

GUIDELINES

FOR THE CLINICAL USE OF ELECTROPHYSICAL AGENTS

2001

VJ Robertson

LS Chipchase

EL Laakso

KM Whelan

LJ McKenna



AUSTRALIAN PHYSIOTHERAPY ASSOCIATION

TABLE OF CONTENTS

INTRODUCTION	2
Duty of care	2
Disclaimer.....	2
Invitation to provide feedback.....	2
Legislative differences between states.....	2
Authors and acknowledgements.....	2
SECTION 1: CONTRAINDICATIONS, PRECAUTIONS, TESTS AND WARNINGS	3
Contraindications and precautions	3
Table 1. Contraindications (C/I) and precautions (P).....	3
Tests conducted prior to treatment	4
Table 2. Specific tests.....	5
Recommended warnings	5
SECTION 2: EPA PRACTICE STANDARDS AND NOTES ON SPECIFIC EPAs.....	8
EPA practice standards	8
Table 3. Practice standards	8
Notes on specific EPAs	9
Ultrasound	9
Thermal - superficial heating and cooling	10
Thermal - deep	10
Electrical stimulation.....	11
Ultraviolet.....	12
Laser	13
Low frequency magnetic fields.....	13
SECTION 3: INFECTION CONTROL PROCEDURES	14
Routine care.....	14
Non-critical treatment.....	14
Semi-critical treatment	14
Critical treatment.....	15
Cleaning.....	15
Disinfection	15
Sterilisation.....	15
SECTION 4: EPA EQUIPMENT SAFETY.....	16
Basic EPA equipment safety requirements.....	16
SECTION 5: BIBLIOGRAPHY	17
Authors' affiliations.....	20
Contributors.....	20

ABBREVIATIONS

APA	Australian Physiotherapy Association	IR	Infra-red
C/I	Contraindication	MW	Microwave
EPA	Electrophysical agent	P	Precaution
EPAGs	Electrophysical agent guidelines	SWD	Shortwave diathermy
EStims	Electrical stimulation	US	Ultrasound
E1	Erythema first degree	UV	Ultraviolet

INTRODUCTION

The Electrophysical Agents Guidelines outline the basic standards of clinical practice for applying electrophysical agents (EPAs) safely and effectively.

The booklet has 5 sections.

- Section 1. Tables of contraindications and precautions, specific tests, and patient warnings
- Section 2. EPA practice standards and notes on specific EPAs
- Section 3. Infection control procedures when using EPAs
- Section 4. EPA equipment safety requirements
- Section 5. Bibliography.

This booklet is not a treatment manual or a textbook. A qualified physiotherapist will use such resources and relevant recent publications plus their own professional knowledge and experience in order to plan and implement effective treatments for their patients. The Guidelines outline basic clinical standards for using EPAs by indicating what is necessary to ensure patient and therapist safety. They are aimed at reducing the risks associated with using EPAs and do not address issues of the clinical effectiveness of modalities. While not mentioning all EPAs, or combinations of EPAs that physiotherapists might use, the Guidelines provide general principles applicable to all. The most commonly used EPAs at the time of publication are addressed specifically and additional notes provided on them.

The main changes in this edition are an updating of information and a reorganisation to facilitate access for both physiotherapy practitioners and students. These Guidelines, however, suffer from the same problems as those preceding them because of the lack of an adequate database to substantiate some of the accepted contraindications and methods of using some EPAs. When in doubt we have erred on the conservative side. We remind readers that the Guidelines must always be read in the context of current research findings.

Duty of care

Physiotherapists have a duty of care which includes an obligation to take all reasonable steps to avoid the risk of damage or harm being caused to their patients. One part of this obligation includes explanations being given to patients of both the benefits and potential dangers of treatments. Patient consent following a detailed explanation of benefits and

potential dangers does not absolve a physiotherapist from liability if a reasonable physiotherapist would have acted in such a manner as to avoid the damage which ultimately arises (see Vines 1996 and Delany 1996).

Disclaimer

No person should rely solely on the contents of this publication. This publication is of a general nature and is not intended to be a comprehensive statement of minimal standards of care covering all individual circumstances. The Australian Physiotherapy Association, the authors and other contributors expressly disclaim all and any liability and responsibility to any person in respect of anything, and of the consequences of anything done or omitted to be done by any such person in reliance, whether wholly or partially, upon the whole or any part of the contents of this publication.

Invitation to provide feedback

The Australian Physiotherapy Association invites readers to forward any comments or feedback on the contents of this document or suggestions as to how future editions might be improved.

Copyright in this document and the concepts it represents are strictly reserved to the Australian Physiotherapy Association 2001. No unauthorised use or copying of this document is permitted.

Legislative differences between states

All physiotherapists have an obligation to be aware of any legal requirements in their state of practice that alter any requirements stated in these Guidelines.

Authors¹ and acknowledgements

Authors: VJ Robertson PhD (convenor); LS Chipchase; EL Laakso PhD; KM Whelan; LJ McKenna.

Contributors: A Ward PhD; D Bastians

Physiotherapy in Australia owes a considerable debt to those who wrote the first edition of these Guidelines. By detailing and setting standards of care in using EPAs they provided incommensurable help to the physiotherapy profession in ensuring patient and therapist safety. The current edition is intended to continue their lead.

¹ Details follow bibliography.

SECTION 1:

Contraindications, precautions, tests and warnings

Contraindications and precautions

The table below provides a general guide to when different categories of modalities are always contraindicated or should be used only with appropriate precautions. The table errs on the conservative side and repeats some historically accepted contraindications and precautions in the absence of an adequate database or research findings to exclude them.

Modality specific information follows on the next

page. Physiotherapists should use this information in conjunction with individual patient assessments and treatment decisions.

Note: Possible interactive effects of modalities used concurrently or sequentially may increase the dangers usually associated with an individual modality. Therapists using modalities in this manner incur an additional obligation to ensure any risks of damage or harm to their patients are avoided. For example, using ice prior to another modality can reduce a patient's capacity to distinguish the level of heating or current flow.

Table 1. Contraindications (C/I) and precautions (P)

Modality category	Pregnancy ²	Inbuilt stimulator, e.g pacemaker ³	Circulatory insufficiency ⁴	Risk of dissemination ⁵	Exacerbation of existing conditions ⁶	Unable to communicate	To eyes or testes	Sensory loss ⁷
Heating - deep [SWD*, MW* US]	C/I	SWD C/I within 3m MW and US C/I over stimulator	C/I	C/I	C/I	C/I	C/I ⁸	MW and SWD C/I
Heating - superficial [wax*, infra-red, hot packs]	-	-	C/I	C/I	C/I	P	C/I	P
Cold	-	-	C/I	-	C/I	P	-	P
EStims*	C/I vicinity of uterus	C/I over stimulator	P	P	P	P	-	P
US [no/low heat]	C/I vicinity of uterus	C/I over stimulator	P	P	P	P	C/I	P
Ultraviolet*	-	-	P	-	P	P	C/I to eyes	-
Laser*	C/I vicinity of uterus	-	-	P	P	P	C/I to eyes	-

KEY-

Abbreviations: SWD, shortwave diathermy; MW, microwave diathermy; US, ultrasound; EStims, electrical stimulation; C/I, contraindication; P, precaution; m, metres.

*See modality specific information on the next page for further details and the relevant notes on specific EPAs in Section 2.

² Pregnancy: in the absence of reliable information pregnancy is considered a contraindication to any applications of radiofrequency modalities (MW & SWD) and to applications of some other modalities in vicinity of the uterus (US, EStims, laser).

³ Inbuilt stimulators: most commonly used are pacemakers. Unless the specific risk has been evaluated by the relevant medical specialist, must be considered contraindicated (see Chen et al 1990, Low and Reed 2000, Rasmussen et al 1988).

⁴ Circulatory insufficiency: identified using objective testing and/or clinical findings including presenting symptoms, past history and skin discolouration.

⁵ Dissemination: conditions with known or accepted risks

include acute infections, tumours (benign or malignant), TB, osteomyelitis.

⁶ Exacerbation: existing conditions with known or accepted risks include acute infective or inflammatory conditions, skin disorders such as eczema and dermatitis, areas of increased fluid tension, regions treated within 3 to 6 months by radiotherapy, haemorrhagic conditions, and severe organ states such as cardiac failure (Lorenze et al 1960, Low and Reed 2000, p.272, Stanghelli and Nilsson 1983).

⁷ Any relevant sensory loss for each EPA listed in table of specific tests (Table 2).

⁸ Mesh goggles are not always effective eye protectors (Delpizzo and Joyner, 1987).

Modality specific information

Read in conjunction with table of contraindications and precautions (Table 1).

Wax

Contraindicated if skin is broken.

Microwave/Shortwave Diathermy (MW/SWD)

Contraindicated if metal within field (any deep or superficial internal, or external within 30cm). (Note that metal objects can act as aerials eg ceiling wiring to smoke alarms and other equipment.)

Contraindicated if unable to accurately detect heat in area to be treated (see specific tests, Table 2).

Contraindicated within 3m of operating EStims or biofeedback.

Precaution: remove hearing aid(s).

Precaution: turn off mobile phones within 3m.

Precaution for SWD operators: ensure a minimum distance of 1m from applicators and 0.5m from leads.

Ultraviolet Light (UV)/Laser

Precaution: with UV or Class 3B lasers⁹ eye protection *is required* for therapist and patient and recommended with other classes of laser. Use only safety glasses/goggles designed to screen relevant wavelengths.

Precaution: for UV therapy confirm photosensitivity status is unaltered ie medical condition and medical status unaltered, no skin lotions applied.

Electrical Stimulation (EStims)

Contraindicated: trans-thoracic applications (antero-posterior thorax, arm to arm, leg to arm).

Contraindicated: long duration direct current (ie monophasic pulses of at least 10msec duration) in absence of sharp/blunt discrimination under electrodes (see next section).

Contraindicated: use within 3m of operating SWD equipment (risk is to person having EStims).

Precaution: if reduced sharp/blunt discrimination can, with care, apply low and medium frequency currents and interrupted galvanic and high voltage pulsed currents, eg use new self-adhesive electrodes or electrode sponges and lowest intensity output practicable.

Precaution: avoid applications over broken skin. Marked reduction in impedance will cause concentrated current flow. **EXCEPTION:** when suitably low intensity current applied for wound treatment.

Precaution: repeated uses of self-adhesive electrodes, electrode sponges and covers can reduce their conductivity and necessitate higher stimulus intensities (see manufacturers' guidelines).

Tests conducted prior to treatment

The tests listed in Table 2 are for thermal sensitivity, reaction to ice, sharp and blunt discrimination and erythema levels. Testing should *always* be conducted if the history indicates the patient has a problem which may increase the risks associated with using EPAs. Testing is otherwise *strongly advised routinely* at the first treatment *and*, subsequently, *after any relevant change* in a patient's condition. Which test is selected depends on the modality to be used.

Note: always record all tests undertaken and results.

General guidelines:

- if the modality produces or can produce heat (ie SWD, MW, wax, infra-red, hot packs, ultrasound) use the test for thermal sensitivity;
- if the modality might cause a reaction to cold (ie the application of ice) test for a reaction to ice;
- if the modality might cause skin irritation, pain, or electrolytic burns (eg the different types of transcutaneous electrical stimulators) test for sharp/blunt discrimination; and
- if the skin will be exposed to ultraviolet rays (ie UV) establish the erythema level (E1) prior to treatment.

⁹ AS/NZS 2211.1 Suppl.1 (1999): Laser safety. Part 1; Equipment classification, requirements and user's guide. Supplement 1: Application guidelines and explanatory notes. "Class 3B laser products are unsafe for eye exposure.

Usually only ocular protection would be required. Visible Class 3A laser products are safe as long as staring is not required." p.12.

Table 2. Specific tests

Modality	Risk	Test
Wax baths Hot packs Infrared radiation Microwave diathermy Shortwave diathermy Ultrasound ¹⁰	Thermal burns	Thermal sensitivity
Cryotherapy	Adverse reaction to ice	Ice reaction test
Sensory stimulation (TENS) Motor stimulation (FES, NMES, FNS) Interferential therapy High voltage pulsed stimulation Direct current Ultrasound	Skin irritation ¹¹ Electrical burns Pain	Sharp/blunt discrimination
Ultraviolet Light	UV burns	Erythema skin test (E1)

Thermal sensitivity

Test patient's ability to discriminate hot from cold objects at site to be treated. Typical items used are appropriately heated and cooled dry test tubes (filled) or metal spoons.

Look for: inability to reliably discriminate hot from cold.¹²

Ice reaction test

Test by either performing an ice cube massage for a minimum of 30 seconds or apply an ice pack and examine local response under the pack after 5 minutes and be aware of the possibility of latent effects.

Look for: an excessive redness, an inflammatory weal or a systemic reaction, including increased blood pressure or heart rate.¹³

Sharp/blunt discrimination

The area under the electrodes is tested using, typically, a new toothpick, a partially unfolded paperclip, or sharp pin. The skin must not be pierced and any test instrument only reused following the cleaning procedures outlined for non-critical treatment in Section 3 of this document.

Look for: inability to reliably differentiate sharp from blunt.

See table of contraindications and precautions and the modality specific information following it (Table 1).

Erythema skin test (E1)

Always conduct an E1 skin test prior to commencing treatment with UV or after lamp bulb/tube is changed. See Section 2, notes on specific EPAs, UV page, and consult a standard textbook for further details.

Recommended warnings

The therapist is responsible for ensuring the patient has the information required to make an informed decision and consent to treatment. This information should include the relative risks and benefits of the proposed treatment as well as what the patient should usually expect and their responsibilities regarding notifying the physiotherapist of undesirable effects. The following warning statements are recommended, bearing in mind that each will need to be tailored to each patient's specific needs.¹⁴

The first is a general warning intended to cover modalities not specifically addressed.

*Note: record details of warnings given and document informed verbal consent.*¹⁵

¹⁰ Therapeutic ultrasound: risks are typically thermal burns and pain.

¹¹ Skin irritation, either an allergy or, more likely, electrolysis will occur at electrode site with long duration monophasic pulses (direct current) and possibly with unbalanced biphasic pulses (time averaged current not zero).

¹² Oda and Aigbogum 1988.

¹³ Knight 1995.

¹⁴ Delany 1996, p. 252.

¹⁵ Vines 1996, p. 246.

General warning

When having [magnetic field therapy or an EPA not covered below], what you should feel is

If you feel anything other than that call [**your physiotherapist**] **immediately**: otherwise, you may be in danger of [**details if known**].

If in doubt, call [your physiotherapist].

Please **do not move** or **touch** any of the equipment during treatment. If you become uncomfortable, call [**your physiotherapist**].

Do you understand what I have said?

Do you have any questions?

Are you happy for me to proceed?

Notes
.....

Heat treatments: includes wax, IR, hot packs, MW, SWD¹⁶

When having [a heat treatment], all you should feel is a **mild comfortable warmth**. If you feel any more than this or if the heat concentrates in any particular spot or it starts to feel uncomfortable you must **call** [**your physiotherapist**] **immediately**: otherwise, you may be in danger of being **burnt**.

If in doubt, call [your physiotherapist].

Please **do not move** or **touch** any of the equipment during treatment. If you become uncomfortable, call [**your physiotherapist**].

Do you understand what I have said?

Do you have any questions?

Are you happy for me to proceed?

Notes
.....

Ultrasound treatments

When having ultrasound you will usually feel [nothing other than the applicator pressure/ very little/ some heat]. If you feel any discomfort or it feels hot under the applicator you must immediately tell [**your physiotherapist**]: otherwise, you may be in danger of being **burnt**.

Do you understand what I have said?

Do you have any questions?

Are you happy for me to proceed?

Notes
.....

Cryotherapy treatments

When having an ice treatment you will usually feel gradually increasing cold, which may be followed by a period of discomfort. The area should then go numb. If you feel any extreme discomfort or pain you must immediately tell [**your physiotherapist**]: otherwise, you may be in danger of an ice **burn**.

Please **do not move** during treatment. If you become uncomfortable, call [**your physiotherapist**].

Do you understand what I have said?

Do you have any questions?

Are you happy for me to proceed?

Notes
.....

¹⁶ Ultrasound is listed separately given its extensive use in Australian physiotherapy practice.

Electrical stimulation treatments: includes TENS (sensory or motor), interferential, etc

When having electrical stimulation you should feel [tingling or similar if for sensory stimulation, pain relief or wound healing; and/or muscle contractions if motor level stimulation such as FES, NMES, or oedema control]. If you feel anything other than [...] or any pain or discomfort you **must call [your physiotherapist] immediately:** otherwise, you may risk skin and other tissue damage under the electrodes.

If in doubt, call [your physiotherapist].

Please **do not move** or **touch** any of the equipment during treatment. If you become uncomfortable, call **[your physiotherapist].**

Do you understand what I have said?

Do you have any questions?

Are you happy for me to proceed?

Notes

.....

Laser treatments

During laser treatment you should feel nothing (other than the pressure of the applicator against your skin). If you do feel any discomfort you must immediately tell..... **[your physiotherapist]** and the treatment will be terminated. Side effects from laser therapy can include dizziness, nausea or an initial increase in pain. They are short term only and usually only occur if the treatment dose is too high.

Please **do not move** or **touch** any of the equipment during treatment. If you become uncomfortable, call **[your physiotherapist].**

Do you understand what I have said?

Do you have any questions?

Are you happy for me to proceed?

Notes

.....

UV treatments

Initial treatment: During a UV treatment you may feel nothing or you may notice a little heat. If you do feel any discomfort or notice any other change you **must call.... [your physiotherapist] immediately:** otherwise, you may risk skin damage.

If in doubt, call [your physiotherapist].

Please **do not move** or **touch** any of the equipment during treatment. If you become uncomfortable, call **[your physiotherapist].**

Subsequent treatments: If you have changed your medication or noticed any differences in response following the last treatment it is important you tell me as this may mean today's dosage should be changed.

Do you understand what I have said?

Do you have any questions?

Are you happy for me to proceed?

Notes

.....

SECTION 2: EPA practice standards and notes on specific EPAs

EPA practice standards

The table of EPA practice standards (below) indicates the usual sequence that follows a patient assessment when an EPA has been selected for use in the treatment. The physiotherapist is assumed to be familiar with the specific equipment selected and the relevant manufacturer's instruction manual. The therapist is required to ensure that the equipment

satisfies the relevant Australian Standards (AS/NZS 3200.1.0:1998¹⁷; and AS/NZS 3003:1999¹⁸). See Section 4 for a summary of safety requirements for electro-medical equipment, based on AS/NZS 2500:1995¹⁹).

Notes on specific EPAs follow these practice standards. They give details for the specific modalities most commonly used by physiotherapists at the time of writing these Guidelines.

Table 3. Practice standards

Check modality specific risks in table of contraindications and precautions (Table 1).

Select modality	1. selection based on assessment of the patient, clinical knowledge, and known effects of individual EPAs.
Check contraindications	1. read table of contraindications and precautions and modality specific information (Table 1) 2. if together with clinical assessment, specific risk(s) are identified, conduct relevant test(s) shown in table of specific tests (Table 2) prior to use of modality.
Explain to patient	1. reasons for selecting a particular modality, how it works and how it will be applied 2. expected effects of the modality 3. possible risks of using the modality in the specific circumstances 4. ensure patient understands and consents to use of EPA.
Treatment preparation	<p><i>Patient</i></p> <ol style="list-style-type: none"> fully expose area to be treated by EPA and check skin for damage, wounds, scars, condition, colour etc. position patient appropriately for treatment and comfort drape to minimise threat to modesty <p><i>Treatment area</i></p> <ol style="list-style-type: none"> eliminate sources of possible electrical interference (eg no operating SWD within 3m of operating EStims or biofeedback) ensure no metal furniture used or in vicinity if MW or SWD <p><i>Equipment</i></p> <ol style="list-style-type: none"> test machine output prior to use²⁰ and also safety switch if applicable set adjustable output controls at zero (except: UV lamps – cover during warm up).
Warnings See Section 1.	<p><i>On each occasion the patient should be advised:</i></p> <ol style="list-style-type: none"> what they can expect to feel during treatment what they should not feel and responses they should not have what they are to do if they do feel or have unwanted responses not to move during the treatment not to touch the equipment or applicators <p><i>See recommended warnings in Section 1.</i> In conjunction with the warning, teach the patient to use a safety switch if relevant and available.</p> <p><i>Signs</i> If radio-frequency equipment (MW/SWD) is present and might be in use, provide appropriate multilingual signs to advise all clinic entrants in case any have a pacemaker or other indwelling stimulator. Make every effort to ensure all patients can understand these signs.</p>

Table continued next page.

¹⁷ AS/NZS 3200.1.0:1998 Medical electrical equipment. Part 1.0: General requirements for safety – Parent Standard

¹⁸ AS/NZS 3003:1999 Electrical installations – Patient treatment areas of hospitals and medical and dental practices.

¹⁹ AS/NZS 2500:1995 Guide to the safe use of electricity in patient care.

²⁰ See notes on specific EPAs following this section.

Table from previous page

Administration	<p><i>Apply</i></p> <ol style="list-style-type: none"> 1. as explained to the patient and only after informed consent to proceed is obtained from them 2. as advised in most recent manufacturers' guidelines relevant to specific item of equipment being used 3. see Notes on specific EPAs, Section 2. <p><i>Remain within call</i></p> <ol style="list-style-type: none"> 1. so immediately accessible to patient 2. to monitor treatment and make checks as appropriate.
Completion	<ol style="list-style-type: none"> 1. turn equipment off as advised by the manufacturer: usually output to zero first 2. question patient and examine treated and adjacent areas for any abnormal reactions to treatment 3. record specific details including: <ul style="list-style-type: none"> • C/Is checked, results of initial sensation tests and machine tests, that warnings were given and appeared to be understood, and consent obtained • all treatment details, including intensity and if continuous or pulsed (with on:off ratio), duration, area treated, location of electrodes, and method used, equipment details including which machine and frequency (as appropriate) • immediate result of treatment – including any abnormal reactions and any subsequent action taken or recommended • all other treatment details.
Subsequent treatments	<ol style="list-style-type: none"> 1. re-evaluate effects and effectiveness of EPA used 2. modify treatment parameters/method of application as required.

Notes on specific EPAs

Ultrasound

Check particular risks in table of contraindications and precautions (Table 1).

Output check	<p>Set continuous output. While applying one of the following two tests, observe water (or gel) near applicator for ripple pattern or marked disturbance which should increase as intensity is increased:</p> <ol style="list-style-type: none"> 1. applicator face covered by water in metal or plastic bowl or bucket of water and angled towards the surface (to prevent beam reflection back into itself), briefly turn to high intensity output and then off OR 2. cover face of applicator with 0.5-1cm of gel, turn on briefly to high intensity and immediately off²¹ <p>Testing frequency varies with usage level – if high, test each day. Note: these tests indicate only if there is an output, not the level of output.</p>
Dosage parameters	<p>Base intensity and frequency selection on the following:</p> <ol style="list-style-type: none"> 1. stage of the problem (acute/sub-acute/chronic) 2. nature of the tissue (superficial bone or metal implant) 3. depth of the tissues being treated 4. size of the treatment area 5. the use of pulsed or continuous mode 6. coupling medium options 7. frequency options available 8. effective size of the radiating surface.
Method of application	<ol style="list-style-type: none"> 1. apply appropriate transmission medium (usually gel) directly to skin or, immerse part in water (preferably degassed) at a comfortable temperature or, use water bag with gel on bag surfaces in contact with the skin and the applicator 2. have applicator in contact with skin (if subaqueous with 1-2cm distance and appropriate increase in intensity ie 30%-55%²²) and moving before turning on output 3. maintain full contact with (or if subaqueous, constant distance from) skin and move applicator at a constant rate 4. avoid air bubbles in gel (can markedly reduce transmission) and maintain maximal applicator contact (if subaqueous method, rapidly remove bubbles manually from skin and applicator face as they develop)

²¹ This is not the preferred method as it may cause damage to the crystal in some machines or alter the machine output.

²² Ward and Robertson 1996.

5. move the applicator at all times there is an output to minimise production of hot spots resulting from the beam intensity pattern and standing wave formation, and pain with transmitted and shear waves at bony surfaces.

Records

Must be kept and must include the following:

1. C/Is checked, results of initial sensation tests and machine tests, that warnings were given and consent obtained
2. treatment details, including intensity and if continuous or pulsed (with on:off ratio), duration, area treated and method used, equipment details including applicator, machine and frequency
3. immediate result of treatment – including any abnormal reactions and subsequent action taken or recommended
4. all other treatment details.

Thermal - superficial heating and cooling

Check particular risks for thermal EPAs in table of contraindications and precautions (Table 1).

Output check

Wax: temperature in middle depth of wax bath in range 42-52°C²³

Hotpacks: hydrocollator temperature 76-80°C²⁴

IR: therapist hand under lamp at approx. 60-75cm distance (750-1,000W), or 40-45cm if less power,²⁵ after 5 minute warm up

Ice: examine skin under ice pack after 5 minutes to ensure no adverse reaction.

Dosage parameters

Superficial heating

Guided by patient's thermal responses - superficial heating modalities should provide comfortably or perceptibly warm heat to patient. Therapists must limit the max. heating possible for patient with reduced thermal discrimination

Wax: ask about level of heating immediately after first and last layers of wax application and again at 5 minutes and regularly thereafter

Hot packs and IR lamps: check skin immediately under hot packs²⁶ and infra-red lamps for levels of heating and adverse reactions and again after 8 minutes and regularly thereafter

Cooling

Ice packs: check skin under ice packs immediately and after 5 minutes for adverse reactions.

Method of application

Precise distance and methods used to apply cooling or heating vary with the particular EPA. Avoid weightbearing on heating or cooling sources. Consult standard textbook for details

Superficial heating

1. *wax:* usually 6 to 8 layers with first most extensive, cover with plastic or waxed paper and wrap in towel

2. *hot packs:* place in wrap or towel so there is approximately 1-2cm covering between skin and pack

3. *infra-red:* lamp with parabolic reflector up to 70cm from and parallel to area

Since these methods do not incorporate safety switches, provide the patient with a bell or similar device to use if the heat/sensations alter, become localised or uncomfortable, patient's position becomes uncomfortable or they or any equipment moves

Cooling

1. *ice pack - methods include R.I.C.E. (rest, ice, compression, elevation).*

Records

Must be kept and must include the following:

1. C/Is checked, results of initial sensation tests and machine tests, that warnings were given and consent obtained
2. treatment details, including the EPA used and specific technique (eg distance of IR applicator from skin and alignment, distance between hot pack and skin), and duration of application etc
3. immediate result of treatment - including any abnormal reactions and subsequent action taken or recommended
4. all other treatment details.

Thermal - deep

Check particular risks for thermal EPAs in table of contraindications and precautions (Table 1).

Output check

SWD: operator's hand between electrodes prior to use on patient or purpose-designed fluorescent test tube for SWD

MW: operator's hand under transducer for MW with comfortable warmth setting

Testing frequency varies with usage level - see manufacturers' guidelines.

Dosage parameters

Requires patient has accurate thermal discrimination. See standard textbook for details of different electrode arrangements (SWD). Check level of heating throughout the application.

²³ Low and Reed (2000), p.244.

²⁴ Low and Reed (2000), p.246.

²⁵ Low and Reed (2000), p.352.

²⁶ Fyfe 1982.

Method of application Precise distance and methods used to apply heating vary with the method of deep heating. Consult standard textbook for details.
Do not weightbear on heating or cooling source. Always expose the area fully prior to applying heat and ensure the area is, and remains, dry. See manufacturers' guidelines for separation distances of leads and ensure towel layer separates leads from any surface. If the equipment has a safety switch (eg MW or SWD) instruct the patient on its use. If no safety switch, provide the patient with a bell or similar device to use if the heat/sensations alter, become localised or uncomfortable, patient's position becomes uncomfortable or they or the equipment moves.
SWD - distances and relative sizes of capacitive pads and plates or inductothermy coils used vary with aims. Capacitive: min. electrode to skin distance 2-4cm. Inductothermy: min. distance to skin, one layer of towel. See standard textbook for details of methods. SWD operator distance 0.5-1m from operating equipment²⁷, treatment area free of metal.
MW - usual transducer distance to skin 4cm. See standard textbook.

Records *Must be kept and must include the following:*

1. C/Is checked, results of initial sensation tests and machine tests, that warnings were given and consent obtained
2. treatment details, including the EPA used and specific technique (eg space plate arrangement, distance from skin and alignment), duration of application and any available details of output intensity etc
3. immediate result of treatment - including any abnormal reactions and subsequent action taken or recommended
4. all other treatment details.

Electrical stimulation

Check particular risks with electrical stimulation in table of contraindications and precautions (Table 1).

Output check *Stimulator output*
Set appropriate treatment parameters. With therapist's hand or forearm across connected electrodes, gradually increase output with other hand until tingling sensations are felt. [If using non-reusable electrodes, hold pre-gelled ends of leads 5mm apart and test as above].
This test indicates only that there is an output and electrical continuity of the leads and electrodes. Testing frequency – prior to use on a day and otherwise on first treatment occasion for each patient.

Dosage parameters Consult appropriate research papers and recent textbooks for details.

Method of application *Skin impedance*
Wash skin with warm soapy water and rinse or, clean with alcohol swab before attaching electrodes.
Electrodes
An even contact between the electrode surface and the skin is required for transcutaneous electrical stimulation. Electrodes: disposable or reusable

1. if reusable electrode, reject if any cracks or signs of damage, if pads or sponges ensure they are thoroughly rinsed after cleaning
2. apply electrodes to skin with firm and even pressure, avoiding or minimising weightbearing on sponges and pads. If using longer duration monophasic currents (eg greater than 10msec) use purpose designed electrodes or 2cm thick clean pads under reusable electrodes to reduce electrolytic effects on skin
3. electrode size, number and shape relate to method, area treated and aims. A high current density (mA/cm²) can produce skin damage: do NOT use small electrodes especially with MFAC²⁸ currents such as interferential current.
4. position electrodes considering current path - must not be transthoracic, possibly also not through antero-lateral aspect of neck or either side of head. For interferential, position so interference pattern will develop in chosen area.
5. electrodes (some types) can be moved while current flows but only if kept in effective contact at all times with the skin.

Stimulator
After setting output and checking parameters increase intensity slowly (if motor, only during 'on time') to allow the patient adequate time to adapt to the sensory effects. Increase until required effects (ie degree of sensory stimulation, of torque, etc) are achieved.
If a patient safety switch is available, instruct the patient in its use. If not, provide them with a bell or similar warning device.
Suction devices
Ensure such devices are used at sufficiently low pressure so no skin bruising, damage, or swelling occurs under the suction cups.

²⁷ Delpizzo and Joyner (1987).

²⁸ MFAC: medium frequency alternating currents (usually 1kHz to 10kHz frequency) includes interferential and 'russian' currents.

- Records *Must be kept and must include the following:*
1. C/Is checked, results of initial sensation tests and machine tests, that warnings were given and consent obtained
 2. treatment details, including machine, current type (frequency, pulse width), intensity (V or I), options (eg modulations), duty cycle or on: off ratio, responses (sensory, motor, pain), duration of treatment, location and type of electrodes, etc
 3. immediate result of treatment - including any abnormal reactions and subsequent action taken or recommended
 4. all other treatment details.

Ultraviolet

Check particular risks for using UV in table of contraindications and precautions (Table 1).

- Output check
1. requires professional testing
 2. keep records with UV lamp of time for E1 with successive patients - list distance and skin type, time, and area of body tested. Adjust stabiliser only if marked increases documented in E1 times as necessitates re-establishing the E1 dosages for all patients currently being treated with that lamp
 3. replace distilled water in water cooled lamp (eg Kromayer) at least annually.

- Testing and dosage parameters
- Erythmal testing*
1. test either an area of skin adjacent to the area to be treated and with similar exposure to sunlight or, the inner surface of a forearm
 2. categorise patient's skin type, check for medications that might alter sensitivity to UV and ascertain the patient's usual reaction to exposure to sunlight
 3. estimate appropriate test exposure times and apply exposure range to be slightly above and below expected E1 level using same lamp as for future treatments
 4. provide patient with card at end of test and instructions to observe test area, and record reactions to report at the subsequent visit.

Dosage parameters

1. see a standard textbook for details of factors that alter UV sensitivity and erythmal definitions and recommended dosage levels
2. do not treat if the skin over the area to be irradiated is peeling
3. breaks between treatment
 - if 10 or more days, reduce or repeat the previous exposure time
 - if 3 or more weeks, restart dosage on basis of original E1.

- Method of application
- General*
1. check for changes in any systemic or applied photosensitising agents (eg some medications) prior to treatment
 2. apply UV in enclosed area - all who are exposed must wear UV protective goggles
 3. cover areas of patient not to be exposed with non-UV penetrating material, eg fine cotton sheeting
 4. select comfortable treatment position that gives appropriate UV access
 5. calculate treatment dose based on initial E1 for first session, and then on previous session for subsequent treatments, and time precisely
 6. warmup lamp for recommended period prior to treatment (usually 5 minutes for hot quartz mercury vapour lamps)
 7. inspect area after exposure and advise patient what to expect.
- Wounds*
1. remove dressings and clean area using a sterile technique
 2. on completion of treatment, inspect irradiated area and dress wound as necessary.

- Records *Must be kept and must include the following:*
1. that warnings were given and consent obtained
 2. check made for presence of any photosensitising agents prior to treatment
 3. the E1 test results for patient and the test and treatment lamp used
 4. distance from the lamp, dose selected and exposure time given in each treatment session, time of day and date
 5. immediate result of treatment - including any abnormal reactions and subsequent action taken or recommended
 6. if treating a wound: the shape, size and depth of wound
 7. all other treatment details.

Laser²⁹

Check particular risks for using laser in table of contraindications and precautions (Table 1).

Output check	<ol style="list-style-type: none"> 1. check probe output using appropriate testing meter or photoelectric device 2. alternatively, ensure frequent testing by appropriate electromedical technician.
Dosage parameters	<p>Regardless of acuteness/chronicity of the condition being treated:</p> <ol style="list-style-type: none"> 1. commence treatments with a low dose 2. base any dosage increase on the results of previous treatments of that patient. <p>Refer to textbook for further advice on dosage.</p>
Method of application	<ol style="list-style-type: none"> 1. clean skin and applicator/probe with an alcohol wipe prior to use; clean open wounds with normal saline solution 2. apply laser so the beam strikes the skin at a right angle 3. use applicator in contact with intact skin, and with open wounds, as close as possible without contact.
Records	<p><i>Must be kept and must include the following:</i></p> <ol style="list-style-type: none"> 1. that warning was given, consent obtained, that goggles worn 2. treatment details, including the particular equipment (class and type of laser) and applicator used (single probe, scanner, multi-diode probe), the specific technique (eg in contact or held over skin, gridding, scanning), energy density, size of area treated, number and location of points treated and duration per point 3. immediate result of treatment - including any abnormal reactions and subsequent action taken or recommended 4. all other treatment details.

Low frequency magnetic fields

Output check	Test output according to manufacturers' instructions eg small magnet supplied will pulse at test frequency (eg 1 Hz) when held inside the applicator.
Dosage parameters	Refer to textbook and current research.
Method of application	<ol style="list-style-type: none"> 1. position applicators close to the area being treated to ensure that the pulsed magnetic field adequately affects the tissues 2. connect applicator to machine, set frequency and intensity, then switch on 3. do not cover part being treated and/or applicator or apparatus, with any form of covering – heat may be generated if the treatment time is protracted.
Records	<p><i>Must be kept and must include the following:</i></p> <ol style="list-style-type: none"> 1. that warning was given and consent obtained 2. treatment details, including the frequency used (Hz), intensity (Gauss), duration of treatment, applicator used and its position/polarity as appropriate 3. immediate result of treatment - including any abnormal reactions and subsequent action taken or recommended 4. all other treatment details.

²⁹ Laser: Light Amplification by Stimulated Emission of Radiation.

SECTION 3: Infection control procedures

Physiotherapists have a responsibility to be cognisant of and to apply principles of infection control in their clinical practice. This section lists items of routine care, followed by care appropriate to the different levels of risk relevant when using EPAs.

Users of EPA equipment should:

1. always apply standard precautions and, when necessary, additional precautions (NHMRC 1996 and 2000 *draft*)
2. perform a risk assessment to ascertain the level of precautions necessary.

Routine care

1. Hand washing

- is essential immediately before and immediately after every patient to prevent cross infection between patients and protect physiotherapists from pathogenic micro-organisms (Bryan et al 1995, Horton 1995, Larson 1995).

2. Disposal of sharps

- requires a sharps container (thick yellow plastic purpose built and must meet Australian Standards AS 4261, AS 4031)
- sharps container must be in safe and accessible place
- sharps container must not be filled above capacity.

Levels of care

Non-critical treatment

EPA treatment involving contact with intact skin is considered a low risk procedure (non-critical).

EPA probes, electrode covers or sponges

- routinely wipe this equipment with 70% alcohol (alcohol wipes) or soak regularly in fresh Milton (sodium hypochlorite) solution between patients (according to manufacturers' guidelines) eg see Lambert et al (2000)
- dry electrode covers and sponges completely

overnight to enhance disinfection

hot or cold packs

- use fresh towels with each new patient

self-adhesive electrodes

- re-use only with same patient (see modality specific information following Table 1) provided their skin is intact and store as suggested by the manufacturer

other EPA equipment

- if not in contact with patients, EPA devices should be wiped routinely with hot water, a neutral detergent, a disposable cloth and allowed to dry. The frequency of this environmental cleaning should be determined by the level of risk of the clinical area eg where there is a high risk of infection, such as a burns unit, environmental cleaning should occur daily.

Semi-critical treatment

Where there is an open wound or the potential for contact with blood or body substances, non-intact skin or mucous membranes, physiotherapists should apply Standard Precautions (NHMRC 1996, 2000 *draft*)

- wear gloves and ensure contaminated gloves do not contact the EPA control panel or equipment.
- ensure gloves, single use covers, vaginal electrodes, etc. are removed without inadvertent flicking of gel onto other surfaces and dispose of in double plastic bagging
- wash hands thoroughly with soap and water before and after each procedure
- use probes (laser, UV), electrodes (vaginal and other), perineometer and US applicator with single use (eg vaginal electrodes) or sterile cover (eg laser). Following this any covers must be disposed of carefully and all equipment *cleaned then disinfected* (see definitions next page). If single-use sterile covers are not available, any equipment that comes in contact with intact mucous membranes or non-intact skin must be sterilised eg UV Kromayer probes

gel

- possible source of infection when used in semi-critical treatments
- single use sterile gel packets are preferred since they remove any risk of contact between the source of infection and the nozzle or outer container.

Critical treatment

Treatment that involves submucosal invasion

acupuncture or needle EMG electrodes

- sterile needles must be used
- use alcohol wipe on skin prior to insertion of any needle to reduce the bacterial load on the skin to lessen the risk of infection.

Definitions***Cleaning***

Cleaning of applicators and non-electrical equipment is essential prior to disinfection and sterilisation processes (NHMRC 2000 *draft*). The following cleaning technique is recommended (NHMRC 2000 *draft*):

1. gloves, face protection and a plastic apron must be worn
2. flush in running water
3. fully dismantle instrument and immerse in warm water (45 degrees) and a neutral detergent
4. scrub gently with a brush. Cleaning instruments should be stored dry
5. rinse in hot water to assist the drying process
6. inspect instrument to ensure that it is free from protein residues and other stains
7. dry mechanically in drying cabinet or hand dry with a clean lint free cloth (NHMRC 2000 *draft* guidelines recommend that items are NOT left to dry in ambient air).

Disinfection

Disinfection is the inactivation of non-spore forming organisms using either thermal or chemical means (AS 4187). Chemical disinfection involves chemicals such as hyperchlorites and aldehydes. The effectiveness of these agents is dependent on several factors including temperature, pH, concentration, the presence of organic material, and the relative resistance of any infectious agents involved (NHMRC 2000 *draft*).

Suitable agents include those containing chlorine, glutaraldehyde or alcohol. Glutaraldehyde (2%) is the most readily available chemical disinfectant for manual use and has a demonstrated effectiveness against a range of viruses and bacteria (Hanson et al 1994). However, glutaraldehyde must be used only in controlled circumstances and with careful monitoring. Glutaraldehyde is unlike sodium hypochlorite or alcohol which are relatively safe. Alcohol assists in drying but has limited efficacy as a disinfectant. Thermal disinfection can be used if the EPA device can tolerate boiling. Also, manufacturers' recommendations should be sought prior to the use of specific agents.

Sterilisation

Sterilisation is a validated process used to render a product free of all forms of viable micro-organisms eg autoclaving, dry heat and high level or automated chemical process systems (eg ethylene oxide gas). Manufacturers' recommendations regarding the sterilisation process suitable for each EPA device must be sought to prevent damage.

Recommendation: *That each practice/clinic have a written set of procedures detailing the agents and processes used for infection control in each situation.*

SECTION 4:

EPA equipment safety

Basic EPA equipment safety requirements

Physiotherapy treatment areas should be electrically wired as body protected areas (Type BF), to protect the therapist and patient from electrical macroshock, unless only Type CF or BF patient equipment is used in them.³⁰ The EPA user, however, is responsible for ensuring the level of equipment safety established by design and manufacture. The following points are basic and apply to any electrical equipment. More detailed information can be obtained from the relevant Australian/New Zealand Standards publication.³¹

1. All electromedical equipment is required to be tested at least every 12 months³² for basic electrical safety by suitably qualified technical staff competent in the area of biomedical engineering and a label affixed which indicates the date, tester, and period covered by the safety test. All electromedical equipment is to be calibrated at least every two years.³³ Where electromedical equipment is used heavily and daily it is recommended that servicing should be considered more often, at least six-monthly.³⁴ All new electromedical equipment purchased should be electrical safety tested and cleared prior to commissioning.
2. Inspect the supply cord and plug before plugging equipment into the power outlet. Check for any physical damage such as a cracked or split plug casing or damage to the outer sheath of the power cord. Look for loose screw connections, frayed wires, signs of overheating and loose cord clamps. Ensure the earth wire is intact (green/yellow or all green). The use of transparent plugs (now mandatory) facilitates this.
3. Fault tag *any* suspected faulty leads and equipment, disconnect from the power, and remove from use. Fault tags should be readily available and identifiable and have space for a description of the fault symptoms. Ensure faulty equipment is not re-used until tested by appropriately qualified engineering staff.
4. Double adaptors and extension cords are not permitted. Both can lead to overloading of a lead or wall socket and, extension cords are hazardous in a work environment. Power boards are permitted but only if used with caution because of the risk of overloading either the board or wall socket. Consider installing additional wall sockets.
5. Inspect patient leads (or cables) and electrodes prior to use for damage. Frequent flexing of leads can result in broken wires in the lead or at the machine or electrode connections and can disrupt the output. With ultrasound machines, inspect the cable to the applicator and the cable insulation. Ensure the applicator remains waterproofed. With shortwave diathermy equipment check accessories including leads, pads, space plates, and coils. Damage can lead to arcing within an accessory or at the socket.
6. Connecting patients to more than one item of electrical equipment at a time increases the electrical hazard as well as possibly creating additional risks because of interactive effects (see Note on possible interactive effects, Section 1).
7. Space needs to be left around machines for ventilation as most electrical equipment generates some heat during use. Should the equipment emit an unusual odour or be too hot to touch, switch off immediately, fault tag it, and do not re-use until checked and cleared.³⁵
8. Loose switches, controls, dials or non-functioning indicator lights/meters require repairing before the equipment is safe to use.
9. If, during use, any unexpected disturbance in the output or an uncontrolled surge/shock occurs, turn off equipment immediately. Fault tag it and have it checked before further use.
10. The wax bath temperature should be checked regularly to prevent fire and, the bath should have a metal lid. Have a fire extinguisher suitable for electric fires present and a fire blanket.

³⁰ AS/NZS 3003:1999, pp.8, 15-19.

³¹ AS/NZS 2500:1995, Guide to the safe use of electricity in patient care.

³² AS/NZS 3551:1996, p.19.

³³ May need updating when the AS/NZS currently being developed for ultrasound equipment becomes available.

³⁴ AS/NZS 3551:1996, p.19.

³⁵ All equipment checking and testing must be done by qualified technical staff competent in biomedical engineering.

SECTION 5: Bibliography

General

- Cameron MH (Ed.) (1999): *Physical Agents in Rehabilitation*. Philadelphia: WB Saunders Co.
- Delany C (1996): Should I warn the patient first? *Australian Journal of Physiotherapy*, 42: 249-255.
- Low J and Reed A (2000): *Electrotherapy Explained*. (3rd ed.) Oxford: Butterworth-Heinemann Ltd.
- Nelson R, Hayes K and Currier D (Eds) (1999): *Clinical Electrotherapy*. (3rd ed.) Stamford: Appleton and Lange.
- Vines P (1996): Informed consent: From paternal benevolence to trust mediated by truthfulness. *Australian Journal of Physiotherapy* 42: 245-246.
- Fyfe M (1982): Skin temperature, colour, and warmth felt, in hydrocollator pack applications to the lumbar region. *Australian Journal of Physiotherapy* 28: 12-15.
- Kallen B, Malmquist G and Moritz U (1992): Delivery outcomes among physiotherapists in Sweden: Is non-ionising radiation a fetal hazard? *Physiotherapy*, 78: 15-18.
- Logue JN, Hamburger S, Silverman PM and Chiacchierini RP (1985): Congenital anomalies and paternal occupational exposure to shortwave, microwave, infrared and acoustic radiation. *Journal of Occupational Medicine* 27: 451-452.
- Low J and Reed A (2000): *Electrotherapy Explained* (3rd ed.) Oxford: Butterworth-Heinemann Ltd, pp. 212-254.

Ultrasound

- Baker K, Robertson V and Duck F (2001): A review of therapeutic ultrasound. Part 2: Biophysical effects. *Physical Therapy* 81.
- Ebenbichler GR, Erdogmus CB, Resch KL, Funovics MA, Kainberger F, Barisani G, Aringer M, Nicolakis P, Weisinger GF, Baghestanian M, Priesinger E, Fialka-Moser V and Weinstabl R. (1999): Ultrasound therapy for calcific tendinitis of the shoulder. *New England Journal of Medicine* 340: 1533 -1538.
- Ebenbichler GR, Resch KL, Nicolakis P, Weisinger GF, Uhl F, Ghanem AH and Fialka V (1998): Ultrasound treatment for treating the carpal tunnel syndrome: randomised "sham" controlled trial. *British Medical Journal* 316: 731-735.
- Robertson V and Baker K (2001): A review of therapeutic ultrasound. Part 1: Effectiveness studies. *Physical Therapy* 81.
- Ward AR and Robertson VJ (1996): Dosage factors for the subaqueous application of 1MHz ultrasound. *Archives of Physical Medicine and Rehabilitation* 77: 1167-1172.
- Martin CJ, McCallum HM, Strelley S and Heaton B (1991): Electromagnetic fields from therapeutic diathermy equipment: A review of hazards and precautions. *Physiotherapy* 77: 3-7.
- Odia G and Aigbogun O (1988): Thermal sensation and the skin sensation test: Regional differences and their effects on the issue of reliability of temperature ranges. *Australian Journal of Physiotherapy* 34: 89-93.

Cold Therapy

- Belitsky RB, Odam SJ and Hubley-Kozey C (1987): Evaluation of the effectiveness of wet ice, dry ice and cryogen packs in reducing skin temperature. *Physical Therapy* 67: 1080-1084.
- Day MJ (1974): Hypersensitive response to ice massage. Report of a case. *Physical Therapy* 54: 592-593.
- Ho SSW, Illgen RL, Meyer RW, Torok PJ, Cooper MD and Reider B (1994): Comparison of various icing times in decreasing bone metabolism and blood flow in the knee. *American Journal of Sports Medicine* 23: 74-76.
- Knight KL (1995): *Cryotherapy in Sport Management*. Champaign (Illinois): Human Kinetics.
- Lorenze EJ, Carontonis G and De Rosa AJ (1960): Effect on coronary circulation of cold packs to hemiplegic shoulders. *Archives of Physical Medicine and Rehabilitation* 41: 394-399.

Heat Therapy

- Ayling J and Marks R (2000): Efficacy of paraffin wax baths for rheumatoid arthritic hands. *Physiotherapy* 86: 190-201.

Meeusen R and Lievens P (1986): The use of cryotherapy in sports injuries. *Sports Medicine* 3: 398-414.

Rasmussen M, Hayes D, Vlietstra R and Thorsteinsson G (1988): Can transcutaneous electrical nerve stimulation be safely used in patients with permanent cardiac pacemakers? *Mayo Clinic Proceedings* 63: 443-445.

Stanghelle JK and Nilsson S (1983): Angina pectoris and cold. *International Journal of Rehabilitation Medicine* 5: 189-191.

Taber C, Contryman K, Fahrenbruch J, LaCount K and Cornwall MW (1992): Measurement of reactive vasodilation during cold gel pack application to non-traumatized ankles. *Physical Therapy* 72: 294-299.

Electrical stimulation

APTA Electrotherapy Standards Committee (1990): *Electrotherapeutic Terminology in Physical Therapy*. Virginia: American Physical Therapy Association.

Nelson R, Hayes K and Currier D (Eds) (1999): *Clinical Electrotherapy*. (3rd ed.) Stamford: Appleton and Lange.

Selkowitz DM (1999): Electrical currents. In Cameron MH (Ed.): *Physical Agents in Rehabilitation*. Philadelphia: WB Saunders Co., pp. 345-427.

Ultraviolet

Low J and Reed A (2000): *Electrotherapy Explained*. (3rd ed.) Oxford: Butterworth-Heinemann Ltd, pp. 376-412.

Stern RS, Nichols KT and Vakeva LH (1997): Malignant melanoma in patients treated for psoriasis with methoxsalen (psoralen) and ultraviolet A radiation (PUVA). *New England Journal of Medicine* 336:1041-1045.

Laser

Kleinkort JA and Foley RA (1984): Laser acupuncture: Its use in physical therapy. *American Journal of Acupuncture* 12: 51-56.

Kramer JF and Sandrin M (1993): Effects of low-power laser and white light in sensory nerve conduction rate of the superficial radial nerve. *Physiotherapy Canada* 45: 165-170.

Laakso L, Cramond T, Richardson C and Galligan JP (1994): Plasma ACTH and beta-endorphin levels in response to low level laser therapy (LLLT) in

myofascial trigger points. *Laser Therapy* 6: 133-142.

Laakso EL, Richardson C and Cramond T (1997): Pain scores and side effects in response to Low Level Laser Therapy (LLLT) for myofascial trigger points. *Laser Therapy* 9: 67-72.

Mester E, Mester AF and Mester A (1985): The biomedical effects of laser application. *Lasers in Surgery and Medicine* 5: 31-39.

Magnetic field therapy

Leclaire R and Bourgouin J (1991): Electromagnetic treatment of shoulder peri-arthritis: A randomized controlled trial of the efficiency and tolerance of magnetotherapy. *Archives of Physical Medicine and Rehabilitation* 72: 284-287.

McMeeken J (1992): Magnetic fields: Effects on blood flow in human subjects. *Physiotherapy Theory and Practice* 8: 3-9.

Railton R and Newman P (1983): Magnetic field therapy - does it affect soft tissue? *Journal of Orthopaedic and Sports Physical Therapy* 4: 241-246.

Ramey DW (1998): Magnetic and electromagnetic therapy. *Scientific Review of Alternative Medicine* 2: 13-15.

Sharrard WJW (1990): A double blind trial of pulsed electromagnetic fields for delayed union of tibial fractures. *Journal of Bone and Joint Surgery (British)* 72B: 347-355.

Vallbona C and Richards T (1999): Evolution of magnetic therapy from alternative to traditional medicine. *Physical Medicine and Rehabilitation Clinics of North America* 10: 729-754.

Hazards with EPAs and Australian/New Zealand Standards

Australian and New Zealand Standard AS/NZS 2500 (1995): *Guide to the safe use of electricity in patient care*. Sydney: Standards Association of Australia.

Australian and New Zealand Standard AS/NZS 3551 (1996): *Technical management programs for medical devices*. Sydney: Standards Association of Australia.

Australian Standard AS 3200.2.6 (1992): *Approval and test specification - Medical electrical equipment. Part 2.6: Particular requirements for safety - Microwave therapy equipment*. Sydney: Standards Association of Australia.

Australian and New Zealand Standard AS/NZS

- 2211.1 Suppl.1 (1999): Laser safety. Part 1; Equipment classification, requirements and user's guide. Supplement 1: Application guidelines and explanatory notes. Sydney: Standards Association of Australia.
- Australian and New Zealand Standard AS/NZS 4173 (1994): Guide to the safe use of lasers in health care. Sydney: Standards Association of Australia.
- Australian and New Zealand Standard AS/NZS 3003 (1999): Electrical installations - Patient treatment areas of hospitals and medical and dental practices. Sydney: Standards Association of Australia.
- Australian and New Zealand Standard AS/NZS 3200.1.0 (1998): Medical electrical equipment: General requirements for safety - Parent Standard. Sydney: Standards Association of Australia.
- Chen D, Philip M, Philip PA and Monga TN (1990): Cardiac pacemaker inhibition by transcutaneous electrical nerve stimulation. *Archives of Physical Medicine and Rehabilitation* 71: 27-30.
- Delpizzo V and Joyner K (1987): On the safe use of microwave and shortwave diathermy units. *Australian Journal of Physiotherapy* 33: 152-162.
- Hocking B and Joyner K (1995): Re: Miscarriages among female physical therapists who report using radio- and microwave frequency electromagnetic radiation [letter to editor]. *American Journal of Epidemiology* 141: 273-274.
- Kitchen S (2000): Audit of the unexpected effects of electrophysical agents. *Physiotherapy* 86: 152-155.
- Lerman Y, Caner A, Jacobovich R and Riback J (1996): Electromagnetic fields from shortwave diathermy equipment in physiotherapy departments. *Physiotherapy* 82: 456-458.
- Lundstrom R (1985): Effects of local vibration transmitted from ultrasonic devices on vibrotactile perception in the hands of therapists. *Ultrasonics* 28: 793-803.
- Ouellet-Hellstrom R and Stewart W (1993): Miscarriages among female physical therapists who report using radio- and microwave frequency electromagnetic radiation. *American Journal of Epidemiology* 138: 775-786.
- Partridge C and Kitchen S (1999): Adverse effects of electrotherapy used by physiotherapists. *Physiotherapy* 85: 298-303.
- Taskinen H, Kyyronen P and Hemminki K (1990): Effects of ultrasound, shortwave, and physical exertion on pregnancy outcome in physiotherapists. *Journal of Epidemiology and Community Health* 44: 196-201.

Infection control procedures

- Australian Standard AS 4031 (1992): Non-reusable containers for the collection of sharp medical items used in healthcare areas. Sydney: Standards Association of Australia.
- Australian Standard AS 4187 (1998): Cleaning, disinfecting and sterilizing reusable medical and surgical instruments and equipment, and maintenance of associated environments in health care facilities. Sydney: Standards Australia.
- Australian/New Zealand Standard AS/NZS 4261 (1994): Reusable containers for the collection of sharp items used in human and animal medical applications. Sydney: Standards Australia and Standards New Zealand.
- Bryan J, Cohran J and Larson E (1995): Hand washing: A ritual revisited. *Critical Care Nursing Clinics of North America* 7: 617-625.
- Hanson PJ, Bennett J, Jeffries DJ and Collins JV (1994): Enteroviruses, endoscopy and infection control: an applied study. *Journal of Hospital Infection* 27: 61-67.
- Horton R (1995): Hand washing : the fundamental infection control principle. *British Journal of Nursing*. 4: 926-933.
- Lambert I, Tebba S, Hill D, Moss H, Davies A and Elliott T (2000): Interferential therapy machines as possible vehicles for cross-infection. *Journal of Hospital Infection* 44: 59-64.
- Larson E (1995): APIC guidelines for hand washing and hand antisepsis in health care settings. *American Journal of Infection Control*. 23: 251-269.
- NHMRC (1996): Infection control in the health care setting. Canberra: Commonwealth of Australia.
- NHMRC (2000): Infection control in the health care setting - draft guidelines for the prevention of transmission of infectious diseases. Canberra: Commonwealth of Australia. www.health.gov.au/pubhlth/strateg/communic/review.

Authors' Affiliations

Valma J Robertson PhD, BAppSc(Phty), BA(Hons), CertElectronics, MAPA
Associate Professor, La Trobe University, Bundoora, Victoria 3086.
[email: v.robertson@latrobe.edu.au]

Lucy S Chipchase, MAppSc(Phty), MAPA
Lecturer, University of South Australia, North Terrace, Adelaide, South Australia 5000.
[email: lucy.chipchase@unisa.edu.au]

E Liisa Laakso PhD, BPhy, GradCertHealthMgmt, MAPA
Conjoint Lecturer/Senior Physiotherapist, The University of Queensland/Royal Brisbane Hospital, Queensland.

Karyn M Whelan BAppSc(Phty), MAppSc(Phty), MAPA
Lecturer, School of Physiotherapy, The University of Sydney, Lidcombe, New South Wales 2141.

Leanda J McKenna BAppSc(Phty), PGradDip(Sports), MAPA
Lecturer, Curtin University of Technology, Shenton Park, Western Australia 6008.
[email: tmckenna@cc.curtin.edu.au]

Contributors

Alex R Ward PhD
Senior Lecturer, La Trobe University, Bundoora, Victoria 3086.
[email: a.ward@latrobe.edu.au]

David Bastians BAppSc(Phty)
Lecturer, Charles Sturt University, Albury, New South Wales 2640.
[email: dbastians@csu.edu.au]

Published by: Australian Physiotherapy Association
PO Box 6465 St Kilda Road Central, Victoria 8008
Ph. 03 9534 9400 Fax 03 9534 9199
E-mail: national.office@physiotherapy.asn.au