Ambulatory chemotherapy for teenagers and young adults

Caroline Newton and Bethan Ingram

Abstract

Ambulatory chemotherapy allows high-dose chemotherapy to be delivered in an outpatient facility with multidisciplinary planning and management. At University College London Hospitals NHS Foundation Trust, this model of care has been successfully applied to a teenage and young adult population. A mobile infusion device, CADD-Solis VIP pump has allowed chemotherapy and supportive therapy administration in the ambulatory setting. Continuous and intermittent therapies have been delivered. Patients attend the ambulatory care unit daily for assessment and treatment set up. Overnight, they reside in nearby accommodation. Patients are educated to self-manage, promoting independence and empowerment; however, they also have 24-hour access to nursing and medical advice. Clear communication and patient education, adopting a multidisciplinary team approach and clear assessment guidance for patients and staff, is essential to make this model of care successful.

Key words: Ambulatory chemotherapy ■ Teenage cancer ■ Young adult cancer ■ Mobile infusion device ■ CADD pump

Historically, high-dose chemotherapy regimens and subsequent supportive care have been delivered on inpatient wards for cancer patients. Owing to the complex nature of these treatments and limitations in infusional devices, as well as the duration of treatments, they have required specialist inpatient monitoring (Loefellor et al, 1991; Goren et al, 1997) Practical aspects of patients' lives have favoured this modality of treatment as many have to travel a long way and, often on repeated occasions, to hospital (NHS England, 2013). Previously, inpatient care was required to manage potential toxicities caused by cytotoxic treatment including fluid balance monitoring and intravenous (IV) fluid replacement (Goren et al, 1997). The management of side effects such as nausea and vomiting required regular IV antiemetic drug therapy that could not have been delivered outside of the hospital setting (Skubitz et al, 1993; Kelly, 2008; Mahadeo et al, 2010)

Cancer incidence continues to grow but advancements in treatment, research and improved diagnostics have improved overall survival for some cancer groups, including breast, bowel and prostate cancer and Hodgkin's lymphoma (Cancer Research UK, 2013). This has placed an increased pressure on the capacity of inpatient wards and financial budgets of the NHS. Other factors influencing service delivery have included a national drive to improve patient experience (Department of Health (DH), 2011) and technological advances. Together, these factors have prompted an international shift in the location of treatment delivery from an inpatient to outpatient facility (Matziou et al, 2012; Sive et al, 2012). This has improved patient experience by encouraging an attitude of self-care (McIlfatrick et al, 2007) and allowing more patients to be treated within an oncology service (Sive et al, 2012). There has been a drive within children's health care in the UK to administer specific treatment at home; however, this does not include complex cytotoxic chemotherapy regimens that are given within an acute oncology service (Spiers et al, 2011; Knott et al, 2013).

Caring for teenagers and young adults

Teenagers and young adults (TYAs) are in a period of transition and development as they grow out of childhood towards adulthood. It is a time of emotional, social, psychological and physical growth and maturity (Kelly, 2008; Smith et al, 2010). A cancer diagnosis can challenge this, and some individuals have difficulty adopting coping mechanisms to cope with complex treatments and uncertainty. Whenever clinically feasible, health professionals should aim to minimise the impact on patients' psychosocial wellbeing by supporting them to live as much of 'a normal life' as possible (Teenage Cancer Trust (TCT), 2012). Teenagers and young adults should be treated in an age-appropriate environment alongside their peers, who can encourage one another through common experience (Smith et al, 2010; National Cancer Action Team, 2013a). An ambulatory model could empower and facilitate self-management, allowing teenagers and young adults to regain some control in a period of vast change (Mcllfatrick et al, 2007).

Ambulatory care

Ambulatory care is a term used within health care to discuss a model of care that applies to patients who are mobile and able to attend to receive their care (Kliethermes and Brown, 2011) and who require close monitoring but do not need to stay in hospital overnight. Previously, the complexities of these treatments, treatment-related toxicities and their management would have required care on an inpatient ward (Sive et al, 2012).

Caroline Newston is Macmillan Oncology Teenage Clinical Nurse Specialist, Children & Young People's Cancer Services and Bethan Ingram is Teenage Cancer Trust Ambulatory Care Lead Nurse, Teenage and Young Adult Day and Ambulatory Care Unit; both at University College London Hospitals NHS Foundation Trust, London.

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Table 1. Chemotherapy regimens administered on case study TYA AC unit	
Disease group	**Regimen**
Sarcoma	VIDE (Vincristine, ifosfamide, doxorubicin, etoposide)
	VAI (Vincristine, dactinomycin, ifosfamide)
	IVA (Ifosfamide, vincristine, dactinomycin)
	MAP (High-dose methotrexate, doxorubicin, cisplatin)
	IVADO (Ifosfamide, vincristine, dactinomycin, doxorubicin)
	IFOS/DOX (Ifosfamide, doxoubicin)
	VDC/IE (Vincristine, doxorubicin, cyclophosphamide, ifosfamide, etoposide)
	VAC (Vincristine, dactinomycin, cyclophosphamide)
	Trabectadin
	VI (Vincristine, irinotecan)
	Iri/ Tem (Irinotecan, temozolomide)
Lymphoma	ESHAP (Etoposide, cytarabine, methylprednisolone, cisplatin, +/- rituximab)
	IVE (Ifosfamide, epirubicin, etoposide)
	OEPA (Doxorubicin, etoposide, vincrtstine, prednisolone)
Acute myeloid leukaemia	HD ARA-C (High-dose cytarabine)
	Clof/Cyclo/Etop (Clofarabine, cyclophosphamide, etoposide)
	MiniLEAM (Lomustine, etoposide, cytarabine, melphelan)
	FLA-IDA (Fludarabine, cytarabine idarubicin) +/- MYLOTARG (high-dose cytarabine)
	ADE (Daunorubicin, etoposide, cytarabine)
	Arsenic consolidation
Acute lymphoid leukaemia	UKALL 11 induction (UKALL trial protocol)
All haematology	Supportive care/ count recovery
PBSCT	RI BEAM-Campath ALLO (Reduced-intensity allograft with carmustine, etoposide, cytarabine, melphalan, alemtuzumab)
	RI FMC ALLO (Reduced-intensity allograft with fludarabine, melphalan, alemtuzumab)
	TREO/MELPH/AUTO (Autograft with treosulphan and melphalan)
Oncology	BEP (Bleomycin, etoposide, cisplatin)
	OXMDG (Flouracil, oxaliplatin)
Miscellaneous	Work up/investigations

In this article, ambulatory care (AC) will refer to this service that delivers cancer treatments and supportive care therapies in an outpatient facility. Tan et al (2010) and Matziou et al (2012) have proven this model as safe and efficient for chemotherapy and supportive care delivery internationally. Sive et al (2012) adopted an ambulatory model to treat a range of oncology and haematology patients with high-dose chemotherapy regimens and haematopoetic stem-cell transplants. Zelcer et al (2008) safely delivered high-dose methotrexate to paediatric patients using an ambulatory model. In both studies, chemotherapy delivery was made possible by the use of portable infusion pumps.

Tan et al (2010) found that changing chemotherapy delivery to an ambulatory model has also proven to reduce costs. Sive et al (2012) reported cost savings in using this model and estimated staffing costs to be just over a third of the cost of a traditional inpatient stay. Patients and carers also report outpatient services to be preferable to inpatient services as they allow individuals to maintain more normal day-to-day routines (McIlfatrick et al, 2007; Matziou et al, 2012). However, when transitioning services to an outpatient setting, clear patient pathways must be in place to ensure patients and carers have immediate access to care and support.

Ambulatory care within the authors' Trust

The safety aspects within an AC service are important as the chemotherapy regimes are complex and each individual patient needs to be risk assessed as suitable (Sive et al, 2012; National Cancer Action Team, 2013b). At University College Hospital, the TYA AC unit serves patients aged 13–24 years (TCT, 2010; National Cancer Action Team, 2013a) At the time of establishing this TYA service, the examples of AC were based on adult models of care that had proved safe and effective for adult service users (Zelcer et al, 2008).

Within the same trust, the adult haematology and oncology services had several years of experience delivering AC chemotherapy successfully to an adult cohort. With special consideration by senior nursing and medical teams, adaptations were made to this adult model of care. AC was assigned a specific project lead to work alongside the modern matron. Teaching for ward staff and information for inpatients were provided to introduce the concept of AC. It was agreed that this could be applied to a younger user group safely.

At the TYA ambulatory care unit, many chemotherapy regimens are administered (*Table 1*) with the full support of a specialist nursing, pharmacy and medical team. Daily, patients attend the unit for assessment, review and administration of drugs or therapeutics. Many patients will leave the AC unit with chemotherapy or supportive infusions running intravenously via portable infusion pumps.

When admitted to AC, the patient stays with a carer at a patient hotel or CLIC Sargent charity-funded 'Home from Home', both within minutes walk of the hospital. Patients who meet the eligibility criteria (described in the next section) and live within 1 hour of the hospital can reside at home during their admission. Patients who live over 1 hour away must stay in hospital accommodation as this ensures quick access to medical support should they require it. Patients and carers have 24-hour access to nursing and medical advice via telephone. A contingency bed is reserved on an inpatient ward for all patients ambulating should they require admission.

Eligibility criteria

All eligible patients are offered the choice to receive their treatment within the AC service rather than on the inpatient ward. The eligibility criteria for TYA AC includes:

- Having a carer/companion (over 18 years old) to accompany them
- Having a good level of written, spoken and understanding of English
- Having access to a mobile phone (the AC service can provide one if needed)
- Receiving a suitable chemotherapy regimen (*Table 1*)

- Having the ability to use and interpret a thermometer
- Having a reasonable level of awareness and understanding to undertake extra responsibilities (these may include performing urinalysis; self-medicating; monitoring and troubleshooting infusion device; and maintaining a fluid input/output chart)
- To stay in hospital 'Home from Home' or patient hotel overnight, while receiving AC treatment unless patient lives within 1 hour of the hospital.

Finally, the AC and clinical teams must be confident that the patient is suitable for ambulatory care. Owing to the increased level of responsibility AC places on patients and carers, careful and clear communication must be used to inform and educate. Daily monitoring and remote 24-hour support will ensure patients are empowered to undertake tasks safely and compliance is maintained. For some patients, this process may start on the inpatient ward before coming to AC.

Chemotherapy standards and patient safety

For chemotherapy administration including AC delivery systems, safe principles from the PAN-London Network (London Cancer Networks, 2011) are followed. Staff nurses setting up the chemotherapy infusion devices are competent in intravenous drug administration, chemotherapy administration and use of infusion pumps within the Trust. A chemotherapy register is held within the Trust, which requires annual update as required by the *Manual for Cancer Services Chemotherapy Measures* (National Cancer Action Team, 2013b). All AC chemotherapy and supportive care infusions are administered via central venous catheter (including PICC lines, Hickman lines and ports) to maximise vein integrity and stability, as well as minimise risk of extravasation (Wickham et al, 1992). Aseptic non-touch technique (ANTT) is used to access central lines safely reducing the risk of infection (Rowley and Clare, 2009).

Infusion device and delivery

The infusion device of choice is CADD®-Solis VIP ambulatory infusion pump by Smiths Medical (*Figure 1*). This infusion pump is a small, light and portable pump that can be programmed to deliver therapies in multiple ways, including:

- PCA (patient controlled analgesia)
- Continuous delivery
- Intermittent delivery
- Step delivery
- Taper delivery (Smiths Medical, 2010).

Step or incremental delivery is a new feature for the CADD–Solis VIP ambulatory infusion pump, which has not been available for older CADD models. Within clinical practice, the authors only have experience of using continuous and intermittent delivery to administer chemotherapy and supportive products.

PCA delivery allows a continuous rate of therapy infusion, patient-controlled dosing or both (Smiths Medical, 2010). Step delivery enables delivery of therapies with incremental infusion times, up to a maximum infusion rate (Smiths Medical, 2010). Taper delivery mode administers therapies with a tapered start (or end) of infusion and reaches a plateau infusion rate (Smiths Medical, 2010). Continuous delivery allows therapy to be infused at a set rate for a set period of time; for example, it is used for continuous hydration, chemotherapy infusion or total parental nutrition. Intermittent delivery has allowed therapy to be infused at set intervals; for example, twice daily boluses of intermittent chemotherapy (Smiths Medical, 2010).

Infusing a concurrent compatible solution via a three-way tap or 'Y-connecter' ensures line patency is maintained

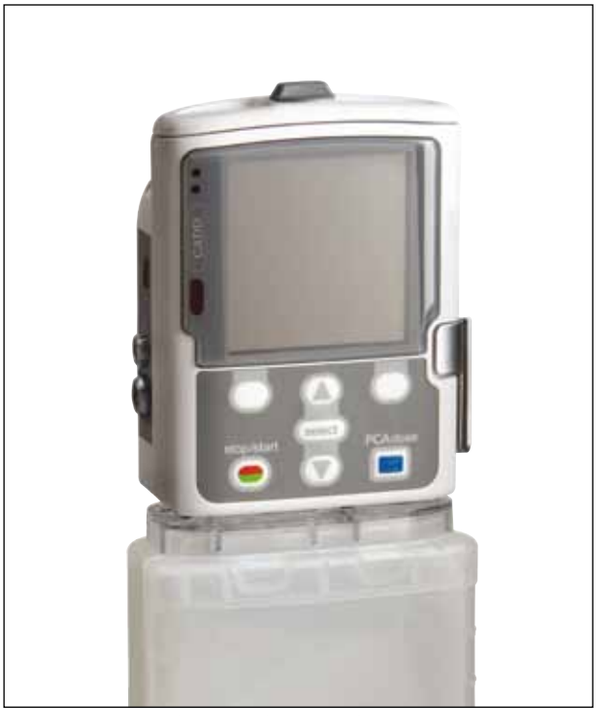

Figure 1. CADD-Solis VIP ambulatory infusion pump

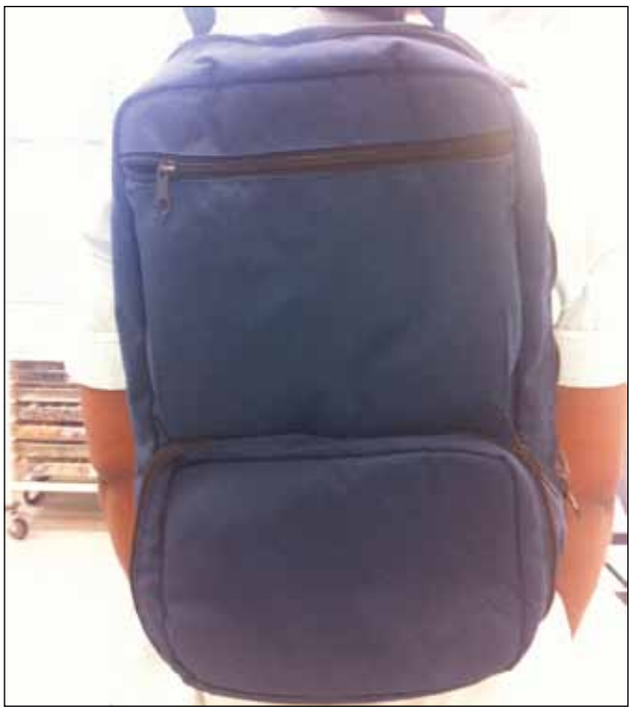

Figure 2. Continuous supportive fluids are delivered via backpack hydration

Teenage Cancer Trust

Ambulatory care facilities allow teenagers and young people with cancer to receive care with more normalcy and empowerment while still receiving 24-hour support

between doses. The CADD-Solis VIP ambulatory infusion pump's other features include simple patient-centred usability, clinician programming (with security code protection), trend reports of delivery history and an alarm priority system. Carry cases in varied sizes are available from the manufacturer to suit patient infusion needs.

Chemotherapy administered via the CADD-Solis VIP pump is contained within a hard, durable, plastic cassette, and is held within a small, specifically designed, shoulder bag. Continuous supportive fluids are delivered via the backpack hydration system. Specially produced three-litre fluid bags are created in pharmacy and delivered over a set period. These can be heavy but can be carried in specially designed back packs as supplied by Smiths Medical (*Figure 2*). For patients that have had their first chemotherapy treatments as inpatients, there will have been an opportunity to trial the back pack and check this is safe from a moving and handling perspective. Two trained nurses check the pump programming and drugs. Pump infusion times, volumes and doses are also recorded on a written record sheet. Once the chemotherapy is set up, it is administered through a closed IV system. All patients are issued with a home chemotherapy spill kit and are provided with the education to use it.

Patient education

As many AC chemotherapy agents are high dose, patients are educated by nursing staff regarding the potential higher toxicity profile of specific chemotherapy agents and how to self-screen, appropriately manage side effects and, importantly, when to seek help while ambulating. This teaching takes place face to face with the patient and their main carer and this is reinforced with written information specifically designed by the AC service. Fallowfield (2001) demonstrated that patients who had been provided with information targeted at their level of understanding were better able to participate in decisions surrounding their treatment.

Side effects of chemotherapy may include risk of encephalopathy associated with ifosfamide, haematuria associated with ifosfamide and cyclophosphamide and risk of impaired kidney function associated with Methotrexate (The European and American Osteosarcoma Study Group (Euramos), 2011). To help prompt the nursing team in their patient assessment, a locally developed tool, based on the National Cancer Institute's (NCI) Common Terminology Criteria for Adverse Events (NCI, 2010), is used to assess chemotherapy-associated toxicities.

Before leaving the unit with the CADD-Solis VIP pump, patients will have been educated about how to identify battery life, how to charge the power pack, knowing to have four spare AA disposable lithium batteries and being aware of how to replace them. Patients are taught about the different priority alarms and what they mean, how to identify line occlusions, how to start and stop the pump (for emergency purposes or if a chemotherapy spill occurred) and, importantly, when to seek advice. The CADD-Solis VIP pump has built-in mechanisms to make it user friendly

and minimise inconvenience for users. For example, should the pump detect pressure in the line as a result of a potential occlusion (this may be caused by a line kink), the pump will notify the user via an alarm. Once the line is manipulated to remove the kink, the pump automatically restarts, requiring no re-programming, making it user friendly. If the pump alarms indicate there is air in the line, patients are informed to call the AC phone number and will need to attend the hospital to have this cleared. Wherever possible, the aim is to keep patients out of hospital for as long as is safe. However, some pump alarms, such as an air bubble in the line or an unresolved alarm, will require a hospital visit.

Patients are taught practical aspects of care when ambulating with an attached infusion device. Some examples include keeping the backpack system propped upright overnight to prevent air bubble in the line, how to shower/dress with an infusion device and safe manual handling principles when carrying the backpack system.

There has been a requirement by the Trust's medical equipment department for a financial commitment to purchase infusion pumps. Issues for consideration include that these devices would be suitable for use throughout the oncology service. Prior to purchasing the CADD-Solis VIP pump, an early version of the CADD pump had been used. This had proved effective despite the model's limitations and was already being used within the adult ambulatory care service. The limitations of the earlier model were a short battery life, only two delivery modes (continuous or intermittent) and no ability to track back through trend report data. Overall, the previous pump was not as user friendly and had a smaller maximum infusion rate. Also, Smiths Medical offered a comprehensive training programme for key nursing staff who were identified as 'Super Users'. These individuals were then responsible for training staff nurses through the service. Pump maintenance and servicing, as well as an overall commitment to this service development, were contributing factors in the purchase of this particular pump. These commitments resulted from a drive to improve patient experience and maximise the patient group's psychosocial wellbeing.

Case studies will now be presented to illustrate the use of the CADD-Solis VIP ambulatory pump. All names have been changed to ensure patient confidentiality is protected and maintained (Nursing and Midwifery Council, 2008).

Case studies

Mike—high-dose methotrexate

Continuous alkalised hydration, delivered via a backpack system, was provided to Mike post methotrexate using the continuous delivery mode of the CADD-Solis VIP pump. The backpack hydration system allowed three litres of fluid to be delivered in a 24-hour period (Euramos, 2011). After the initial methotrexate infusion, Mike returned for daily assessment and review, blood tests, methotrexate assay and renewal of his hydration bag. In his time away from AC, Mike was free to spend it with family or friends, providing he stayed within an hour's travel of the hospital in case of any unexpected problems.

Mike was taught by the nursing staff in AC to perform urinalysis to monitor his urine pH. Folinic acid rescue was tolerated orally. Methotrexate levels were reported daily and folinic acid rescue dose was calculated and adjusted accordingly. Threshold guidance for ward admission was in place to ensure Mike was clinically safe. This included:

- Reduced pH: provision of 'top-up' oral sodium bicarbonate allowed Mike to self-manage a reduced pH of 6 or above; below that required intravenous 'top up' on the unit
- Impaired renal function: calculated folinic acid dose of >50 mg four times daily—folinic acid rescue has reduced absorption orally when dose exceeds this and requires intravenous administration (Euramos, 2011)
- A reduced urine output (patients were advised to pass 100 ml/h on average)
- All the normal ambulatory care education and advice.

During Mike's initial admissions to the TYA inpatient ward, Mike had reported that he had struggled with this environment and had not always been compliant with nursing or medical advice and instruction. Within AC, Mike responded well to the extra responsibilities he had, showing maturity, and proving compliant and competent.

Kate—high-dose cytarabine

Kate was able to receive twice-daily administration of cytarabine through use of the intermittent delivery setting on the CADD-Solis VIP pump. Doses were programmed on a 12-hourly cycle to run over a set time. Multiple doses were administered in a single cassette and therefore provided timely delivery of treatment and efficient delivery for both nursing staff and Kate. Kate carried the pump continuously in a small shoulder bag or bum-bag. Kate attended daily for assessment and review, blood tests and CADD pump check.

The age difference between Kate and her siblings was significant. She was a young teenager and her brother and sister were both below the age of 5. She had treatment in the AC unit and stayed in the hospital 'Home from Home'. The daily visit to AC in the daytime was kept as short as possible, so as to provide her and her family sufficient time together. By staying in the 'Home from Home', they had privacy to spend time together. This facility has both children and teenager-specific recreational areas and facilities to prepare food. Kate had often not slept well during hospital admissions in the past and felt she got a much better quality of sleep staying in this accommodation as she found it more peaceful.

The nursing team provided Kate and her parents with education regarding pump trouble shooting and general safety. It was imperative that her parents also felt supported and informed and that a 'burden' of care was not placed on the patient's main carers.

Sam—ESHAP

Sam was able to ambulate for his ESHAP (etoposide, cytarabine, methylprednisolone and cisplatin). The etoposide, cytarabine and methylprednisolone were infused on the unit owing to drug stability when prepared in alternative delivery systems and practicalities for the unit, however, the cisplatin was administered continuously via the CADD-Solis VIP pump. Sam was educated by the nursing staff about drinking sufficient volumes of fluid when receiving his cisplatin, as well as measuring his urine and maintaining a fluid input/output

chart. This would be reviewed daily when he attended for treatment and review.

During his treatment on AC, Sam did not turn up to the unit as expected on the last day of his chemotherapy. This was different to his normal behaviour as he had been compliant with treatment up until this point. When the AC team managed to contact Sam, he had visited friends some distance away but was travelling back to the hospital. The trend reports available on the CADD-Solis VIP pump allowed staff to review his chemotherapy delivery and ensure the dose had been administered as intended.

AC requires a mutual contract of agreement from patients and hospital staff to ensure safety is protected and maintained while promoting independence and normalcy. On this occasion, Sam had breached aspects of the AC policy by travelling more than 1 hour away from the unit and not turning up to his appointment on time. This was concerning and, subsequently, the authors found that he had not maintained sufficient oral intake while receiving his cisplatin, which was reflected in his slightly raised urea and electrolytes. The implications of Sam's behaviour were discussed with him. It was explained that he had gone against AC advice, which outlines regulations to maintain patients' safety and that his behaviour had put his own wellbeing under unnecessary risk. He understood this and it was decided on this occasion to admit Sam to the inpatient ward for further monitoring and agreed that if his parent would stay with him overnight in the hospital hotel, he could try AC again in future.

Conclusion

Establishing an ambulatory care service for teenagers and young adults has required expertise from a range of professions. Learning from other international and local service provisions has enabled the development of a model of care that fits this unique user group's needs. It has been successful as a result of the vision of staff members, the provision of accommodation close to the hospital and the flexibility of the teenagers and young adults themselves. The reliability and functions of the CADD-Solis VIP pump have supported this service through comprehensive portable technology. This has maximised the time patients have spent outside the hospital setting, thus improving overall patient experience and wellbeing. BJN

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KEY POINTS

- Chemotherapy regimens can be safely administered in an outpatient setting for teenagers, young people and adults alike
- Establishing an ambulatory care service requires multidisciplinary working across adult and paediatric medicine
- The experience of ambulatory care is empowering to the teenager and young person, as it enables them to take control of their care
- The reliability and functions of the CADD-Solis VIP pump allows treatment to be administered in an ambulatory setting
- Assessment and patient education are vital components of running a safe and comprehensive service

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