer periods. Fourteen children (47%: 2 girls, 12 boys) were considered by parents to be "constant".

- Familial History.

Five 5 (12.5%) children had siblings who currently wet or who had a history of wetting. Approximately 10 (33%) children had one or both parents who had a history of recurrent wetting during their own childhood.

- Past Treatment.

Four children (7.5%) previously had been subjected to a bell-and pad alarm apparatus. Parents of 3 of these children reported having had negligible success. All had abandoned its use because their child tended to fail to respond to the alarm's sound, and/or the alarm had consistently woken other family members.

Six (20%) children had been previously prescribed tricyclic medication for enuresis in the past. None had had a lasting effect.

Other methods recorded included fluid restriction in the evenings, regular nighttime waking, chiropractic, acupuncture, and herbal remedies. Several children had been subject to more than one approach.

- Depth of Sleep.

A consistent definition of 'depth' was unfeasible given the nature of the data gathering, although a number of parents asserted that a wetting child was more difficult to wake than their non-wetting siblings.
### APPENDIX D

**Summary of Data from Record and Information Sheets**

<table>
<thead>
<tr>
<th>Sub age</th>
<th>Sex</th>
<th>No. of WETS</th>
<th><em>Total days</em></th>
<th>No. of <em>t</em> ment trials</th>
<th><strong>BLADDER VOL (mls)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BASE</td>
<td>MT</td>
<td>RCT</td>
<td>BASE</td>
</tr>
<tr>
<td>POST/</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>MT-RCT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(GP 1)</td>
<td>2</td>
<td>11</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VISIT/</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>MT-RCT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(GP 2)</td>
<td>14</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCT MT</td>
<td>17</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST/</td>
<td>18</td>
<td>9</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>RCT-MT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(GP 3)</td>
<td>19</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VISIT/</td>
<td>21</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>RCT-MT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(GP 4)</td>
<td>22</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEANS</td>
<td>23</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP</td>
<td>24</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP</td>
<td>25</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP</td>
<td>26</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP</td>
<td>27</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEANS</td>
<td>28</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note: RCT calculations are based on the provided data.*